

TWELFTH ANNUAL REPORT

1960

NORTHWESTERN MONTANA BRANCH

MONTANA AGRICULTURAL EXPERIMENT STATION

Route Four

Kalispell, Montana

During the first half of 1960, work was shared by Don R. Graham, Assistant in Soils, and C. W. Roath, Superintendent. After his return from leave for study, Vern R. Stewart, Assistant Agronomist, was primarily responsible for work with small grains, weeds, and annual forages; Mr. Graham for work with irrigation, fertilizers, and potatoes; and Mr. Roath for work with perennial forages, farm flock, and fiscal projects. All had some studies in the preliminary investigations project. The work of each of these men is reported in separate sections, as it pertains to the following projects.

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GENERAL ADMINISTRATION 1062

Staff:

Vern R. Stewart, Assistant Agronomist, returned July 1 after utilizing his leave, plus one advance quarter on pay, for study at the University of Minnesota, working toward a Doctors Degree.

Don R. Graham spent the fall and winter quarters at Montana State College, without pay, for work on his Masters Degree.

Northwestern Montana Branch now has what appears to be the basic allowable staff under current budgetary allowances. Current need is for help to enable the Staff members to utilize their time and talents to full advantage.

Help:

Winter help is quite adequately provided for by employment of two men on a year around basis. Seasonal help needs to be provided. Each Staff member could use two seasonal helpers, one each is an absolute minimum.

Farm Foreman:

After the minimum of one seasonal worker per Staff member is provided, the greatest need at Northwestern Branch is for someone, who also has help, to do a good job of farming on the Station, and keep equipment, fences, and buildings in repair. Research men, primarily concerned with research, do a poor job of farming to the detriment, in the long run, of the research that must be done on the farm in years to come.

Office:

A need has long been felt for more adequate clerical help in the office. A step in the right direction has been taken by the employment of clerical help on a Monday, Wednesday, and Friday basis.

Furniture and Equipment:

One new three-drawer metal file has been secured, and two used three-drawer files and one used desk secured through surplus channels. Two new desks and four new office chairs could scarcely be considered luxuries.

Library:

Joint effort by Branch Stations and the Main Station aimed at providing scientific literature to Branch Stations is underway and making progress.

Budget:

The 1960-61 budget for Administrative expenditures is \$3130.00.

PHYSICAL PLANT 1063

1960-61 Budget -- \$1965.00

Land:

1960 is the third year of a seven-year lease of the Roberts dryland eighty. We, at Northwestern Branch, sincerely hope that the 1961 Legislature will provide for the purchase of this land, not only to eliminate the necessity of annual lease payments, but to assure continued use of the area.

Buildings:

The Research Building is now fully utilized. All four offices are occupied, and workers with forages, grains, and soils get in each others way in the work area provided. How we operated at all without this building, I can't remember, but a facility designed especially for work with grains and oil crops would be highly advantageous.

Plans for additional buildings:

Necessity, they say, is the mother of invention. Need for efficient facilities for care of livestock and for storage and feeding of chopped hay and silage has led to preparation of plans for a livestock facility that will provide for feed storage and feeding where the feed is stored. If it becomes necessary to dismantle the present barn to secure a major portion of the materials for this facility, then additional machine and vehicle storage will be required.

GENERAL FARM 1064

1960-61 Budget -- \$7225.04

All of the expenditures for labor, fuel, machinery, etc. charged to this fiscal project contribute to research, and should not be interpreted as supporting general farm operations that have no relation to research.

It is becoming very obvious that on the Northwestern Montana Branch Station a much better job of farming is needed in order to provide suitable conditions for research. Uniform conditions are very necessary for research, which means uniform cropping and tillage and uniform fertilizer and moisture application for a period of years, prior to establishment of a detailed research study. Uniformly effective weed control, prior to trial establishment, is also essential.

Several steps are being considered to improve conditions for research.

1. Employment of a farm foreman who will be responsible for farming areas, not in research, according to definite rotation systems.
2. Placing men and machines at the foreman's disposal which are not under the direction of research personnel, when necessary. For instance, the foreman quite obviously needs an irrigation system that is separate and distinct from the research system.

ACTIVITIES 1960

Staff members participated in Community, County, Area, and State programs and functions as follows:

| | | |
|---|-------------|-----------------------|
| Flathead Wool Growers | Kalispell | Jan. 6 |
| N.W. Mont. Br. Sta. Advisory Committee | Missoula | Jan. 12 |
| Western Districts Agents Meet | Missoula | Jan. 13-14 |
| District Supervisors Outlook Meet | Eureka | Jan. 20 |
| Research Planning Conference | Bozeman | Feb. 11-13 |
| Soils and Fertilizer Meet | Missoula | Feb. 18 |
| Montana Seed and Forage Show | Kalispell | Feb. 24-26 |
| Coop. Seedgrowers Annual Meet | Charlo | Mar. 5 |
| Conservation Day Programs | Eureka | Mar. 10 |
| | Libby | Mar. 11 |
| | Polson | Mar. 23 |
| Flathead Electric Coop. Irrigation Program | Kalispell | Mar. 24 |
| Summer Research Conference | Miles City | June 9-10 |
| N. W. Branch Station Field Day | | July 20 |
| Agricultural Division Conference | Bozeman | Oct. 11-14 |
| Hay and Silage Show and Program | Great Falls | Oct. 26 |
| Flathead Agricultural Council | Kalispell | Monthly, if called |
| Kalispell Chamber of Commerce Agriculture Committee | | |
| Eastside Grange Agricultural Committee | | |
| Flathead Weed Control Program | | |

Information:

Progress Report
Monthly Letter
Montana Stockman-Farmer article
Daily Inter Lake articles

FORAGES 5022

1960-61 Budget -- \$4863.33

Introduction:

Not since Northwestern Montana Branch Station was established have results from forage studies been so adversely affected by weather as in 1960. Four irrigated nurseries suffered severe winter injury and were not harvested. These were:

1. Seeding Rates and Methods, seeded in 1957
2. Intrastate Irrigated Alfalfa Nursery, seeded in 1957
3. Wheatgrass Variety Nursery, seeded in 1957
4. Orchardgrass Nursery, seeded in 1956.

Other irrigated nurseries recovered slowly and early growth was retarded.

Unusually dry, hot weather in summer adversely affected summer growth on dryland and those irrigated trials not irrigated with sufficient frequency. The dry, hot summer did, however, make field curing easier than in all previous seasons at N. W. Branch.

Perennial Forages:

| <u>Description</u> | <u>Location</u> | <u>Seeding Year</u> |
|--------------------------------|-----------------|---------------------|
| Dryland Legumes | Station | 1956 |
| Fescues-Irrigated | Station | 1958 |
| Fescues-Dryland | Station | 1959 |
| Brome-grasses-Irrigated | Station | 1958 |
| Rambler Alfalfa-Irrigated | Station | 1958 |
| Forage Harvesting Methods | Station | 1958 |
| Hay Mixtures-Irrigated | Ravalli Co. | 1958 |
| Hay Mixtures-Irrigated | Lake Co. | 1959 |
| Dryland Grasses | Lake Co. | 1958 |
| Orchardgrasses-Irrigated | Station | 1959 |
| Orchardgrasses-Dryland | Station | 1959 |
| Bluegrasses-Irrigated | Station | 1959 |
| Small Seeded Legumes-Irrigated | Station | 1960 |

Perennial Forages Seeded in 1960:

| | |
|------------------------------------|--------------|
| Intrastate Wheatgrasses-Dryland | Station |
| Intrastate Wheatgrasses-Irrigated | Station |
| Noculized Alfalfas-Irrigated | Station |
| Winter Hardiness Alfalfa-Irrigated | Station |
| Small Seeded Legumes-Dryland | Station |
| Small Seeded Legumes-Irrigated | Station |
| Grasses for Native Meadows | Flathead Co. |

Dryland Legumes

Rambler, Ladak, Wilt Resistant Ladak Alfalfa, and Cicer and Sickle Milkvetch were seeded alone and with Crested Wheatgrass in 1956 on dryland. There was no appreciable difference in yield between the alfalfas over the four-year period. Alfalfas always exceeded Milkvetches in yield, and nearly always exceeded the yield of Crested alone. Having Crested seeded with alfalfa resulted in yields averaging .5 T per acre more than for alfalfa alone over the four-year period.

| Dry Legumes 1960 | Two cuttings if regrowth justified | | | Lbs. per plot @ 12% moisture | | 4 year Average | |
|----------------------|------------------------------------|-------|-------|------------------------------|-----------|----------------|------|
| | Replications | | | 1960 | | | |
| | I | II | III | Total | T/A @ 12% | | |
| Rambler & Crested | first | 6.05 | 7.04 | 7.06 | | | |
| | second | 1.43 | 1.61 | 2.49 | | | |
| | season | 7.48 | 9.38 | 9.55 | 26.41 | 3.19** | 2.98 |
| Ladak & Crested | first | 6.43 | 8.06 | 6.62 | | | |
| | second | 2.42 | 2.34 | 2.93 | | | |
| | season | 8.85 | 10.40 | 9.55 | 28.80 | 3.48** | 2.95 |
| W.R. Ladak & Crested | first | 7.64 | 8.06 | 6.72 | | | |
| | second | 2.49 | 2.34 | 2.06 | | | |
| | season | 10.13 | 10.40 | 8.78 | 29.31 | 3.55** | 3.21 |
| Cicer & Crested | season | 5.27 | 5.88 | 5.94 | 17.09 | 2.07 | 2.57 |
| Sickle & Crested | season | 4.0 | 7.58 | 4.28 | 15.86 | 1.92 | 2.26 |
| Crested | season | 2.46 | 6.04 | 4.15 | 12.65 | 1.53 | 2.16 |
| Rambler | first | 6.30 | 6.86 | 5.68 | | | |
| | second | 1.78 | 1.68 | .77 | | | |
| | season | 8.08 | 8.54 | 6.45 | 23.07 | 2.79** | 2.55 |

Continued ---

| Dry Legumes | 1960 | (Con't.) | | Two cuttings if regrowth justified | | | Lbs. per plot @ 12% moisture | | |
|----------------------|--------|--------------|-------|------------------------------------|-----------|-------|------------------------------|-------|----------------|
| | | 1960 | | | | | | Total | 4 year Average |
| | | Replications | | | T/A @ 12% | | | | |
| | | I | II | III | | | | | |
| Ladak | first | 7.86 | 7.65 | 5.54 | | | | | |
| | second | 1.58 | 2.65 | 2.21 | | | | | |
| | season | 9.44 | 10.30 | 7.75 | 3.33** | 27.49 | 2.52 | | |
| W. R. Ladak | first | 7.91 | 6.30 | 7.47 | | | | | |
| | second | 1.68 | 1.40 | 1.99 | | | | | |
| | season | 9.59 | 7.70 | 9.46 | 3.24** | 26.75 | 2.57 | | |
| Cicer $\frac{1}{2}$ | season | 5.78 | 5.27 | 4.87 | | 15.92 | 1.74 | | |
| Sickle $\frac{1}{2}$ | season | 4.17 | 5.45 | 4.0 | | 13.62 | 1.69 | | |

| | |
|-----------------------|-------|
| Mean Yield..... | 2.61 |
| S. E. \bar{x} | .215 |
| L. S. D. (5%)..... | .64 |
| L. S. D. (1%)..... | .86 |
| C. V. | 8.24% |

Area 60 x 3 = 180 sq. ft.
 $43568 \div 180 = 242$
 $242 \div 2000 = .121$

$\frac{1}{2}$ - Largely volunteer bluegrass and weeds
 Crested check

* Mixtures yielding significantly more than the check (5%)
 ** Mixtures yielding significantly more than the check (1%)

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 2 | 4.3143 | 4.11* |
| Species | 10 | 14.23642 | 13.54** |
| Error | 20 | 1.051105 | |
| Total | 32 | | |

Fescues — Irrigated and Dryland

Five varieties of Tall Fescue are grown in replicated and randomized trials on irrigated land and on dryland on the Station. The irrigated trial was seeded in 1958, the dryland trial in 1959.

These are uniform nurseries, being grown in several locations throughout Montana. A Montana report is being prepared in which the growth characteristics by seasons are being compared. For this report, total growth for the season is tabulated.

The irrigated nursery suffered severe winter injury, recovered and remained in good stands, but growth was poor, only about half that of the dryland nursery. Ky-Gl-32 led in production both years harvested.

Alta led in production on dryland, with Goar and Ore. 4-36 significantly lower in yield.

| | Creston, Montana 1960 | | Seasons yield from four cuts in tons/acre | | | | |
|-----------|-----------------------|---------------|---|----------------------|------|--------|------|
| | Total | Average Ton/A | Average | Two-year Average T/A | | | |
| Alta | 1.48 | 1.16 | 1.67 | 1.12 | 5.43 | 1.36 | 2.00 |
| Kg-31 | 1.63 | .90 | 1.49 | 1.13 | 5.15 | 1.29 | 2.01 |
| Goar | 1.52 | .82 | 1.63 | .99 | 4.96 | 1.24 | 1.56 |
| Ky-Gl-32 | 1.97 | 1.61 | 1.94 | 1.43 | 6.95 | 1.74** | 2.28 |
| Ore. 4-36 | 1.57 | 1.02 | 1.78 | 1.44 | 5.81 | 1.45 | 2.11 |

Alta is the check variety

** Varieties yielding significantly more than the check (1%)

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 3 | .4426 | 26.99** |
| Varieties | 4 | .1556 | 9.48** |
| Error | 12 | .0164 | |
| Total | 19 | | |

| | |
|------------------|--------|
| Mean Yield..... | 1.41 |
| S.E.X. | .06403 |
| L.S.D. (5%)..... | .20 |
| L.S.D. (1%)..... | .28 |
| C.V. | 4.53% |

Tall Fescue - Dryland Creston, Montana 1960
Seasons yield from three cuttings in tons per acre

| | Total | | | Average Ton/acre |
|-----------|-------|------|------|---------------------|
| Alta | 3.84 | 2.39 | 3.44 | 3.18 |
| KY-31 | 3.76 | 2.68 | 3.14 | 3.10 |
| Goar | 2.43 | 1.76 | 2.18 | 2.08** |
| KY-G1-32 | 2.73 | 2.62 | 3.67 | 3.03 |
| Ore. 4-36 | 2.55 | 2.09 | 2.72 | 2.44** |

Alta is the check variety
** Varieties yielding significantly less
than the check (1%)

Mean Yield..... 2.77
S. E. X.15025
L. S. D. (5%).... .46
L. S. D. (1%).... .65
C. V. 5.43%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 3 | .6265 | 6.93** |
| Varieties | 4 | .92415 | 10.23** |
| Error | 12 | .0903 | |
| Total | 19 | | |

Bromegrass Varieties - Irrigated

Ten varieties of smooth bromegrass are grown on irrigated land on the Station and harvest scheduled once each month if growth justifies. These were harvested four times in 1960.

This is a uniform Montana nursery being grown statewide. The Montana publication will probably contain considerable detail as to seasonal growth characteristics. For this report, only the entire seasons production is tabulated. Yield in 1960 was much less than expected from irrigated trials, but nonetheless, equal to that of Fescues under comparable conditions. No significant yield differences between varieties were indicated by the data obtained in either 1959 or 1960.

| Bromegrass Varieties - Irrigated | Creston, Montana 60 sq. ft. samples | 1960 | |
|----------------------------------|--|----------------------|---------|
| | | Total | Average |
| Seasons yield of four cuttings | Plot yields in tons per acre | Two-year Average T/A | |
| Achenbach | 1.97 | 1.89 | 1.78 |
| Lancaster | 2.54 | 1.48 | 1.94 |
| Southland | 2.48 | 1.56 | 1.93 |
| Manchar | 2.40 | 1.01 | 1.82 |
| Wisconsin 63 | 2.60 | 1.27 | 1.86 |
| Saratoga | 2.49 | .95 | 1.51 |
| Montana I | 1.94 | 1.04 | 1.62 |
| Montana II | 1.91 | 1.55 | 1.64 |
| Lincoln | 1.63 | 1.54 | 1.58 |
| Canadian Common | 1.25 | 1.11 | 1.48 |
| | | 7.12 | 2.29 |
| | | 7.76 | 2.32 |
| | | 7.72 | 2.33 |
| | | 7.30 | 2.24 |
| | | 7.43 | 2.07 |
| | | 6.04 | 2.05 |
| | | 6.47 | 1.97 |
| | | 6.56 | 2.04 |
| | | 6.32 | 2.04 |
| | | 5.91 | 1.99 |

Mean Yield..... 1.72
 S. E. \bar{x}64725
 L. S. D. (5%)..... NS
 C. V. 37.72%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 3 | 1.6235 | 9.69 |
| Varieties | 9 | 1.1790 | |
| Error | 27 | 1.6756 | |
| Total | 39 | | |

Rambler Alfalfa

Grown under irrigation on the Station, Rambler Alfalfa has for two years produced slightly more than Nordan Crested Wheatgrass, but less than a mixture of the two. This is the usual result in terms of total yield in irrigated Station trials at Creston. Plot yields of each species varied widely and 1960 data indicated no significant difference between species.

Rambler - Irrigated Station, 1960 T/A - 2 cuts - 12% moisture

| Species or Mix | Cut | Replications | | | | Total | Ave. T/A | Two-year Average |
|----------------|-----|--------------|------|------|------|-------|----------|------------------|
| | | I | II | III | IV | | | |
| Rambler | 1 | 1.90 | 1.74 | 1.62 | 1.05 | | | |
| | 2 | 1.25 | .71 | .66 | .43 | | | |
| | S | 3.15 | 2.45 | 2.28 | 1.48 | 9.36 | 2.34 | 2.76 |
| Nordan | 1 | 1.87 | 2.02 | 1.35 | 1.45 | | | |
| | 2 | .52 | .82 | .55 | .59 | | | |
| | S | 2.39 | 2.84 | 1.90 | 2.04 | 9.17 | 2.29 | 2.49 |
| R & N | 1 | 2.04 | 2.04 | 2.03 | 1.60 | | | |
| | 2 | .83 | .83 | .82 | .65 | | | |
| | S | 2.87 | 2.87 | 2.85 | 2.25 | 10.84 | 2.71 | 3.24 |

Nordan check

Mean Yield..... 2.44
 S. E. \bar{x}1833
 L. S. D. (5%)...NS
 C. V. 7.49%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---|
| Replications | 2 | .7797 | - |
| Species | 3 | .1243 | - |
| Error | 6 | .1344 | |
| Total | 11 | | |

Forage Harvesting Methods

Ladak Alfalfa and eleven alfalfa mixtures were seeded in 1958 in nine replications to be harvested at different times or by different methods. Methods employed in 1960 were:

1. Two cuttings, July 5 and August 29, or the first cutting delayed until weather might be favorable.
2. Two cuttings, June 23 and August 9, or at early bloom stage.
3. Three cuttings, June 7, July 21, and September 6, or at approximately forty-five day intervals.

In total yield, as was the case in 1959, two cuttings, the first after July 1, resulted in the most tonnage, with three cuttings second. In protein harvested, the three cutting system was much the better in 1959. No chemical analysis has been obtained on 1960 samples. However, if the same relative percentages apply, 20.5% for three cuttings compared to 16.1 for two with the first overripe, the three cutting system would result in harvesting 140 lbs. additional protein per acre, worth at protein supplement prices about \$16.80 per acre. Cutting twice at early bloom stage, while producing good hay, if it can be stored without loss, does not take advantage of the entire growing season unless that produced after early August is fall grazed.

Mixtures are important in this study and change rank when harvested three times rather than two. Based on two-year averages, Orchard and Alfalfa and Tall Oatgrass and Alfalfa tie for top honors when cut twice, producing .69 T per acre more than Alfalfa alone. But when cut three times, the Lincoln Brome and Alfalfa mixture leads and is .34 T per acre above Alfalfa alone.

Alfalfa alone and the Brome Alfalfa mixture produced within .06 and .11 T per acre as much in three cuttings as in two. Other mixtures produced from .18 to .82 T per acre less in three than in two cuttings.

Forage Production - Irrigated - Station

Method I. Seasons production from two cuttings
 Dates: 7/5 and 8/29
 Lbs. per plot of 50 sq. ft. Dry

| Species or Mixture | Replications | | | Total | T/A | T/A @ 12% |
|--------------------|--------------|------|------|-------|------|--------------|
| | I | II | III | | | |
| Ladak Alfalfa | 5.48 | 6.65 | 6.06 | 18.19 | 2.64 | 2.96 |
| Orchard & A. | 7.53 | 6.99 | 7.45 | 21.97 | 3.19 | 3.57 |
| Fescue & A. | 7.08 | 8.75 | 4.99 | 20.82 | 3.02 | 3.38 |
| Big Blue & A. | 5.00 | 7.11 | 5.62 | 17.73 | 2.57 | 2.88 |
| Erect Brome & A. | 6.59 | 7.83 | 6.01 | 20.43 | 2.97 | 3.33 |
| M. Foxtail & A. | 5.90 | 6.19 | 6.00 | 18.09 | 2.63 | 2.94 |
| Gr. Stipa. & A. | 6.08 | 6.94 | 5.21 | 18.23 | 2.65 | 2.97 |
| Lincoln Br. & A. | 7.60 | 7.31 | 5.27 | 20.18 | 2.93 | 3.28 |
| Tall Oat & A. | 7.53 | 8.07 | 6.84 | 22.44 | 3.26 | 3.65 |
| Ree Wheat & A. | 7.43 | 7.05 | 6.83 | 21.31 | 3.09 | 3.46 |
| 404 Brome & A. | 7.77 | 5.90 | 5.32 | 18.99 | 2.76 | 3.09 |
| Whitmar W. & A. | 8.74 | 6.03 | 6.05 | 20.82 | 3.02 | 3.38 |

Method II. Two cuts
 Dates: 6/23 and 8/9

| Species or Mixture | Replications | | | Total | T/A | T/A @ 12% |
|--------------------|--------------|------|------|-------|------|--------------|
| | I | II | III | | | |
| Ladak Alfalfa | 5.41 | 4.94 | 4.31 | 14.66 | 2.13 | 2.38 |
| Orchard & A. | 6.63 | 6.84 | 6.13 | 19.60 | 2.84 | 3.18 |
| Fescue & A. | 6.84 | 7.56 | 6.72 | 21.12 | 3.07 | 3.44 |
| Big Blue & A. | 5.06 | 5.34 | 4.84 | 15.24 | 2.21 | 2.47 |
| Erect Brome & A. | 5.47 | 5.50 | 6.16 | 17.13 | 2.49 | 2.79 |
| M. Foxtail & A. | 4.87 | 6.15 | 5.40 | 16.42 | 2.38 | 2.66 |
| Gr. Stipa. & A. | 5.78 | 5.07 | 4.37 | 15.22 | 2.21 | 2.47 |
| Lincoln Br. & A. | 5.68 | 5.07 | 5.90 | 16.65 | 2.42 | 2.71 |
| Tall Oat & A. | 5.85 | 4.96 | 5.56 | 16.37 | 2.38 | 2.66 |
| Ree Wheat & A. | 4.37 | 4.84 | 5.06 | 14.27 | 2.07 | 2.32 |
| 404 Brome & A. | 5.90 | 5.72 | 4.53 | 16.15 | 2.34 | 2.62 |
| Whitmar W. & A. | 6.18 | 3.94 | 4.69 | 14.81 | 2.15 | 2.41 |

Forage Production - Irrigated - Station (Continued)

Method III. Seasons production from three cuttings
 Dates: 6/7, 7/21, & 9/6
 Lbs. per plot of 50 sq. ft. Dry

| Species or Mixture | Replications | | | Total | T/A | T/acre @ 12% |
|--------------------|--------------|------|------|-------|------|-----------------|
| | I | II | III | | | |
| Ladak Alfalfa | 5.38 | 5.97 | 6.61 | 17.96 | 2.61 | 2.92 |
| Orchard & A. | 7.36 | 6.50 | 6.57 | 20.43 | 2.97 | 3.33 |
| Fescue & A. | 7.12 | 6.98 | 6.27 | 20.37 | 2.96 | 3.32 |
| Big Blue & A. | 5.36 | 5.13 | 4.87 | 15.36 | 2.23 | 2.50 |
| Erect Brome & A. | 6.10 | 5.98 | 5.87 | 17.95 | 2.60 | 2.91 |
| M. Foxtail & A. | 6.25 | 5.71 | 6.27 | 18.23 | 2.65 | 2.97 |
| Gr. Stipa. & A. | 5.82 | 5.09 | 5.47 | 16.38 | 2.38 | 2.66 |
| Lincoln Br. & A. | 6.45 | 7.05 | 7.79 | 21.29 | 3.09 | 3.46 |
| Tall Oat & A. | 5.84 | 6.37 | 5.49 | 17.70 | 2.57 | 2.88 |
| Ree Wheat & A. | 6.12 | 5.56 | 6.42 | 18.10 | 2.63 | 2.94 |
| 404 Brome & A. | 6.18 | 4.76 | 4.92 | 15.86 | 2.30 | 2.58 |
| Whitmar W. & A. | 5.61 | 4.81 | 5.34 | 15.76 | 2.29 | 2.56 |

Three replication average of seasons yield for three methods

| Species or Mixture | Mix | Rank | Two cuts | | Two cuts | | Three cuts | | Ave. Rank |
|--------------------|-----|------|----------|------|----------|------|--------------|----|--------------|
| | | | 7/5-8/28 | Rank | 6/23-8/9 | Rank | 6/7-7/21-9/6 | | |
| Ladak Alfalfa | 1 | 9 | 2.96 | 9 | 2.38 | 6 | 2.92 | 9 | |
| Orchard & A. | 2 | 2 | 3.57 | 2 | 3.18 | 2 | 3.33 | 1 | |
| Fescue & A. | 3 | 4 | 3.38 | 1 | 3.44 | 3 | 3.32 | 2 | |
| Big Blue & A. | 4 | 11 | 2.88 | 7 | 2.47 | 12 | 2.50 | 10 | |
| Erect Brome & A. | 5 | 5 | 3.33 | 3 | 2.79 | 7 | 2.91 | 5 | |
| M. Foxtail & A. | 6 | 10 | 2.94 | 5 | 2.66 | 4 | 2.97 | 7 | |
| Gr. Stipa. & A. | 7 | 8 | 2.97 | 7 | 2.47 | 9 | 2.66 | 9 | |
| Lincoln Br. & A. | 8 | 6 | 3.28 | 4 | 2.71 | 1 | 3.46 | 3 | |
| Tall Oat & A. | 9 | 1 | 3.65 | 5 | 2.66 | 8 | 2.88 | 4 | |
| Ree Wheat & A. | 10 | 3 | 3.46 | 10 | 2.32 | 5 | 2.94 | 6 | |
| 404 Brome & A. | 11 | 7 | 3.09 | 6 | 2.62 | 10 | 2.58 | 8 | |
| Whitmar W. & A. | 12 | 4 | 3.38 | 8 | 2.41 | 11 | 2.56 | 8 | |

Irrigated Hay Mixtures

Three irrigated hay mixture nurseries were harvested in two cuttings in 1960. One was seeded on deep, sandy, loam soil in Ravalli County in 1958. One was seeded on shallow, clay, loam soil in Lake County in 1959. One was seeded on imperfectly drained, silty clay, loam soil on the Station in 1958. Two have identical entries, the third has twelve of the sixteen entries found in the other two.

One purpose of the study is to determine, if possible, if two mixtures of bunch-type grasses, Orchardgrass & Alfalfa and Alta Fescue & Alfalfa, have the same yield advantage over Alfalfa alone and over alfalfa-sod grass mixtures on other soils and locations as they have demonstrated in Station studies. Another is to compare Wheatgrasses and Bromegrasses selected for mild sod forming character with others selected for their rapid sod forming character, and with Orchard, Fescue, and other bunch grasses in mixtures. A third is to compare three alfalfa varieties in off-station locations.

Comparison of Yield of Irrigated Hay Mixtures
Grown on three soils and locations in 1960
Based on 3 or 4 replication averages for mixture and location

| Species or Mixture | T/A for location | | | Three location Rank |
|----------------------------|------------------------------------|-----------------------------------|---|---------------------|
| | Ravalli Co. deep, sandy loam | Lake Co. shallow, clay loam | Station imperfectly drained silty clay | |
| Vernal Alfalfa | 3.82 | 2.78 | | |
| Rhizoma Alfalfa | 3.79 | 2.74 | | |
| Ladak Alfalfa | 3.53 | 2.52 | 2.38 | 9 |
| Whitmar Wheatgrass & Ladak | 3.71 | 2.80 | 2.41 | 5 |
| Greenar Wheatgrass & Ladak | 3.71 | 2.66 | | |
| Ree Wheatgrass & Ladak | 3.47 | 2.50 | 2.32 | 10 |
| Mandan 404 Brome & Ladak | 3.32 | 2.98 | 2.62 | 5 |
| Manchar Brome & Ladak | 3.72 | 2.42 | | |
| Lincoln Brome & Ladak | 3.45 | 3.09 | 2.71 | 2 |
| Potomac Orchard & Ladak | 3.76 | 2.18 | 3.18 | 3 |
| Alta Fescue & Ladak | 3.70 | 2.66 | 3.44 | 1 |
| Sherman Big Blue & Ladak | 3.98 | 2.24 | 2.47 | 7 |
| Reed Canary & Ladak | 3.70 | 2.65 | | |
| Meadow Foxtail & Ladak | 3.85 | 2.40 | 2.66 | 6 |
| Green Stipa. & Ladak | 3.51 | 2.58 | 2.47 | 8 |
| Tall Oat & Ladak | 3.65 | 2.62 | 2.66 | 4 |
| | N.S. | N.S. | | |

1960 Results

Alfalfa Varieties:

Vernal ranked first in yield over Rhizoma and Ladak, with Vernal & Rhizoma very close.

Orchard & Fescue mixtures compared to Alfalfa alone:

These appear to have less advantage elsewhere than on the Station. The advantage average of these two compared to Ladak was .93 ton on the Station, .20 ton in Ravalli County and -.10 ton in Lake County.

Sod Forming Characters related to yield:

In Ravalli County, while one or both mixtures containing the more moderate sod forming wheat and brome grasses produced slightly more per acre than the most rapid sod former in the groups, the differences were below statistical significance. In Lake County, the first harvest year of the study, no yield pattern is evident. On the Station, even with Orchard & Fescue outstanding, there is no difference between bromes or wheatgrasses of different sod forming character. And as shown in Forage Production Tables, mixtures containing Lincoln Brome, Potomac Orchard, and Alta Fescue, a rapid sod former and two bunch types are 1-2-3 in yield rank with little difference between them when harvested in three cuttings.

Irrigated Hay Mixtures - Ravalli County 1960
Two cuttings Tons per acre at 12%

| Species or Mixture | Cut | I | Replications | | | Total T/A | T/A Ave. |
|--------------------|-----|-------------|--------------|-------------|-------------|--------------|-------------|
| | | | II | III | IV | | |
| Vernal | 1 | 1.60 | 1.91 | 2.22 | 2.54 | 15.28 | 3.82 |
| | 2 | <u>1.75</u> | <u>1.52</u> | <u>1.46</u> | <u>2.28</u> | | |
| | S | 3.35 | 3.43 | 3.68 | 4.82 | | |
| Rhizoma | 1 | 1.74 | 2.21 | 2.10 | 2.49 | 15.15 | 3.79 |
| | 2 | <u>1.66</u> | <u>1.56</u> | <u>1.99</u> | <u>1.40</u> | | |
| | S | 3.40 | 3.77 | 4.09 | 3.89 | | |
| Ladak | 1 | 2.00 | 1.98 | 1.80 | 1.54 | 14.13 | 3.53 |
| | 2 | <u>1.69</u> | <u>1.80</u> | <u>1.35</u> | <u>1.97</u> | | |
| | S | 3.69 | 3.78 | 3.15 | 3.51 | | |
| Whitmar & A. | 1 | 2.03 | 2.14 | 1.40 | 2.53 | 14.85 | 3.71 |
| | 2 | <u>1.63</u> | <u>1.71</u> | <u>1.75</u> | <u>1.66</u> | | |
| | S | 3.66 | 3.85 | 3.15 | 4.19 | | |
| Greenar & A. | 1 | 1.96 | 2.27 | 2.07 | 1.63 | 14.85 | 3.71 |
| | 2 | <u>1.54</u> | <u>1.52</u> | <u>2.07</u> | <u>1.79</u> | | |
| | S | 3.50 | 3.79 | 4.14 | 3.42 | | |
| Ree & A. | 1 | 1.86 | 1.51 | 1.57 | 2.26 | 13.89 | 3.47 |
| | 2 | <u>1.62</u> | <u>1.25</u> | <u>1.89</u> | <u>1.93</u> | | |
| | S | 3.48 | 2.76 | 3.46 | 4.19 | | |
| Man. 404 & A. | 1 | 1.54 | 1.62 | 1.49 | 1.69 | 13.28 | 3.32 |
| | 2 | <u>1.99</u> | <u>1.56</u> | <u>1.80</u> | <u>1.59</u> | | |
| | S | 3.53 | 3.18 | 3.29 | 3.28 | | |
| Manchar | 1 | 1.90 | 2.25 | 2.03 | 2.73 | 14.88 | 3.72 |
| | 2 | <u>1.46</u> | <u>1.63</u> | <u>1.58</u> | <u>1.30</u> | | |
| | S | 3.36 | 3.88 | 3.61 | 4.03 | | |
| Lincoln | 1 | 2.19 | 1.72 | 1.58 | 1.43 | 13.81 | 3.45 |
| | 2 | <u>1.54</u> | <u>1.71</u> | <u>1.99</u> | <u>1.65</u> | | |
| | S | 3.73 | 3.43 | 3.57 | 3.08 | | |
| Potomac | 1 | 2.00 | 1.74 | 2.22 | 2.16 | 15.05 | 3.76 |
| | 2 | <u>1.81</u> | <u>1.66</u> | <u>1.53</u> | <u>1.93</u> | | |
| | S | 3.81 | 3.40 | 3.75 | 4.09 | | |

Continued --

Irrigated Hay Mixtures - Ravalli County (Continued)

| Species or Mixture | Cut | Replications | | | | Total T/A | T/A Ave. |
|---------------------|-----|--------------|-------------|-------------|-------------|--------------|-------------|
| | | I | II | III | IV | | |
| Alta & A. | 1 | 2.26 | 2.10 | 1.94 | 2.16 | 14.79 | 3.70 |
| | 2 | <u>1.75</u> | <u>1.40</u> | <u>1.60</u> | <u>1.58</u> | | |
| | S | 4.01 | 3.50 | 3.54 | 3.74 | | |
| Sherman & A. | 1 | 2.10 | 2.42 | 1.94 | 2.34 | 15.94 | 3.98 |
| | 2 | <u>1.79</u> | <u>1.40</u> | <u>1.82</u> | <u>2.13</u> | | |
| | S | 3.89 | 3.82 | 3.76 | 4.47 | | |
| Reed Canary & A. | 1 | 2.06 | 1.49 | 2.04 | 1.67 | 14.82 | 3.70 |
| | 2 | <u>1.75</u> | <u>1.74</u> | <u>2.33</u> | <u>1.74</u> | | |
| | S | 3.81 | 3.23 | 4.37 | 3.41 | | |
| Meadow Foxtail & A. | 1 | 2.03 | 1.94 | 2.34 | 2.13 | 15.40 | 3.85 |
| | 2 | <u>1.69</u> | <u>1.79</u> | <u>1.57</u> | <u>1.91</u> | | |
| | S | 3.72 | 3.73 | 3.91 | 4.04 | | |
| G. Stipa. & A. | 1 | 2.53 | 1.60 | 1.42 | 1.86 | 14.03 | 3.51 |
| | 2 | <u>1.61</u> | <u>1.71</u> | <u>1.80</u> | <u>1.50</u> | | |
| | S | 4.14 | 3.31 | 3.22 | 3.36 | | |
| Tall Oat & A. | 1 | 1.98 | 2.08 | 2.05 | 2.19 | 14.62 | 3.65 |
| | 2 | <u>1.71</u> | <u>1.34</u> | <u>1.41</u> | <u>1.86</u> | | |
| | S | 3.69 | 3.42 | 3.46 | 4.05 | | |

| Analysis of Variance | | | | Mean Yield..... | 3.67 |
|----------------------|------|-------------|------|-----------------------|--------|
| Source | D.F. | Mean Square | F | S. E. \bar{x} | .17955 |
| Replications | 3 | .3000 | 2.32 | L. S. D. (5%)... | NS |
| Species | 15 | .11703 | | C. V. | 4.89% |
| Error | 45 | .12896 | | | |
| Total | 63 | | | | |

Irrigated Hay Mixtures - Lake County 1960
Two cuttings Yields in tons per acre

| Species or Mixture | Cut | Replications | | | | Total T/A | T/A Ave. |
|--------------------|-----|--------------|-------------|-------------|-------------|--------------|-------------|
| | | I | II | III | IV | | |
| Vernal | 1 | 2.03 | 1.92 | 1.60 | 1.18 | | |
| | 2 | <u>1.37</u> | <u>1.50</u> | <u>.84</u> | <u>.70</u> | | |
| | S | 3.40 | 3.42 | 2.44 | 1.88 | 11.14 | 2.78 |
| Rhizoma | 1 | 1.99 | 1.32 | 1.32 | 1.99 | | |
| | 2 | <u>1.24</u> | <u>1.22</u> | <u>.76</u> | <u>1.13</u> | | |
| | S | 3.23 | 2.54 | 2.08 | 3.12 | 10.97 | 2.74 |
| Ladak | 1 | 1.89 | 1.30 | 1.42 | 1.89 | | |
| | 2 | <u>1.24</u> | <u>.74</u> | <u>.63</u> | <u>.99</u> | | |
| | S | 3.13 | 2.04 | 2.05 | 2.88 | 10.10 | 2.52 |
| Whitmar & A. | 1 | 1.94 | 1.37 | 2.51 | 1.37 | | |
| | 2 | <u>1.22</u> | <u>.78</u> | <u>1.42</u> | <u>.57</u> | | |
| | S | 3.16 | 2.15 | 3.93 | 1.94 | 11.18 | 2.79 |
| Greenar & A. | 1 | 1.69 | 1.45 | 1.57 | 2.41 | | |
| | 2 | <u>1.25</u> | <u>.55</u> | <u>.74</u> | <u>.98</u> | | |
| | S | 2.94 | 2.00 | 2.31 | 3.39 | 10.64 | 2.66 |
| Ree | 1 | 1.57 | 1.93 | 1.45 | 1.57 | | |
| | 2 | <u>.89</u> | <u>1.14</u> | <u>.75</u> | <u>.71</u> | | |
| | S | 2.46 | 3.07 | 2.20 | 2.28 | 10.01 | 2.50 |
| Man. 404 & A. | 1 | 1.39 | 1.98 | 2.18 | 1.09 | | |
| | 2 | <u>.96</u> | <u>1.77</u> | <u>1.83</u> | <u>.74</u> | | |
| | S | 2.35 | 3.75 | 4.01 | 1.83 | 11.94 | 2.98 |
| Manchar & A. | 1 | 1.40 | 1.40 | 1.52 | 2.10 | | |
| | 2 | <u>.90</u> | <u>.79</u> | <u>.67</u> | <u>.92</u> | | |
| | S | 2.30 | 2.19 | 2.19 | 3.02 | 9.70 | 2.42 |
| Lincoln & A. | 1 | 1.59 | 1.34 | 3.17 | 2.80 | | |
| | 2 | <u>.90</u> | <u>.57</u> | <u>1.47</u> | <u>.53</u> | | |
| | S | 2.49 | 1.91 | 4.64 | 3.33 | 12.37 | 3.09 |
| Potomac & A. | 1 | 1.51 | 1.51 | 1.38 | 1.38 | | |
| | 2 | <u>.85</u> | <u>.81</u> | <u>.65</u> | <u>.62</u> | | |
| | S | 2.36 | 2.32 | 2.03 | 2.00 | 8.71 | 2.18 |

Continued --

Irrigated Hay Mixtures - Lake County (Continued)

| Species or Mixture | Cut | Replications | | | | Total T/A | T/A Ave. |
|---------------------|-----|--------------|-------------|-------------|-------------|--------------|-------------|
| | | I | II | III | IV | | |
| Alta | 1 | 1.43 | 1.68 | 2.20 | 1.94 | 10.63 | 2.66 |
| | 2 | <u>.76</u> | <u>.76</u> | <u>1.12</u> | <u>.74</u> | | |
| | S | 2.19 | 2.44 | 3.32 | 2.68 | | |
| Sherman & A. | 1 | 1.45 | 1.45 | 1.45 | 1.34 | 8.98 | 2.24 |
| | 2 | <u>.71</u> | <u>.84</u> | <u>.84</u> | <u>.90</u> | | |
| | S | 2.16 | 2.29 | 2.29 | 2.24 | | |
| Reed Canary & A. | 1 | 1.31 | 1.31 | 1.97 | 1.97 | 10.61 | 2.65 |
| | 2 | <u>.74</u> | <u>.70</u> | <u>1.42</u> | <u>1.19</u> | | |
| | S | 2.05 | 2.01 | 3.39 | 3.16 | | |
| Meadow Foxtail & A. | 1 | 1.48 | 1.48 | 1.60 | 1.72 | 9.60 | 2.40 |
| | 2 | <u>.82</u> | <u>.99</u> | <u>.81</u> | <u>.70</u> | | |
| | S | 2.30 | 2.47 | 2.41 | 2.42 | | |
| Gr. Stipa. & A. | 1 | 1.62 | 2.24 | 1.74 | 1.37 | 10.31 | 2.58 |
| | 2 | <u>.94</u> | <u>1.02</u> | <u>.85</u> | <u>.53</u> | | |
| | S | 2.56 | 3.26 | 2.59 | 1.90 | | |
| Tall Oat & A. | 1 | 1.49 | 2.06 | 1.60 | 1.37 | 10.57 | 2.64 |
| | 2 | <u>1.16</u> | <u>1.40</u> | <u>.74</u> | <u>.75</u> | | |
| | S | 2.65 | 3.46 | 2.34 | 2.12 | | |

| Analysis of Variance | | | | Mean Yield..... | 2.62 |
|----------------------|------|-------------|---|-------------------|--------|
| Source | D.F. | Mean Square | F | S. E. \bar{x} . | .66053 |
| Replications | 3 | .18053 | | L. S. D. (5%)... | NS |
| Species | 15 | .23499 | | C. V. | 12.62% |
| Error | 45 | .43630 | | | |
| Total | 63 | | | | |

Irrigated Hay Mixtures - Station 1960
 Two cuttings early bloom Tons per acre from 50 sq. ft.
 Dates: 6/23 & 8/9

| Species or mixtures | Cut | Replications | | | Total T/A | T/A Ave. |
|---------------------|-----|--------------|-------------|-------------|--------------|-------------|
| | | I | II | III | | |
| Ladak A. | 1 | 1.34 | 1.34 | .91 | 7.15 | 2.38 |
| | 2 | <u>1.30</u> | <u>1.07</u> | <u>1.19</u> | | |
| | S | 2.64 | 2.41 | 2.10 | | |
| Potomac & A. | 1 | 1.92 | 2.19 | 1.78 | 9.55 | 3.18** |
| | 2 | <u>1.31</u> | <u>1.14</u> | <u>1.21</u> | | |
| | S | 3.23 | 3.33 | 2.99 | | |
| Alta & A. | 1 | 2.13 | 2.41 | 1.83 | 10.22 | 3.41** |
| | 2 | <u>1.21</u> | <u>1.28</u> | <u>1.36</u> | | |
| | S | 3.34 | 3.69 | 3.19 | | |
| Sherman & A. | 1 | 1.13 | 1.44 | 1.40 | 7.48 | 2.49 |
| | 2 | <u>1.34</u> | <u>1.21</u> | <u>.96</u> | | |
| | S | 2.47 | 2.65 | 2.36 | | |
| Erect Brome & A. | 1 | 1.35 | 1.51 | 1.54 | 8.35 | 2.78 |
| | 2 | <u>1.31</u> | <u>1.18</u> | <u>1.46</u> | | |
| | S | 2.66 | 2.69 | 3.00 | | |
| Meadow Foxtail & A. | 1 | 1.37 | 1.89 | 1.49 | 8.01 | 2.67 |
| | 2 | <u>1.01</u> | <u>1.11</u> | <u>1.14</u> | | |
| | S | 2.38 | 3.00 | 2.63 | | |
| Gr. Stipa & A. | 1 | 1.33 | 1.26 | .99 | 7.43 | 2.48 |
| | 2 | <u>1.49</u> | <u>1.22</u> | <u>1.14</u> | | |
| | S | 2.82 | 2.48 | 2.13 | | |
| Lincoln Brome & A. | 1 | 1.62 | 1.42 | 1.49 | 8.11 | 2.70 |
| | 2 | <u>1.15</u> | <u>1.05</u> | <u>1.38</u> | | |
| | S | 2.77 | 2.47 | 2.87 | | |
| Tall Oat & A. | 1 | 1.43 | 1.03 | 1.46 | 7.97 | 2.66 |
| | 2 | <u>1.42</u> | <u>1.38</u> | <u>1.25</u> | | |
| | S | 2.85 | 2.41 | 2.71 | | |
| Ree Wheat & A. | 1 | 1.25 | 1.33 | 1.25 | 6.96 | 2.32 |
| | 2 | <u>.88</u> | <u>1.03</u> | <u>1.22</u> | | |
| | S | 2.13 | 2.36 | 2.47 | | |

Continued --

Irrigated Hay Mixtures - Station (Continued)

| Species or Mixture | Cut | Replications | | | Total T/A | T/A Ave. |
|--------------------|-----|--------------|-------------|-------------|--------------|-------------|
| | | I | II | III | | |
| Mandan 404 & A. | 1 | 1.28 | 1.43 | 1.08 | 7.87 | 2.62 |
| | 2 | <u>1.60</u> | <u>1.35</u> | <u>1.13</u> | | |
| | S | 2.88 | 2.78 | 2.21 | | |
| Whitmar & A. | 1 | 1.25 | 1.10 | 1.07 | 7.22 | 2.41 |
| | 2 | <u>1.76</u> | <u>.82</u> | <u>1.22</u> | | |
| | S | 3.01 | 1.92 | 2.29 | | |

| | | |
|--|-----------------------|-------|
| Ladak Alfalfa-check | Mean Yield..... | 2.68 |
| ** Mixtures yielding significantly more than the check (1%) | S. E. \bar{x} | .1652 |
| | L. S. D. (5%)... | .48 |
| | L. S. D. (1%)... | .66 |
| Analysis of Variance | C. V. | 6.17% |

| <u>Source</u> | <u>D.F.</u> | <u>Mean Square</u> | <u>F</u> |
|---------------|-------------|--------------------|----------|
| Replications | 2 | .10405 | 1.27 |
| Mixtures | 11 | .3177 | 3.87** |
| Error | 22 | .08189 | |
| Total | 35 | | |

Dryland Grasses at Polson 1960

This second year of harvest, on a dry hill top near Vista Point, west of Polson, and in a season of much less than normal June rain, Intermediate Wheatgrass led in production among fourteen grasses and was significantly higher in yield than Standard Crested. Other good grasses in the trial, with yields comparable to or slightly exceeding Standard Crested, were Pubescent, Slender and Tall Wheatgrass, Sherman Big Blue Grass, and Lincoln Bromegrass. Significantly lower in yield than Standard Crested were Potomac Orchardgrass and Meadow Foxtail. Russian Wild Rye, in this trial, was too poor in yield or stand to harvest.

Dryland Grasses at Polson T/A @ 12% One cutting - July 7

| | Replications | | | | Total | Ave. /A |
|--------------------|------------------|------|-------------------|------|-------|---------|
| | I | II | III | IV | | |
| Intermediate | 1.20 | 1.20 | 1.06 | 1.51 | 4.97 | 1.24* |
| Nordan Crested | 1.22 | .50 | .62 | .73 | 3.07 | .77 |
| Standard Crested | 1.37 | .50 | .87 ₂ | .73 | 3.47 | .87 |
| Pubescent | .78 | 1.04 | .80 ₂ | .79 | 3.41 | .84 |
| Tall Wheat | .94 | 1.23 | .67 | 1.16 | 4.00 | 1.00 |
| Manchar Brome | .52 | .69 | 1.12 | .76 | 3.09 | .77 |
| Slender Wheatgrass | .52 ₁ | .74 | .96 | 1.13 | 3.35 | .84 |
| R. W. Rye | .26 ₁ | | | | | |
| Potomac Orchard | .31 | .32 | .21 | .83 | 1.67 | .42 |
| Sherman Big Blue | .92 | .82 | 1.35 ₁ | .90 | 3.99 | 1.00 |
| Tall Oat | | | .54 ₁ | | | |
| Meadow Foxtail | .38 | .32 | .20 | .29 | 1.19 | .27 |
| Meadow Foxtail | .39 | .36 | .34 | .42 | 1.51 | .38 |
| Alta Fescue | .60 | 1.02 | .46 | .56 | 2.64 | .66 |
| Lincoln Brome | .92 | .54 | .77 | 1.34 | 3.57 | .89 |
| Hopkins Tim. | .62 | .78 | .49 | .64 | 2.53 | .63 |

$\frac{1}{2}$ not included in the analysis
 $\frac{2}{2}$ calculated missing plot

Mean Yield.... .76
 S. E. \bar{x}12125
 L. S. D. (5%). .35
 L. S. D. (1%). .46
 C. V. 15.99%

Standard Crested-check

* Species yielding significantly more than the check (5%)

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|--------|
| Replications | 3 | .0518 | |
| Species | 13 | .2752 | 4.68** |
| Error | 39 | .0588 | |
| Total | 55 | | |

Montana Uniform Orchardgrass Nurseries

This nursery of nineteen entries was seeded in 1959. The irrigated trial was harvested four times in 1960 on May 26, June 21, July 27, and September 6 and the dryland trial three times on May 26, July 11, and September 5.

The soil, where the irrigated trial was located, remained cold and wet late in the spring and growth on May 26 was generally from one-fourth to one-half that of the dryland trial located on a warmer, drier soil. From then on, growth was more rapid on the irrigated location but in total, more for some varieties and less for others than for the dryland location.

1960 Results

Irrigated: Remarkable uniformity in yields by dates and varieties, but with significant differences between the highest and lowest in yield. It was interesting to note the similarity in yield between early and late maturing varieties under this cutting frequency.

Dryland: Three varieties were considerably lower in yield than Potomac, none much higher. Some late maturing varieties were equal to Potomac in seasons' yield.

Orchardgrass - Irrigated - Station 1960
Plot yields in tons per acre 60 sq. ft. 12% moisture

| Variety | Date | Cut | Replications | | | | Total | Average |
|---------|------|-----|--------------|------------|------------|------------|-------------|---------|
| | | | I | II | III | IV | | |
| Potomac | 5/26 | 1 | .42 | .82 | .73 | .75 | 2.72 | |
| | 6/21 | 2 | .45 | .69 | .82 | .70 | 2.66 | |
| | 7/27 | 3 | .44 | .63 | .71 | .67 | 2.45 | |
| | 9/6 | 4 | <u>.42</u> | <u>.59</u> | <u>.27</u> | <u>.62</u> | <u>1.90</u> | |
| | | | 1.73 | 2.73 | 2.53 | 2.74 | 9.73 | 2.43 |
| Akaroa | | 1 | .27 | .41 | .30 | .50 | 1.48 | |
| | | 2 | .62 | .82 | .51 | .64 | 2.59 | |
| | | 3 | .58 | .63 | .57 | .74 | 2.52 | |
| | | 4 | <u>.51</u> | <u>.72</u> | <u>.65</u> | <u>.58</u> | <u>2.46</u> | |
| | | | 1.98 | 2.58 | 2.03 | 2.46 | 9.05 | 2.26 |
| Aurora | | 1 | .33 | .65 | .56 | .72 | 2.26 | |
| | | 2 | .70 | .73 | .73 | .82 | 2.98 | |
| | | 3 | .50 | .51 | .78 | .70 | 2.49 | |
| | | 4 | <u>.56</u> | <u>.49</u> | <u>.65</u> | <u>.61</u> | <u>2.31</u> | |
| | | | 2.09 | 2.38 | 2.72 | 2.85 | 10.04 | 2.51 |

Continued —

Orchardgrass - Irrigated (Continued)

| Variety | Date | Cut | Replications | | | | Total | Average |
|-------------|------|-----|--------------|-------------|-------------|-------------|--------------|---------|
| | | | I | II | III | IV | | |
| Commercial | | 1 | .42 | .49 | .85 | .80 | 2.56 | |
| | | 2 | .70 | .57 | .79 | .73 | 2.79 | |
| | | 3 | .57 | .53 | .61 | .51 | 2.22 | |
| | | 4 | <u>.65</u> | <u>.56</u> | <u>.84</u> | <u>.54</u> | <u>2.59</u> | |
| | | | <u>2.34</u> | <u>2.15</u> | <u>3.09</u> | <u>2.58</u> | <u>10.16</u> | 2.54 |
| Iowa I | | 1 | .56 | .71 | .69 | .59 | 2.55 | |
| | | 2 | .56 | .82 | .79 | .85 | 3.02 | |
| | | 3 | .53 | .76 | .57 | .67 | 2.53 | |
| | | 4 | <u>.46</u> | <u>.67</u> | <u>.69</u> | <u>.53</u> | <u>2.35</u> | |
| | | | <u>2.11</u> | <u>2.96</u> | <u>2.74</u> | <u>2.64</u> | <u>10.45</u> | 2.61 |
| Penlate | | 1 | .54 | .73 | .66 | .59 | 2.52 | |
| | | 2 | .67 | .73 | .88 | .95 | 3.23 | |
| | | 3 | .52 | .67 | .52 | .62 | 2.33 | |
| | | 4 | <u>.53</u> | <u>.81</u> | <u>.58</u> | <u>.56</u> | <u>2.48</u> | |
| | | | <u>2.26</u> | <u>2.94</u> | <u>2.64</u> | <u>2.72</u> | <u>10.56</u> | 2.64 |
| Avon | | 1 | .62 | .75 | .29 | 1.03 | 2.69 | |
| | | 2 | .67 | .62 | .82 | .95 | 3.06 | |
| | | 3 | .57 | .72 | .61 | .72 | 2.62 | |
| | | 4 | <u>.52</u> | <u>.57</u> | <u>.70</u> | <u>.62</u> | <u>2.41</u> | |
| | | | <u>2.38</u> | <u>2.66</u> | <u>2.42</u> | <u>3.32</u> | <u>10.78</u> | 2.69 |
| Danish | | 1 | .44 | .61 | .61 | .66 | 2.32 | |
| | | 2 | .66 | .76 | .67 | .64 | 2.73 | |
| | | 3 | .40 | .69 | .51 | .47 | 2.07 | |
| | | 4 | <u>.51</u> | <u>.69</u> | <u>.74</u> | <u>.49</u> | <u>2.43</u> | |
| | | | <u>2.01</u> | <u>2.75</u> | <u>2.53</u> | <u>2.26</u> | <u>9.55</u> | 2.39 |
| Wisc. 52 | | 1 | .48 | .70 | .75 | .94 | 2.87 | |
| | | 2 | .69 | .89 | .71 | .66 | 2.95 | |
| | | 3 | .46 | .74 | .51 | .57 | 2.28 | |
| | | 4 | <u>.59</u> | <u>.65</u> | <u>.59</u> | <u>.57</u> | <u>2.40</u> | |
| | | | <u>2.22</u> | <u>2.98</u> | <u>2.56</u> | <u>2.74</u> | <u>10.50</u> | 2.62 |
| Utah Syn. 2 | | 1 | .35 | .79 | .55 | .75 | 2.44 | |
| | | 2 | .70 | .96 | .76 | .73 | 3.15 | |
| | | 3 | .54 | .66 | .69 | .50 | 2.39 | |
| | | 4 | <u>.52</u> | <u>.58</u> | <u>.52</u> | <u>.51</u> | <u>2.13</u> | |
| | | | <u>2.11</u> | <u>2.99</u> | <u>2.52</u> | <u>2.49</u> | <u>10.11</u> | 2.53 |

Continued --

Orchardgrass - Irrigated (Continued)

| Variety | Date | Cut | Replications | | | | Total | Average |
|------------|------|-----|--------------|-------------|-------------|-------------|--------------|---------|
| | | | I | II | III | IV | | |
| Iowa 6 | | 1 | .72 | .71 | .78 | .85 | 3.06 | |
| | | 2 | .75 | .67 | .75 | .70 | 2.87 | |
| | | 3 | .66 | .71 | .66 | .65 | 2.68 | |
| | | 4 | <u>.71</u> | <u>.74</u> | <u>.63</u> | <u>.58</u> | <u>2.66</u> | |
| | | | <u>2.84</u> | <u>2.83</u> | <u>2.82</u> | <u>2.78</u> | <u>11.27</u> | 2.82 |
| Ky. Syn. | | 1 | .65 | .89 | .73 | .67 | 2.94 | |
| | | 2 | .65 | .92 | .65 | .79 | 3.01 | |
| | | 3 | .51 | .58 | .53 | .55 | 2.17 | |
| | | 4 | <u>.56</u> | <u>.69</u> | <u>.66</u> | <u>.58</u> | <u>2.49</u> | |
| | | | <u>2.37</u> | <u>3.08</u> | <u>2.57</u> | <u>2.59</u> | <u>10.61</u> | 2.65 |
| Latar | | 1 | .55 | .51 | .61 | .85 | 2.52 | |
| | | 2 | .72 | .76 | .58 | .84 | 2.90 | |
| | | 3 | .50 | .44 | .69 | .80 | 2.43 | |
| | | 4 | <u>.51</u> | <u>.49</u> | <u>.59</u> | <u>.59</u> | <u>2.18</u> | |
| | | | <u>2.28</u> | <u>2.20</u> | <u>2.47</u> | <u>3.08</u> | <u>10.03</u> | 2.51 |
| Pa. Early | | 1 | .76 | .86 | .67 | .65 | 2.94 | |
| | | 2 | .91 | .62 | .76 | .71 | 3.00 | |
| | | 3 | .65 | .61 | .72 | .55 | 2.53 | |
| | | 4 | <u>.63</u> | <u>.61</u> | <u>.77</u> | <u>.57</u> | <u>2.58</u> | |
| | | | <u>2.95</u> | <u>2.70</u> | <u>2.92</u> | <u>2.48</u> | <u>11.05</u> | 2.76 |
| Pa. Medium | | 1 | .76 | .76 | .71 | .59 | 2.82 | |
| | | 2 | .86 | .79 | .76 | .66 | 3.07 | |
| | | 3 | .62 | .71 | .63 | .55 | 2.51 | |
| | | 4 | <u>.69</u> | <u>.70</u> | <u>.74</u> | <u>.63</u> | <u>2.76</u> | |
| | | | <u>2.93</u> | <u>2.96</u> | <u>2.84</u> | <u>2.43</u> | <u>11.16</u> | 2.79 |
| S - 26 | | 1 | .13 | .35 | .24 | .36 | 1.08 | |
| | | 2 | .67 | .79 | .55 | .88 | 2.89 | |
| | | 3 | .51 | .55 | .48 | .67 | 2.21 | |
| | | 4 | <u>.48</u> | <u>.65</u> | <u>.59</u> | <u>.71</u> | <u>2.43</u> | |
| | | | <u>1.79</u> | <u>2.34</u> | <u>1.86</u> | <u>2.62</u> | <u>8.61</u> | 2.15 |
| S - 37 | | 1 | .18 | .41 | .38 | .29 | 1.26 | |
| | | 2 | .62 | .73 | .61 | .41 | 2.37 | |
| | | 3 | .57 | .54 | .57 | .51 | 2.19 | |
| | | 4 | <u>.53</u> | <u>.65</u> | <u>.69</u> | <u>.57</u> | <u>2.44</u> | |
| | | | <u>1.90</u> | <u>2.33</u> | <u>2.25</u> | <u>1.78</u> | <u>8.26</u> | 2.06 |

Continued --

Orchardgrass - Irrigated (Continued)

| Variety | Date | Cut | Replications | | | | Total | Average |
|---------|------|-----|--------------|------------|------------|------------|-------------|---------|
| | | | I | II | III | IV | | |
| S - 143 | | 1 | .11 | .21 | .20 | .29 | .81 | |
| | | 2 | .56 | .57 | .70 | .82 | 2.65 | |
| | | 3 | .60 | .48 | .70 | .66 | 2.44 | |
| | | 4 | <u>.52</u> | <u>.46</u> | <u>.93</u> | <u>.58</u> | <u>2.49</u> | |
| | | | 1.79 | 1.72 | 2.53 | 2.35 | 8.39 | 2.10 |
| Trogon | | 1 | .46 | .77 | .85 | .62 | 2.70 | |
| | | 2 | .74 | .79 | .71 | .67 | 2.91 | |
| | | 3 | .55 | .62 | .58 | .57 | 2.32 | |
| | | 4 | <u>.43</u> | <u>.59</u> | <u>.70</u> | <u>.58</u> | <u>2.30</u> | |
| | | | 2.18 | 2.77 | 2.84 | 2.44 | 10.23 | 2.56 |

Orchardgrass - Dryland - Station 1960
Three cuttings in tons per acre @ 12% moisture 60 sq. ft.

| Variety | Date | Cut | Replications | | | | Total | Average |
|------------|------|-----|--------------|------------|------------|------------|-------------|---------|
| | | | I | II | III | IV | | |
| Potomac | 5/26 | 1 | 1.97 | 1.17 | 1.67 | 1.42 | 6.23 | |
| | 7/11 | 2 | .94 | .69 | .56 | .45 | 2.64 | |
| | 9/5 | 3 | <u>.36</u> | <u>.37</u> | <u>.29</u> | <u>.39</u> | <u>1.41</u> | |
| | | | 3.27 | 2.23 | 2.52 | 2.26 | 10.28 | 2.57 |
| Akaroa | | 1 | 1.14 | 1.16 | 1.50 | 1.14 | 4.94 | |
| | | 2 | 1.13 | 1.62 | .84 | .82 | 4.41 | |
| | | 3 | <u>.34</u> | <u>.43</u> | <u>.36</u> | <u>.62</u> | <u>1.75</u> | |
| | | | 2.61 | 3.21 | 2.70 | 2.58 | 11.10 | 2.77 |
| Aurora | | 1 | 1.03 | .56 | .94 | 1.06 | 3.59 | |
| | | 2 | 1.18 | .47 | .89 | .75 | 3.29 | |
| | | 3 | <u>.24</u> | <u>.27</u> | <u>.24</u> | <u>.36</u> | <u>1.11</u> | |
| | | | 2.45 | 1.30 | 2.07 | 2.17 | 7.99 | 2.00 |
| Commercial | | 1 | 1.17 | 1.60 | 1.00 | 1.37 | 5.14 | |
| | | 2 | .76 | .71 | .53 | .69 | 2.69 | |
| | | 3 | <u>.38</u> | <u>.41</u> | <u>.30</u> | <u>.43</u> | <u>1.52</u> | |
| | | | 2.31 | 2.72 | 1.83 | 2.49 | 9.35 | 2.34 |

Continued --

Orchardgrass - Dryland (Continued)

| Variety | Date | Cut | Replications | | | | Total | Ave. |
|------------|---------------------|-----|--------------|------------|------------|------------|-------------|------|
| | | | I | II | III | IV | | |
| Iowa I | | 1 | 1.35 | 1.30 | 1.28 | .76 | 4.69 | 2.20 |
| | | 2 | .69 | .65 | .71 | .56 | 2.61 | |
| | | 3 | <u>.34</u> | <u>.38</u> | <u>.41</u> | <u>.36</u> | <u>1.49</u> | |
| | | | 2.38 | 2.33 | 2.40 | 1.68 | 8.79 | |
| Iowa 6 | 5/26 7/11 9/5 | 1 | 1.00 | 2.26 | .73 | 1.43 | 5.42 | 2.49 |
| | | 2 | .71 | .86 | .57 | .81 | 2.95 | |
| | | 3 | <u>.36</u> | <u>.45</u> | <u>.32</u> | <u>.48</u> | <u>1.61</u> | |
| | | | 2.07 | 3.57 | 1.62 | 2.72 | 9.98 | |
| Ky. Syn. | | 1 | 1.42 | 1.02 | 1.24 | 1.28 | 4.96 | 2.18 |
| | | 2 | .67 | .43 | .58 | .56 | 2.24 | |
| | | 3 | <u>.41</u> | <u>.36</u> | <u>.39</u> | <u>.37</u> | <u>1.53</u> | |
| | | | 2.50 | 1.81 | 2.21 | 2.21 | 8.73 | |
| Latar | | 1 | 1.24 | 1.10 | 1.61 | 1.55 | 5.50 | 2.39 |
| | | 2 | .56 | .61 | .75 | .62 | 2.54 | |
| | | 3 | <u>.32</u> | <u>.33</u> | <u>.38</u> | <u>.48</u> | <u>1.51</u> | |
| | | | 2.12 | 2.04 | 2.74 | 2.65 | 9.55 | |
| Pa. Early | | 1 | 1.65 | 1.38 | 1.06 | 1.69 | 5.78 | 2.49 |
| | | 2 | .65 | .66 | .46 | .78 | 2.55 | |
| | | 3 | <u>.42</u> | <u>.34</u> | <u>.33</u> | <u>.53</u> | <u>1.62</u> | |
| | | | 2.72 | 2.38 | 1.85 | 3.00 | 9.95 | |
| Pa. Medium | | 1 | 1.71 | 1.10 | 1.79 | 1.28 | 5.88 | 2.55 |
| | | 2 | .76 | .44 | .76 | .58 | 2.54 | |
| | | 3 | <u>.46</u> | <u>.38</u> | <u>.51</u> | <u>.42</u> | <u>1.77</u> | |
| | | | 2.93 | 1.92 | 3.06 | 2.28 | 10.19 | |
| Penlate | | 1 | 1.30 | 1.21 | 1.26 | 1.55 | 5.32 | 2.51 |
| | | 2 | .75 | .72 | .86 | .60 | 2.93 | |
| | | 3 | <u>.47</u> | <u>.38</u> | <u>.39</u> | <u>.56</u> | <u>1.80</u> | |
| | | | 2.52 | 2.31 | 2.51 | 2.71 | 10.05 | |
| Avon | | 1 | 1.55 | 1.18 | 1.17 | 2.02 | 5.92 | 2.46 |
| | | 2 | .51 | .52 | .56 | .76 | 2.35 | |
| | | 3 | <u>.34</u> | <u>.32</u> | <u>.28</u> | <u>.63</u> | <u>1.57</u> | |
| | | | 2.40 | 2.02 | 2.01 | 3.41 | 9.84 | |
| Danish | | 1 | 1.23 | .91 | 1.16 | 1.12 | 4.42 | 2.12 |
| | | 2 | .61 | .50 | .57 | .78 | 2.46 | |
| | | 3 | <u>.48</u> | <u>.32</u> | <u>.33</u> | <u>.48</u> | <u>1.61</u> | |
| | | | 2.32 | 1.73 | 2.06 | 2.38 | 8.49 | |

Continued —

Orchardgrass - Dryland (Continued)

| Variety | Date | Cut | Replications | | | | Total | Ave. |
|-------------|------|-----|--------------|------------|------------|------------|-------------|------|
| | | | I | II | III | IV | | |
| Wisc. 52 | | 1 | 1.14 | .78 | 1.48 | 1.43 | 4.83 | 2.32 |
| | | 2 | .69 | .45 | .86 | .81 | 2.81 | |
| | | 3 | <u>.42</u> | <u>.28</u> | <u>.39</u> | <u>.56</u> | <u>1.65</u> | |
| | | | 2.25 | 1.51 | 2.73 | 2.80 | 9.29 | |
| Utah Syn. 2 | | 1 | 1.03 | 1.43 | 1.40 | 1.63 | 5.49 | 2.57 |
| | | 2 | .63 | .70 | .71 | .81 | 2.85 | |
| | | 3 | <u>.50</u> | <u>.50</u> | <u>.46</u> | <u>.50</u> | <u>1.96</u> | |
| | | | 2.16 | 2.63 | 2.57 | 2.94 | 10.30 | |
| S - 26 | | 1 | .70 | .65 | .71 | .81 | 2.87 | 1.85 |
| | | 2 | .63 | .86 | .89 | .62 | 3.00 | |
| | | 3 | <u>.39</u> | <u>.34</u> | <u>.37</u> | <u>.43</u> | <u>1.53</u> | |
| | | | 1.72 | 1.85 | 1.97 | 1.86 | 7.40 | |
| S - 37 | | 1 | .96 | 1.02 | .76 | 1.34 | 4.08 | 2.09 |
| | | 2 | .61 | .58 | .71 | .71 | 2.61 | |
| | | 3 | <u>.36</u> | <u>.42</u> | <u>.37</u> | <u>.51</u> | <u>1.66</u> | |
| | | | 1.93 | 2.02 | 1.84 | 2.56 | 8.35 | |
| S - 143 | | 1 | .30 | .90 | .47 | .45 | 2.12 | 1.61 |
| | | 2 | .54 | .98 | .99 | .66 | 3.17 | |
| | | 3 | <u>.23</u> | <u>.30</u> | <u>.33</u> | <u>.29</u> | <u>1.15</u> | |
| | | | 1.07 | 2.18 | 1.79 | 1.40 | 6.44 | |
| Trogdon | | 1 | .53 | 1.23 | .67 | .93 | 3.36 | 1.63 |
| | | 2 | .33 | .60 | .50 | .51 | 1.94 | |
| | | 3 | <u>.23</u> | <u>.42</u> | <u>.24</u> | <u>.34</u> | <u>1.23</u> | |
| | | | 1.09 | 2.25 | 1.41 | 1.78 | 6.53 | |
| | | | | | | | Mean... | 2.27 |

Bluegrasses for Hay 1960

Nine bluegrasses were selected from among forty-two, in single row observational trials for indicated yield and type, for inclusion in a yield trial for irrigated hay in mixtures with alfalfa. Sherman Big Blue, Troy Blue, and Potomac Orchard were entered as checks.

In 1960, yield differences were obscured by Volunteer Red Clover and no significance obtained. Bunch types averaged 4.12 tons per acre, slow sod formers 4.49, medium sod formers 4.28, and checks 4.04.

Bluegrass Introductions Yield Trial Station 1960
 Tons per acre from two cuttings 60 sq. ft. 12% Moisture
 Harvested: 6/23 & 8/9 - Each grass with alfalfa

| Species & Variety | Number | Replications | | | Total | Ave. T/A |
|----------------------|-----------|--------------|------|------|-------|-------------|
| | | I | II | III | | |
| Bunch Bluegrass | P-5731 | 3.29 | 4.67 | 4.10 | 12.06 | 4.01 |
| Bunch Bluegrass | P-8903 | 3.71 | 4.38 | 3.81 | 11.90 | 3.97 |
| Bunch Bluegrass | P-846 | 4.20 | 4.72 | 4.21 | 13.13 | 4.38 |
| Slow Sod Bluegrass | P-15398 | 4.58 | 3.96 | 4.19 | 12.73 | 4.24 |
| Slow Sod Bluegrass | 13949-410 | 4.61 | 4.68 | 4.34 | 13.63 | 4.54 |
| Slow Sod Bluegrass | 13783-33 | 5.06 | 4.68 | 4.30 | 14.04 | 4.68 |
| Medium Sod Bluegrass | 13703-208 | 4.76 | 3.57 | 3.94 | 12.27 | 4.09 |
| Medium Sod Bluegrass | P-13819 | 4.79 | 4.07 | 4.33 | 13.19 | 4.39 |
| Medium Sod Bluegrass | 14095-803 | 3.95 | 4.43 | 4.74 | 13.12 | 4.37 |
| Sherman Big Blue | | 3.53 | 3.26 | 3.99 | 10.78 | 3.59 |
| Potomac Orchard | | 4.13 | 4.70 | 4.46 | 13.29 | 4.43 |
| Troy Bluegrass | | 3.83 | 3.95 | 4.54 | 12.32 | 4.11 |

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 2 | .00935 | --- |
| Species | 11 | .2629 | 1.45 |
| Error | 22 | .1809 | |
| Total | 35 | | |

Mean Yield..... 4.24
 S. E. \bar{x}2455
 L. S. D. (5%)... NS
 C. V. 5.79%

Small Seeded Legumes - Irrigated

Montana Uniform Nurseries were seeded on both dry and irrigated land in early May of 1960. The irrigated trial was harvested September 6 for indication of relative seeding year growth, if stands were good and growth primarily that of the seeded species rather than mostly weeds.

Yields from the one cutting varied from 1.18 tons per acre to 1.85 tons per acre. None of the three plot average yields were much above that of Kenland Red Clover. Some, however, were less with significance at the 5% level.

Small Seeded Legumes - Irrigated - Station - 1960 (Seedling Year)
Tons per acre @ 12% One cutting-9/6 60 sq. ft. May 6 seeding

| Species & Variety | Replications | | | | Total | Ave. |
|--------------------------------|--------------|------|------|------|-------|--------|
| | I | II | III | IV | | |
| Zigzag Red Clover | 1.63 | 1.58 | 1.67 | 1.62 | 6.50 | 1.63 |
| Pennscott Red Clover | 2.04 | 1.77 | 1.69 | 1.91 | 7.41 | 1.85 |
| Kenland Red Clover Breeders | 1.93 | 1.64 | 1.65 | 1.60 | 6.82 | 1.70 |
| Lakeland Red Clover | 1.76 | 1.95 | 1.71 | 1.65 | 7.07 | 1.77 |
| Dollard Red Clover | 1.83 | 1.99 | 1.75 | 1.57 | 7.14 | 1.79 |
| Altaswede Red Clover | 1.58 | 1.45 | 1.91 | 1.40 | 6.34 | 1.59 |
| Ottio Mammoth Red Clover | 1.75 | 1.83 | 1.60 | 1.52 | 6.70 | 1.68 |
| Weibulls Tetra Red Clover | 1.47 | 1.43 | 1.52 | 1.44 | 5.86 | 1.47 |
| Tomminsto Red Clover | 1.58 | 1.48 | 1.72 | 1.85 | 6.63 | 1.66 |
| Alaskland Red Clover | 1.71 | 1.76 | 1.98 | 1.54 | 6.99 | 1.75 |
| Manhardy Red Clover | 1.36 | 1.35 | 1.34 | 1.47 | 5.52 | 1.38* |
| Weibulls Resistenta Red Clover | 1.68 | 1.46 | 1.63 | 1.74 | 6.51 | 1.63 |
| Common Alsike | 1.48 | .82 | 1.26 | 1.67 | 5.23 | 1.31* |
| Tetra Alsike | 1.26 | 1.12 | .93 | 1.41 | 4.72 | 1.18** |
| Vernal Alfalfa Wyo. Fdn. | 1.12 | 1.17 | 1.50 | 1.67 | 5.46 | 1.37* |
| Sanfoin | .95 | .81 | 1.10 | 1.98 | 4.84 | 1.21** |

* Species yielding significantly less than the check (5%)

** Species yielding significantly less than the check (1%)

Note: 5 other entries not harvested - no stand or little growth

| | |
|-----------------------|---------|
| Mean Yield..... | 1.5584 |
| S. E. \bar{x} | .113215 |
| L. S. D. (5%).. | .32 |
| L. S. D. (1%).. | .43 |
| C. V. | 7.27% |

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 3 | .0628 | |
| Species | 15 | .16826 | 32.82** |
| Error | 45 | .05127 | |
| Total | 63 | | |

FORAGE PLANS FOR 1961

Plans cannot be spelled out in much detail until after the Spring Research Planning Conference. However, it is presumed that Montana Uniform Nurseries involving Bromegrass, Tall Fescue, Orchardgrass, Wheatgrass, Rambler Alfalfa, and small seeded legumes will be harvested again, and some additional uniform nursery seeded.

Northwestern Branch Station trials to be harvested again include off-station nurseries at Hamilton, St. Ignatius, Polson, Marion, and irrigated hay mixture and bluegrass yield trials on the Station.

Harvest method studies of some kind will be made on farm hay fields, and ways of storing and feeding chopped hay will also be studied. A fifth replication, of the eighteen wheatgrasses and twenty-one small seeded legumes in the uniform nurseries, was planted for the purpose of observing maturity dates as indicated by early bloom.

PRELIMINARY INVESTIGATIONS 5028

1960-61 Budget -- \$1523.33

Various miscellaneous crop tests are carried on under this project. Some will be reported in the sections prepared by Mr. Stewart and Mr. Graham.

Sugar Maple

Ten small sugar maple trees were set which were secured by the County Extension Agent. Some grew during the first season. Should they survive for a sufficient length of time, their use for production of maple sugar can be determined.

Fumigants for Strawberry Root Rot

This is the second year of harvest of Dunlap berries from plots treated with soil fumigants to control root rot. No difference has been noted of consequence in either the health and vigor of the plants, or in the weed growth in the treated plots compared to checks. One might assume that two years of production can, under these conditions, be expected without use of fumigants. Yields in ounces per plot and pounds per acre are tabulated below.

| Strawberries | 1960 | | | Ounces picked July 1-20 | | Total X259.28 Lbs./A |
|--------------|--------------|-----|-----|-------------------------|-------|----------------------------|
| | Replications | | | Oz. | Lbs. | |
| | I | II | III | | | |
| Check | 160 | 121 | 160 | 441 | 27.56 | 7145.76 |
| Terrachlor | 164 | 177 | 155 | 496. | 31.0 | 8037.68 |
| Vapam | 137 | 147 | 165 | 449 | 28.06 | 7275.40 |
| Mylone | 166 | 179 | 144 | 489 | 30.56 | 7923.60 |

| | | |
|---------------------------------|-----------------------|---------|
| Highest production: Terrachlor | Mean Yield.... | 7596.24 |
| Area: 16 ft. of 3.5 ft. rows or | S. E. \bar{x} | 547.84 |
| 56 sq. ft. x 3 = 168 | L. S. D. | NS |
| $43560 \div 168 = 259.28$ | C. V. | 7.21% |

Analysis of Variance

| Source | D.F. | Mean Square |
|-----------|------|-------------|
| Blocks | 2 | .75 |
| Treatment | 3 | 256.9733 |
| Error | 6 | 380.9717 |
| Total | 11 | |

FARM FLOCK 5029

1960-61 Budget -- \$1940.00

The gross return in 1960, from the flock of forty-five ewes over one year, was \$1534.71. This, however, included wool returns for 1959. Without this, returns still gross \$28.00 per ewe over one year.

Based on ewes over one year, the lamb crop weaned was 153%. Lambs from ewe lambs contributed to this number.

Drummond and Bassett measured lamb fleeces and estimated wool grade and body condition of lambs at weaning time. These measurements are most valuable in the selection of replacements.

The 1960 clip was core sampled by the Wool Lab. The laboratory report showed the clip to be 60.23% clean wool.

The flock of registered and non-registered Columbias, while still in need of culling and selection for uniformity, is producing wool and lambs quite satisfactorily. There might be room for considerable improvement, however, in the condition and dressing percentage of the market lambs. To explore this possibility, fifteen ewes selected so as to be equal in age and wool and lamb production to fifteen other ewes which were bred to a Columbia ram, were bred to a Polled Dorcet ram belonging to White's Columbia Sheep Company, September 20 to October 18. Fleece and body characteristics of the crossbred lambs are to be compared to those of Columbia lambs in 1961. Also present plans call for comparison of breeding habits and progeny of the crossbred ewes with that of Columbias'.

To make individual production records of ewes of all ages comparable, the total pounds of wool and lambs produced by each ewe is divided by her age. This individual yearly average production figure seems to provide a simple numerical evaluation of production which is useful in selecting ewes of high production irrespective of age. A summary of production records of the ewes in the flock January 1, 1961 follows.

Average Annual Production Record

| Ewes in flock | Years of Record | Highest | | Lowest | | Average | |
|---------------|-----------------|---------|-------|--------|-------|---------|-------|
| | | wool | lamb* | wool | lamb* | wool | lamb* |
| 11 | 5 | 13.4 | 117.8 | 12.0 | 62.5 | 12.6 | 94.1 |
| 5 | 4 | 13.6 | 90.5 | 10.6 | 75.2 | 11.8 | 81.2 |
| 8 | 3 | 13.8 | 96.7 | 9.5 | 24.0 | 11.3 | 67.4 |
| 8 | 2 | 9.2 | 74.0 | 9.0 | 00.0 | 9.6 | 45.0 |
| 13 | 1 | 10.0 | 71.0 | 8.0 | 00.0 | 9.2 | 37.5 |

12 ewe lambs

* lamb weaned

Farm Flock 5029 (Continued)

In 1959, the progeny of two rams were compared and one appeared to sire larger lambs, with more uniform fleeces, than did the other. Again this year, the loser came out second best when compared with a different ram, except in weaning weight of twin lambs.

| Characteristics of Progeny | Last year's loser | Second sire |
|----------------------------------|-------------------|-------------|
| Birth weight of singles (ave.) | 10.2 pounds | 11.0 pounds |
| Birth weight of twins (ave.) | 9.0 pounds | 9.7 pounds |
| Weaning weight of singles | 69.5 pounds | 79.0 pounds |
| Weaning weight of twins | 66.7 pounds | 62.6 pounds |
| Lambs with a pink skin | 4 | 1 |
| Lambs with under or overshot jaw | 6 | 2 |
| Spinning count lamb fleeces: | | |
| 50's | 1 | 0 |
| 54's | 3 | 0 |
| 56's | 8 | 7 |
| 58's | 20 | 9 |
| 60's | 5 | 11 |

PLANS FOR 1961

If possible, a Dorcet sire will be used two more years, or until the desirability of this cross is determined.

Fleece and body characteristics are to be compared at weaning time of crossbred and straight bred lambs.

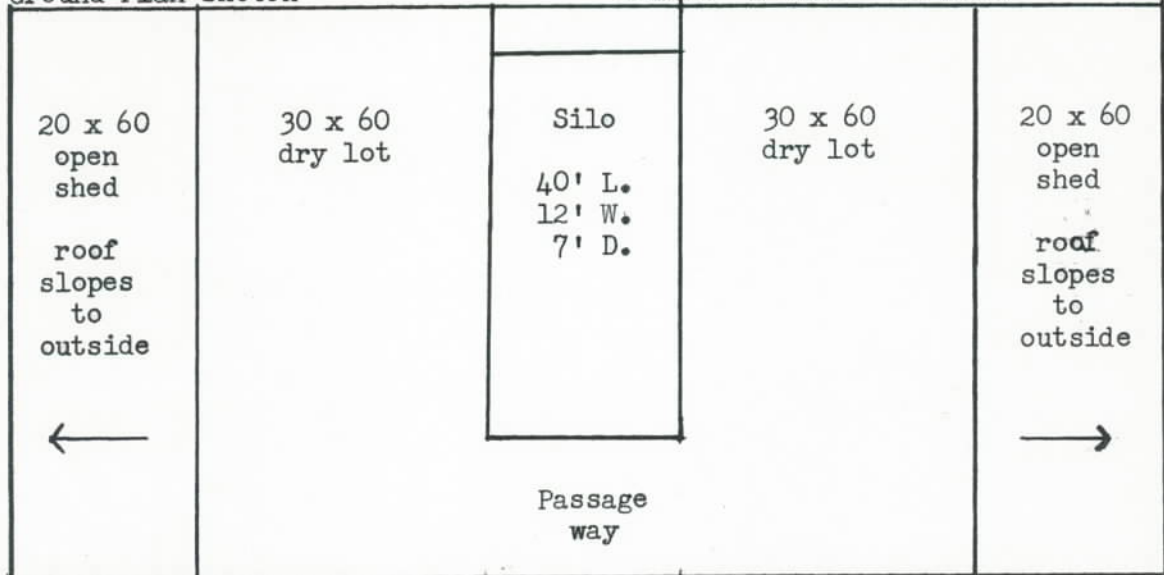
Crossbred ewes are to be kept for comparison with Columbias' as to wool and lamb production and off-season breeding habits.

PLANS FOR LIVESTOCK AND FEED STORAGE FACILITY

Plans for this facility are based on a farm flock of 120 sheep and their needs for feed and shelter.

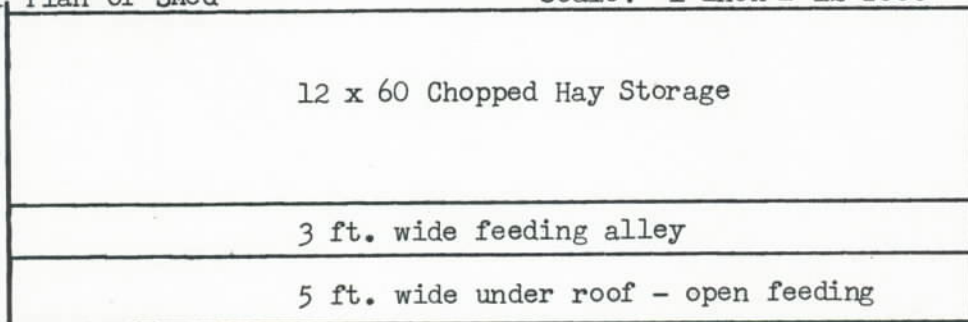
Ground Plan Sketch

Scale: 1 inch = 20 feet



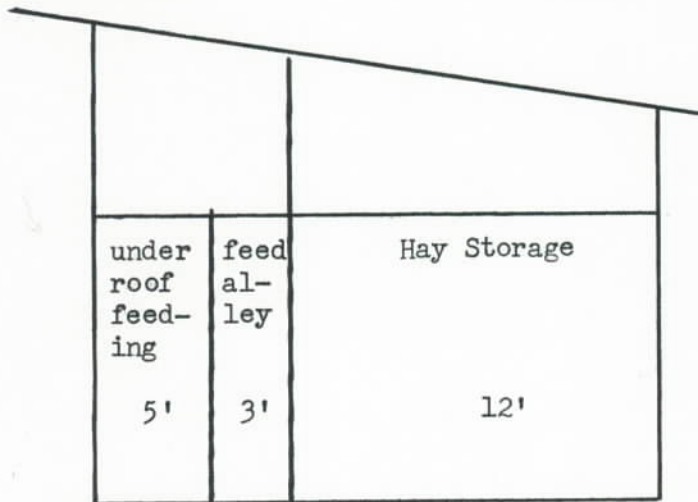
Floor Plan of Shed

Scale: 1 inch = 12 feet



Shed End Elevation

Scale: 1 inch = 6 feet



Part II

1960

ANNUAL RESEARCH REPORT
NORTHWESTERN MONTANA BRANCH

of

MONTANA AGRICULTURAL EXPERIMENT STATION

Kalispell, Montana

by

Vern R. Stewart, B.S., M.S.

Assistant Agronomist

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ACKNOWLEDGEMENT

Much thanks is due to Mr. C. W. Roath, Superintendent and Mr. Don Graham for the part in the work reported here-in and also to Dr. E. R. Hehn.

Mr. Roath carried the small grain investigations project until my return on July 1. Mr. Graham assumed the responsibility of annual forage research and weed research. Mr. Roath also handled the new crops phase of this report until July 1. Dr. Hehn assisted in the planting of winter wheat and gave some assistance in reading disease incidence in hybrid materials.

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INTRODUCTION

The author of this report returned to his duties at the Northwestern Montana Branch Station on July 1, 1960. Since September 1, 1958 he had been on leave doing graduate work in Plant Genetics at the University of Minnesota. Forty-seven credits were obtained in genetics, cytology, chemistry, statistics, and plant pathology.

On returning to the Station, all crops had been seeded and cultivated once. Details of projects are included in this report.

The past year, the author attended or took part in the activities listed here-in.

- June - Survey of Sanders County fertility plots and problems
- July - Weed tour with Flathead County Weed Board
- Annual Field Day - talk on cereal research, conducted tour of research plots
- October - Annual Conference at Bozeman.

Areas of research (projects) included in this report, which were conducted and/or supervised by the author, are (1) small grain investigations (2) annual forages (3) weed investigations and (4) the production of new crops.

A general statement of climatic conditions and growing conditions is made a part of this report.

CLIMATE

Table I gives a brief summary of weather data. For the growing season, total precipitation was 23.66, some 4.69 inches more than normal for the 1949-1959-60 period. In spite of this above normal precipitation, this seasons' crop yields were the lowest in the history of the Station. Above normal precipitation fell during September, October, and November in 1959. Below normal fell in June and July. Only .69 inch of moisture was recorded in June, compared to the average of 2.72 inches.

Dryland grain suffered from hot weather and lack of moisture at heading time. Thus, much of the spring grain was low in yield and test weights were below normal.

The last killing frost occurred June 18, some 18 days later than normal. The first killing frost was September 6, giving a total of 80 frost free days in 1960.

Weed control was very difficult this past season because of a cold, wet May. Crops did not start well and frequent rains in May added to the difficulty of control with herbicides.

Some winter killing of winter wheat in the area was caused by ice forming on fields in low places. Dry weather in June accounts for the low yields of winter wheat this season.

A hail storm on August 3, 1960 completely destroyed all crops in an area north of Bigfork. A 30-50% loss of winter wheat on the Station was sustained. Some damage was done to silage corn and sunflowers. Only the east half of the Station was affected and little or no damage was done to the western part of the Station. Corn recovered some from the damage, but sunflower yields were reduced some.

Irrigation water throughout the season was adequate.

The lowest temperature recorded was 32 degrees below zero on March 3 and the highest was 98 degrees on July 19, 1960. Mean for the period was just .6 of a degree different than the eleven-year average.

Table I. Summary of climatic data by months for the 1959-60 crop year (September to August) and averages for the period, 1959-60, at the Agricultural Experiment Station, Creston, Montana.

| | Month | | | | | | | | | | Total or Ave. | | |
|-------------------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|---------------|-----------|---------------------------|
| | Sept. 1959 | Oct. 1959 | Nov. 1959 | Dec. 1959 | Jan. 1960 | Feb. 1960 | Mar. 1960 | Apr. 1960 | May 1960 | June 1960 | | July 1960 | Aug. 1960 |
| Precipitation (inches) | | | | | | | | | | | | | |
| Current year | 4.22 | 3.36 | 4.32 | .34 | 1.67 | 1.10 | 1.01 | 1.23 | 3.27 | .69 | .13 | 2.32 | 23.66 |
| Ave. 1949 to 1959-60 | 1.28 | 1.70 | 1.54 | 1.60 | 1.68 | 1.31 | .95 | 1.27 | 2.03 | 2.72 | 1.30 | 1.59 | 18.97 |
| Mean temperature (°F) | | | | | | | | | | | | | |
| Current year | 53.0 | 43.9 | 25.5 | 27.6 | 19.4 | 25.2 | 32.3 | 44.3 | 50.6 | 59.6 | 68.8 | 60.7 | 42.5 |
| Ave. 1949 to 1959-60 | 54.1 | 43.7 | 32.3 | 27.1 | 21.1 | 26.3 | 31.2 | 44.7 | 51.8 | 57.9 | 64.4 | 63.2 | 43.1 |
| Last killing frost in spring* | | | | | | | | | | | | | |
| 1960 | | | | | | | | | | | | | June 18 (32°) |
| Ave. 1949-1960 | | | | | | | | | | | | | May 30 (31°) |
| First killing frost in fall* | | | | | | | | | | | | | |
| 1960 | | | | | | | | | | | | | Sept. 6 (32°) |
| Ave. 1949-1960 | | | | | | | | | | | | | Sept. 12 (30.2°) |
| Frost free period | | | | | | | | | | | | | |
| 1960 | | | | | | | | | | | | | 80 days |
| Ave. 1949-1960 | | | | | | | | | | | | | 105 days |
| Maximum summer temperature | | | | | | | | | | | | | 98° on July 19 |
| Minimum winter temperature | | | | | | | | | | | | | 32° below zero on March 3 |

* In this summary 32° is considered a killing frost.

TITLE: Small Grain Investigations

PROJECT NUMBER: 5023

PERSONNEL: Leader - Vern R. Stewart

Coordinators -

1. Winter Wheat - E. R. Hehn
2. Spring Wheat - F. H. McNeal
3. Spring Barley - E. A. Hockett and R. F. Eslick
4. Winter Barley - R. F. Eslick
5. Oats - S. A. Thies

FUNDS: State -- \$5508.31

LOCATION: Northwestern Montana Branch Station and off-station locations in seven Northwestern Montana counties.

PROBABLE DURATION: Indefinite

EXPERIMENTAL DATA:

INTRODUCTION

The small grain investigations project includes winter wheat, spring wheat, winter barley, spring barley, and oats. The trials are conducted in cooperation with personnel at the Main Station in Bozeman. Personnel concerned are listed above. Plans for work on these projects are formulated and designed in a planning meeting at the Main Station in February of each year.

Handling of foundation seed production is included in this project, however, it is not a research problem.

MATERIALS AND METHODS

Station nurseries are grown in four-row plots, ten feet long in general, with either a randomized block or triple lattice design. Off-station plots, generally, were single row plots with four replications.

Planting was done with a four-row belt seeder mounted on a Farmall Cub tractor. Seeding depth depended on moisture and soil conditions, usually one to one and a half inches.

Weeds were controlled by cultivation with a small garden tractor and sprayed with 2,4-D. The irrigated nurseries were irrigated once during the growing season, using two inches of water. Irrigation date was July 10, 1960.

continued --

Materials and Methods (continued)

Plots were harvested by hand, using a small hand scythe. Threshing was done in the field or at the plot immediately following harvest, except oats which were bound and allowed to dry. A portable Vogel threshing machine was used in threshing the plots.

Foundation seed production was done with large general farm machinery, most usually used in production of commercial grain. One planting was made in 35 inch rows to allow for cultivation.

RESULTS AND DISCUSSION

The results and discussion of this project will be considered individually for each crop listed in the introduction.

Winter Wheat

Nurseries grown this year were (1) Western Regional Hard Red Winter (2) Interstate Hard Red Winter and (3) three off-station nurseries. Breeding material consisted of (1) material being screened for Dwarf Bunt control; (2) head row selections of Rego; and (3) head row selections of (Yogo x Wasatch) x Cheyenne (four sister selections). Foundation seed production of Westmont, production studies of wheat on corn ground versus wheat on fallow, and Federal Smut Laboratory projects were other winter wheat research problems this season.

Western Regional Hard Red Winter

This nursery is grown at many stations throughout the western region of the United States.

The nursery consisted of thirty entries in three-row plots, 18 feet long. Four replications were used.

To test these entries for Dwarf Bunt, the nursery was grown on the Conrad Gilbertson farm northwest of Kalispell. This area is known to be infected with Race D-3 of Dwarf Bunt.

All entries were checked for the presence of Dwarf Bunt in the forepart of August and none were found to have escaped infection.

Stands were poor in many plots, because of ice, which killed out the stand completely in low places. No harvest yield data was secured, however, what material was there was harvested and each entry was sent in for quality analysis. These data on quality analysis have not been returned at the writing of this report. Table II shows varieties included in this nursery.

Interstate Hard Red Winter

Material in this nursery is grown throughout the State of Montana in cooperation with other Agronomists in the Experiment Station system. Twenty-five entries were included in this year's nursery and was located on the Station in field No. E-3.

Hail on August 3 did considerable damage in this plot. Stripe rust, Puccinia glumarum, was found on all entries. Some of the Yogo x (Turkey x Oro-221) indicated some resistance.

The mean yield is somewhat lower than we find in this rotation, however, this can be accounted for by moisture limitations and hail damage. Yield differences are not great enough to be significantly different, and this is borne out in the analysis of variance. See Table III for details.

Off-station Nurseries

These nurseries are grown in western Montana counties and contain entries from the Station nursery, which have a yield potential or other factors which warrant testing off-station.

Three nurseries were seeded in the fall of 1959. Each will be listed and discussion of each thereafter.

Ravalli County -- The nursery in Ravalli County was grown in the winter wheat area near Stevensville on the L. B. McFadgen farm. Dry, hot weather at heading time reduced yields in this nursery more than 50% as compared to previous years. The mean yield was 16.7 bushels per acre with no significant difference found between entries. See Table IV.

Sanders County -- This plot was located in the Camas Prairie Valley in above county. Because of severe soil erosion and very dry conditions, this nursery was abandoned.

Mineral County -- This nursery was grown on the Charles Frey ranch at Tarkio, Montana. Yields were about normal, with a mean of 28.1 and test weight was fair in most entries. Statistically, there was no significance found in this nursery. See Table V.

Breeding Material

The breeding material was grown in the same area as the Western Regional Hard Red Winter Wheat nursery, thus assuring some degree of natural infection.

This material was subjected primarily to Dwarf Bunt infection. Seed was planted with a belt seeder and then a suspension of Dwarf Bunt spores were sprayed on the soil surface to insure inoculation of seedlings. Breeding materials were provided by E. R. Hehn, plant

breeder at the Main Station. Table VI show entries screened. No material included in these smut resistant hybrids showed any resistance to Dwarf Bunt.

A few resistant lines or escapes were found in the head-rowed Rego material. There was no resistant material in the (Yogo x Wasatch) x Cheyenne material.

Production Methods

A study to measure the difference between total production in a wheat-fallow rotation and corn-wheat rotation was started in 1956. Data for these five years are presented in Table VII and the 1960 data is in Table VIII.

The value of wheat is figured at \$1.65 per bushel and corn silage at \$5.00 per ton. Cost of raising corn is not figured in the analysis.

These data in Table VII would indicate that a higher return per acre could be obtained from a corn silage-wheat rotation. To really determine the difference, the cost of producing the corn would have to be calculated. At the same time, fallow operational cost would be a factor to consider. Feeding of corn silage, or disposition of the same, should also be considered.

Federal Projects

Men from the Federal Smut Laboratory at Pullman, Washington had two studies located in the Stillwater area in the same location as the Station breeding material. One was a study of chemicals for control of Dwarf Bunt and the other was depth of seeding study. Report of the results can be found in the 1960 annual report of the Regional Smut Research Laboratory by C. S. Holton, et al. This report is on file in the Station's library.

Table II. Western Regional Hard Red Winter Wheat nursery.
Planting Plan for Kalispell and Bozeman in 1959-60.

| <u>Entry</u> | <u>C.I. Number</u> |
|--------------------------------------|--------------------|
| Columbia | 12928 |
| Westmont | 12930 |
| Itana | 12933 |
| Kharkof | ---- |
| Rio | ---- |
| Burt | 12696 |
| Wasatch | 11925 |
| Cheyenne | 8885 |
| Cheyenne - 57 (Tendoy) | 13426 |
| Yogo x (Turkey x Oro-221) - 66 | 13427 |
| Yogo x 112A-520-6-1 | ---- |
| Brevor x Utah Kanred | ---- |
| Rego | 13181 |
| Yogo x (Turkey x Oro-221) - 9 | 13632 |
| Yogo x (Turkey x Oro-221) - 117 | 13633 |
| Yogo x (Turkey x Oro-221) - 10 | ---- |
| Yogo x (Turkey x Oro-221) - 14 | ---- |
| Yogo x (Turkey x Oro-221) - 27 | ---- |
| Yogo x (Turkey x Oro-221) - 29 | ---- |
| Yogo x (Turkey x Oro-221) - 46 | ---- |
| Yogo x (Turkey x Oro-221) - 60 | ---- |
| (Yogo x Wasatch-3) x Cheyenne | M-56-5-3 |
| (Yogo x Wasatch-3) x Cheyenne | M-56-4-6 |
| (Yogo x Wasatch-3) x Cheyenne | M-56-6-5 |
| (Yogo x Wasatch-3) x Cheyenne | M-56-10-1 |
| (Yogo x Wasatch-3) x Cheyenne | M-56-2-5 |
| Pn-Mqo-Hope x Com-Oro-Tk-Flor | K53424 |
| Buck Quequeen x Pawnee | K58295 |
| C.I. 12936 x (Mqo-Oro x Oro-Tk-Flor) | ---- |
| Itana Selection (Montana) | ---- |

Three row plots - eighteen feet long.

Planted: September 22, 1959 on the Gilbertson place, one-fourth mile south of the Lutheran Church.

Table III. Agronomic data from the Interstate Hard Red Winter Wheat nursery, Creston, Montana in 1960. Three row plots, four replications. Planted: September 23, 1959 Harvested: August 11, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. | | | | Total Ave. Grams Bu/A | Bu Wt in lbs |
|--------------------------------------|---------|------|----------------|---------------------|-----------------------|--------------|
| | Number | Date | Heading Height | Plot Yield in Grams | | |
| Columbia | 12928 | 6-16 | 36 | 300 | 355 | 1350 |
| Westmont | 12930 | 6-16 | 37 | 315 | 380 | 1370 |
| Rego | 13181 | 6-18 | 42 | 335 | 365 | 1430 |
| Itana | 12933 | 6-19 | 44 | 315 ¹ | 290 | 1305 |
| Burt | 12696 | 6-19 | 39 | 310 | 335 | 1330 |
| Wasatch | 11925 | 6-19 | 46 | 330 | 315 | 1210 |
| Yogo | 8033 | 6-20 | 45 | 345 | 380 | 1400 |
| Cheyenne | 8885 | 6-19 | 46 | 405 | 465 | 1655 |
| Tendoy | 13426 | 6-19 | 44 | 425 | 360 | 1545 |
| Newturk | 6935 | 6-19 | 41 | 295 | 305 | 1265 |
| Karmont | 6700 | 6-20 | 44 | 355 | 400 | 1500 |
| Triplet | 5408 | 6-20 | 41 | 395 | 225 | 1360 |
| Omar | 13702 | 6-21 | 40 | 250 | 245 | 1165 |
| Yogo x (Turkey x Oro-221) - 9 | 13632 | 6-20 | 46 | 345 | 410 | 1610 |
| Yogo x (Turkey x Oro-221) - 10 | | 6-20 | 46 | 380 | 220 | 1385 |
| Yogo x (Turkey x Oro-221) - 14 | | 6-21 | 47 | 345 | 395 | 1490 |
| Yogo x (Turkey x Oro-221) - 27 | | 6-22 | 48 | 350 | 270 | 1455 |
| Yogo x (Turkey x Oro-221) - 29 | | 6-24 | 48 | 360 | 250 | 1345 |
| Yogo x (Turkey x Oro-221) - 46 | | 6-21 | 44 | 370 | 355 | 1385 |
| Yogo x (Turkey x Oro-221) - 60 | | 6-22 | 41 | 290 | 310 | 1300 |
| Yogo x (Turkey x Oro-221) - 66 | 13427 | 6-22 | 45 | 305 | 420 | 1500 |
| Yogo x (Turkey x Oro-221) - 117 | 13633 | 6-21 | 45 | 325 | 280 | 1335 |
| Itana (Montana selection) | | 6-20 | 44 | 305 | 340 | 1330 |
| (Yogo x Wasatch-3) x Cheyenne | M56-5-3 | 6-19 | 43 | 285 | 300 | 1125 |
| C.I. 12936 x (Mgo-Oro x Oro-Tk-Flor) | K58307 | 6-16 | 36 | 245 | 260 | 1090 |

¹ Calculated missing plot

Analysis of Variance

| | | | |
|--------------|------|-------------|------|
| Source | D.F. | Mean Square | F |
| Replications | 3 | 3321.5833 | 1.10 |
| Varieties | 24 | 4807.9792 | 1.60 |
| Error | 71 | 3015.0211 | |
| Total | 98 | | |

| | |
|-----------------------|--------|
| Mean Yield..... | 34.2 |
| S. E. \bar{x} | 2.7455 |
| L. S. D. (5%)..... | NS |
| C. V. | 8.02% |

Table IV. Agronomic data from off-station winter wheat nursery grown in Ravalli County on the L. B. McFadgen farm, Stevensville, Montana. Single row plots, four replications.

Planted: September 24, 1959 Harvested: July 25, 1960 Size of plot: 16 sq. ft.

| Variety or Cross | C. I. Number | Grams per plot | | | | Total Grams | Average Bu/acre |
|-------------------------------|--------------|------------------|-----|-----|-----|-------------|-----------------|
| | | I | II | III | IV | | |
| Westmont | 12930 | 225 | 175 | 150 | 205 | 755 | 18.9 |
| Itana | 12933 | 155 | 145 | 205 | 200 | 705 | 17.6 |
| Cheyenne | 8885 | 200 | 175 | 165 | 215 | 755 | 18.9 |
| Triplet | 5408 | 170 | 115 | 215 | 195 | 695 | 17.4 |
| Omar | 13072 | 155 | 195 | 70 | 85 | 505 | 12.6 |
| Rego | 13181 | 215 | 130 | 200 | 265 | 810 | 20.3 |
| Yogo x (Turkey x Oro-221)-66 | 13427 | 135 | 135 | 125 | 135 | 530 | 13.3 |
| Yogo x (Turkey x Oro-221)-9 | 13632 | 165 ¹ | 100 | 210 | 180 | 655 | 16.4 |
| Yogo x (Turkey x Oro-221)-117 | 13633 | 120 | 170 | 165 | 165 | 620 | 15.5 |
| Columbia | 12928 | 150 | 250 | 90 | 185 | 675 | 16.9 |

1 Calculated missing plot

| Analysis of Variance | | | Mean Yield..... |
|----------------------|------|-------------|-----------------------|
| Source | D.F. | Mean Square | S. E. \bar{X} |
| Replications | 3 | 1262.2917 | 2.2111 |
| Varieties | 9 | 2374.2361 | NS |
| Error | 26 | 1955.5528 | C. V. |
| Total | 38 | | 13.19% |

Table V. Agronomic data from off-station winter wheat nursery grown in Mineral County on the Charles Frey ranch, Tarkio, Montana. Single row plots, four replications.

Date Seeded: September 24, 1959 Harvested: August 4, 1960 Size of plot: 16 sq. ft.

| Variety or Cross | C. I. Number | Grams per plot | | | | Total Grams | Ave. Bu/A | Bu Wt in lbs |
|-------------------------------|--------------|----------------|-----|-----|-----|-------------|-----------|--------------|
| | | I | II | III | IV | | | |
| Westmont | 12930 | 195 | 370 | 350 | 280 | 1195 | 29.9 | 59.2 |
| Itana | 12933 | 265 | 215 | 415 | 325 | 1220 | 30.5 | 58.6 |
| Cheyenne | 8885 | 305 | 345 | 435 | 280 | 1365 | 34.1 | 59.0 |
| Triplet | 5408 | 335 | 310 | 105 | 310 | 1060 | 26.5 | 58.9 |
| Omar | 13072 | 395 | 190 | 360 | 295 | 1240 | 31.0 | 55.8 |
| Rego | 13181 | 250 | 240 | 175 | 265 | 930 | 23.3 | 57.5 |
| Yogo x (Turkey x Oro-221)-66 | 13427 | 295 | 250 | 245 | 235 | 1025 | 25.6 | 59.1 |
| Yogo x (Turkey x Oro-221)-9 | 13632 | 225 | 305 | 255 | 200 | 985 | 24.6 | |
| Yogo x (Turkey x Oro-221)-117 | 13633 | 280 | 235 | 270 | 205 | 990 | 24.8 | 59.5 |
| Columbia | 12928 | 330 | 300 | 345 | 260 | 1235 | 30.9 | 59.0 |

Mean Yield..... 28.1
 S. E. X. 3.4588
 L. S. D. (5%).... NS
 C. V. 12.30%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 3 | 1725.6267 | |
| Varieties | 9 | 5204.7867 | 1.09 |
| Error | 27 | 4785.3489 | |
| Total | 39 | | |

Table VI. Dwarf Smut Resistant F₄ plant rows planting plan
for Kalispell and Springhill - 1959-60.

| Pedigree | Row No. 59-60 | |
|--|------------------|----|
| (Y x R - 56-30/Wasatch-2) | - 1 - 5 - 1 | 1 |
| | - 2 | 2 |
| | - 3 | 3 |
| | - 4 | 4 |
| | - 5 | 5 |
| | - 1 - 7 - 1 | 6 |
| | - 2 | 7 |
| | - 3 | 8 |
| | - 4 | 9 |
| | - 5 | 10 |
| | - 1 - 14 - 1 | 11 |
| | - 2 | 12 |
| | - 3 | 13 |
| | - 4 | 14 |
| | - 5 | 15 |
| (Y x R - 56-30/Wasatch-2) | - 1 - 16 - 1 | 16 |
| | - 2 | 17 |
| | - 3 | 18 |
| | - 4 | 19 |
| | - 5 | 20 |
| | - 2 - 2 - 1 | 21 |
| | - 2 | 22 |
| | - 3 | 23 |
| | - 4 | 24 |
| | - 5 | 25 |
| (Y x R - 56-30/Wasatch-2) | - 2 - 11 - 1 | 26 |
| | - 2 | 27 |
| | - 3 | 28 |
| | - 4 | 29 |
| | - 5 | 30 |
| | - 3 - 21 - 1 | 31 |
| | - 2 | 32 |
| | - 3 | 33 |
| | - 4 | 34 |
| | - 5 | 35 |
| Wasatch #2 (Y x R - 56-30-4 x Was #3) | - 6 | 36 |
| | - 1 | 37 |
| | - 1 - 6 - 1 | 38 |
| | - 2 | 39 |
| | - 3 | 40 |
| | - 4 | 41 |
| | - 5 | 42 |
| | - 6 | 43 |

Continued --

Table VI . (continued)

| Pedigree | Row No. |
|--|---------|
| | 59-60 |
| - 1 - 20 - 1 | 44 |
| - 2 | 45 |
| - 3 | 46 |
| - 4 | 47 |
| - 5 | 48 |
| (Y x R - 56-30-4 x Was #3) - 2 - 7 - 1 | 49 |
| - 2 | 50 |
| - 3 | 51 |
| - 4 | 52 |
| - 5 | 53 |
| - 2 - 10 - 1 | 54 |
| - 2 | 55 |
| - 3 | 56 |
| - 4 | 57 |
| - 5 | 58 |
| - 2 - 13 - 1 | 59 |
| - 2 | 60 |
| - 3 | 61 |
| - 4 | 62 |
| - 5 | 63 |
| - 2 - 15 - 1 | 64 |
| - 2 | 65 |
| - 3 | 66 |
| - 4 | 67 |
| - 5 | 68 |
| (Y x R - 56-30-4 x Was #3) - 3 - 18 - 1 | 69 |
| - 2 | 70 |
| - 3 | 71 |
| - 4 | 72 |
| - 5 | 73 |
| Wasatch #3 - 1 - 1 - 1 | 74 |
| (Y x R - 56-30-3 x Itana #1) - 1 - 1 - 1 | 75 |
| - 2 | 76 |
| - 3 | 77 |
| - 4 | 78 |
| - 5 | 79 |
| - 19 - 1 | 80 |
| - 2 | 81 |
| - 3 | 82 |
| - 4 | 83 |
| - 5 | 84 |
| - 22 - 1 | 85 |
| - 2 | 86 |
| - 3 | 87 |
| - 4 | 88 |
| - 5 | 89 |

Continued --

Table VI. (Continued)

| Pedigree | | Row No. 59-60 |
|--|--------------|------------------|
| (Y x R - 56-30-3 x Itana #1) | - 2 - 1 - 1 | 90 |
| | - 2 | 91 |
| | - 3 | 92 |
| | - 4 | 93 |
| | - 2 - 6 - 1 | 94 |
| (Y x R - 56-30-3 x Itana #1) | - 2 | 95 |
| | - 3 | 96 |
| | - 4 | 97 |
| | - 2 - 10 - 5 | 98 |
| | - 1 | 99 |
| | - 2 | 100 |
| | - 3 | 101 |
| | - 4 | 102 |
| | - 5 | 103 |
| | - 2 - 14 - 1 | 104 |
| Itana #1 (Y x R - 56-30-6 x Itana #2) | - 2 | 105 |
| | - 3 | 106 |
| | - 4 | 107 |
| | - 5 | 108 |
| | - 1 | 109 |
| | - 1 - 10 - 1 | 110 |
| | - 2 | 111 |
| | - 3 | 112 |
| | - 4 | 113 |
| | - 5 | 114 |
| (Y x R - 56-30-6 x Itana #2) | - 1 - 19 - 1 | 115 |
| | - 2 | 116 |
| | - 3 | 117 |
| | - 4 | 118 |
| | - 5 | 119 |
| (Y x R - 56-30-6 x Itana #2) | - 2 - 8 - 1 | 120 |
| | - 2 | 121 |
| | - 3 | 122 |
| | - 4 | 123 |
| | - 5 | 124 |
| Itana #2 (Itana 6 x 17 - 7 - 3) | - 1 | 125 |
| | - 1 - 3 - 1 | 126 |
| | - 2 | 127 |
| | - 3 | 128 |
| | - 4 | 129 |
| (Itana 6 x 17 - 7 - 3) | - 5 | 130 |
| | - 1 - 11 - 1 | 131 |
| | - 2 | 132 |
| | - 3 | 133 |
| | - 4 | 134 |
| | - 5 | 135 |

Continued —

Table VI. (Continued)

| Pedigree | Row No. 59-60 |
|---------------------------|------------------|
| | - 1 - 12 - 1 136 |
| | - 2 137 |
| | - 3 138 |
| | - 4 139 |
| | - 5 140 |
| | - 6 141 |
| | - 1 - 17 - 1 142 |
| | - 2 143 |
| | - 3 144 |
| | - 4 145 |
| | - 5 146 |
| (Itana 6 x 17 - 7 - 3) | - 1 - 20 - 1 147 |
| | - 2 148 |
| | - 3 149 |
| | - 4 150 |
| | - 5 151 |
| | - 6 152 |
| (Itana #6 6 x 17 - 7 - 3) | - 1 - 26 - 1 153 |
| | - 2 154 |
| | - 3 155 |
| | - 4 156 |
| | - 5 157 |
| | - 1 - 29 - 1 158 |
| | - 2 159 |
| | - 3 160 |
| | - 4 161 |
| | - 5 162 |
| | - 1 163 |
| 17 - 7 #3 | - 1 164 |
| Itana #6 | - 1 165 |
| (17 - 7 - 1 x Was - 1) | - 1 - 13 - 1 166 |
| | - 2 167 |
| | - 3 168 |
| | - 4 169 |
| | - 5 170 |
| | - 1 - 14 - 1 171 |
| | - 2 172 |
| | - 3 173 |
| | - 4 174 |
| | - 5 175 |
| (17 - 7 - 1 x Was - 1) | - 2 - 2 - 1 176 |
| | - 2 177 |
| | - 3 178 |
| | - 4 179 |
| | - 5 |

Continued —

Table VI. (Continued)

| Pedigree | Row No. 59-60 |
|------------------------|------------------|
| | 180 |
| - 2 - 6 - 1 | 181 |
| - 2 | 182 |
| - 3 | 183 |
| - 4 | 184 |
| - 5 | 185 |
| - 2 - 10 - 1 | 186 |
| - 2 | 187 |
| - 3 | 188 |
| - 4 | 189 |
| - 5 | 190 |
| (17 - 1 x Was - 1) | 191 |
| - 2 - 17 - 1 | 192 |
| - 2 | 193 |
| - 3 | 194 |
| - 4 | 195 |
| - 5 | 196 |
| (17-7-1 x Was - 1) | 197 |
| - 3 - 10 - 1 | 198 |
| - 2 | 199 |
| - 3 | 200 |
| - 4 | 201 |
| - 5 | 202 |
| - 3 - 12 - 1 | 203 |
| - 2 | 204 |
| - 3 | 205 |
| - 4 | 206 |
| - 5 | 207 |
| - 3 - 13 - 1 | 208 |
| - 2 | 209 |
| - 3 | 210 |
| - 4 | 211 |
| - 5 | 212 |
| Wasatch #1 | 213 |
| (17 - 7 - 4 x Was-6) | 214 |
| - 1 - 10 - 1 | 215 |
| - 2 | 216 |
| - 3 | 217 |
| - 4 | 218 |
| - 5 | 219 |
| (17 - 7 - 4 x Was-6) | 220 |
| - 2 - 1 - 1 | 221 |
| - 2 | 222 |
| - 3 | 223 |
| (Was - 2 x 17 - 7 - 2) | |
| - 1 - 8 - 1 | |
| - 2 | |
| - 3 | |
| - 4 | |
| - 5 | |

Continued --

Table VI. (Continued)

| Pedigree | | Row No. 59-60 |
|------------------------|--------------|------------------|
| (Was - 2 x 17 - 7 - 2) | - 4 - 7 - 1 | 224 |
| | - 2 | 225 |
| | - 3 | 226 |
| | - 4 | 227 |
| | - 5 | 228 |
| (Was - 2 x 17 - 7 - 2) | - 6 - 4 - 1 | 229 |
| | - 2 | 230 |
| | - 3 | 231 |
| | - 4 | 232 |
| | - 5 | 233 |
| | - 6 - 6 - 1 | 234 |
| | - 2 | 235 |
| | - 3 | 236 |
| | - 4 | 237 |
| | - 5 | 238 |
| (Was - 3 x Itana #6) | - 1 - 5 - 1 | 239 |
| | - 2 | 240 |
| | - 3 | 241 |
| | - 4 | 242 |
| | - 5 | 243 |
| (Was - 3 x Itana #6) | - 2 - 10 - 1 | 244 |
| | - 2 | 245 |
| | - 3 | 246 |
| | - 4 | 247 |
| (Was - 3 x Itana #6) | - 2 - 10 - 5 | 248 |
| | - 6 | 249 |
| | - 2 - 14 - 1 | 250 |
| | - 2 | 251 |
| | - 3 | 252 |
| | - 4 | 253 |
| (Was - 3 x Itana #6) | - 3 - 1 - 1 | 254 |
| | - 2 | 255 |
| | - 3 | 256 |
| | - 4 | 257 |
| | - 5 | 258 |
| (Was 3 x Itana #6) | - 3 - 7 - 1 | 259 |
| | - 2 | 260 |
| | - 3 | 261 |
| | - 4 | 262 |
| | - 5 | 263 |
| | - 3 - 7 - 1 | 264 |
| | - 2 | 265 |
| | - 3 | 266 |
| | - 4 | 267 |
| | - 5 | 268 |

Continued --

Table VI. (Continued)

| Pedigree | Row No. 59-60 | |
|-----------------------|------------------|-----|
| Itana #6 | - 1 | 269 |
| (Was 1 x I/R-56-30-4) | - 1 - 2 - 1 | 270 |
| | - 2 | 271 |
| | - 3 | 272 |
| | - 4 | 273 |
| | - 5 | 274 |
| | - 1 | 275 |
| | - 2 | 276 |
| | - 3 | 277 |
| | - 4 | 278 |
| | - 5 | 279 |
| | | 280 |

Table VII. Data from fallow-wheat versus corn-wheat rotation

| | Rotation | |
|-------------------------------------|--------------|------------|
| | Fallow-wheat | Corn-wheat |
| 5 year production of wheat per acre | 203.1 bu. | 160.6 bu. |
| 5 year production of corn silage | --- | 46.4 T. |
| Value of wheat at \$1.65 per bushel | \$335.11 | \$264.99 |
| Value of corn silage | --- | \$232.00 |
| Total for rotation | \$335.11 | \$496.99 |

Table VIII. Agronomic yield data from Westmont winter wheat grown on summer fallow and land in cultivated corn crop the previous year.

Date Seeded: September, 1959 Harvested: August 16, 1960 Size of plot: 372 sq. ft.

| Treatment | Plot yield in bushels per acre | | | | Total Bushels | Average Bu/acre |
|----------------|--------------------------------|------|------|------|---------------|-----------------|
| | I | II | III | IV | | |
| Fallow F-4a | 16.6 | 21.5 | 20.5 | 22.4 | 81.0 | 20.2 |
| Corn land F-4d | 11.7 | 14.6 | 13.7 | 13.7 | 53.7 | 13.4 |

Mean Yield..... 16.8
 S. E. \bar{x}5487
 L. S. D. (5%)... 2.5
 L. S. D. (1%)... 4.5
 C. V. 2.73%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 3 | 6.821 | 5.66 |
| Treatment | 1 | 93.162 | 77.38** |
| Error | 3 | 1.204 | |
| Total | 7 | | |

Spring Wheat

This past season, the spring wheat research consisted of yield nurseries, milling and baking plots, and one selection nursery of advanced generation material.

The yield nurseries were as follows: (1) dryland advanced yield (2) irrigated advanced yield (3) uniform Western Regional White wheat and (4) off-station nurseries in Ravalli, Lake, and Mineral Counties.

Dryland Advanced Yield

The entries in this nursery consist of breeding material and standard varieties. The promising lines from breeding programs of other stations are included in this material.

Twenty-two entries replicated four times made up this nursery. It was located on the Station in field number A-1a. Yield and bushel weights were the only data obtained from this nursery.

Yields were somewhat below average for this field, because of weather conditions mentioned previously in this report. A mean of 30.4 bushels per acre was calculated. Statistical analysis of these data indicated no significant differences between varieties. Table IX shows complete data for this nursery.

Irrigated Advanced Yield

The entries and design of this nursery are the same as described for the dryland advanced yield nursery.

This nursery was located on the Station in field number Y-5. The mean of 49.9 is about seven bushels below a seven-year average for irrigation on the Station. Lodging was quite severe in some entries. Those with Rescue parentage were noticeably more susceptible to lodging.

C. I. 13220 and C. I. 13242 were the highest yielding entries, but not significantly higher than Thatcher, but significantly higher in yield than Lake, the lowest yielding entry. A C.V. of 4.74% indicates this is a good test. There is little difference in test weight of these entries. Table X gives complete data for this nursery.

Uniform Western Regional White Wheat

This nursery is grown throughout the western states of the United States. Entries are supplied by cooperators throughout the region concerned.

Thirteen entries of three replications made up this nursery. It was located on the Station in field number A-1a.

Yields were lower than normal and stripe rust was found on all entries

except Thatcher. Covered smut was found in all entries except Thatcher. These data for that reason are recorded, but are not to be used in summarization of data. It is felt, because of the smut factor, these data are unreliable. See Table XI.

Off-station Nurseries

The off-station nurseries were made up from entries that have shown promise in the advanced yield nursery. They consist of ten entries replicated four times. A discussion of each nursery follows of which there are three.

Ravalli County - Location of this trial was on the Bitterroot Stock Farm near Corvallis. Irrigation was somewhat uneven as were stands. Irrigation water seeped from the irrigation ditch, making one side of the nursery somewhat more moist than the rest. Volunteer alfalfa was a problem and, no doubt, contributed to the non-significant results obtained. Yields were low for irrigated barley. Table XIII gives complete data for this experiment.

Lake County - This nursery was located on the Walter Mangles farm near Pablo, Montana. Hail, during the growing season, caused severe damage to this test. Yields were very low (15.8 bushels per acre mean) and a very high C.V. Table XIII. These data should not be included in a summary table.

Mineral County - This dryland trial was grown on the Charles Frey Ranch near Tarkio, Montana. Extreme dry growing conditions caused very low yields. The mean being only 3.8 bushels per acre. No conclusive results can be drawn from these data. See Table XIV.

Milling and Baking Plots

These large plots are grown to secure seed enough for baking and milling tests. They were seeded in strips seven feet wide and 225 feet long. They were located in field number E-1 this past season.

Extreme dry conditions caused low yields of the plots. Only six to ten pounds of seed were obtained from each. No yield measurements were taken.

The following varieties and/or crosses were included in the trial: Selkirk, Centana, Thatcher, Lee, Rescue, 1953 x Lee B52-91, Rescue x 1831 B51-9, Ceres, and Canthatch.

Selection Nursery

This nursery consisted of advanced generation material of white wheats from the Idaho wheat breeding program.

Table XV shows the factors studied. It should be noted that stripe rust and late maturity of all these lines are recorded. Little promise is seen in any of these lines. Weak straw is a factor not in favor of these lines. Yield differences do exist between lines.

Table IX. Agronomic data from dryland advanced yield spring wheat nursery at Creston, Montana in 1960. Four row plots, four replications. Planted: April 22, 1960 Harvested: August 18, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. or N. No. | Replications | | | | Total Grams | Ave. Bu/A | Bu. Wt. in lbs. |
|---------------------------------------|----------------|--------------|-----|-----|-----|-------------|-----------|-----------------|
| | | I | II | III | IV | | | |
| Lee | 12488 | 250 | 340 | 255 | 270 | 1115 | 27.9 | 58.9 |
| Thatcher x Lee | B55-5 | 240 | 390 | 255 | 275 | 1160 | 29.0 | 58.4 |
| II-44-29 x Lee ³ II-53-562 | 13458 | 305 | 280 | 275 | 340 | 1200 | 30.0 | 59.3 |
| Thatcher ² x Rescue | B57-191 | 350 | 290 | 245 | 270 | 1155 | 28.9 | 58.0 |
| Selkirk | 13100 | 320 | 355 | 300 | 330 | 1305 | 32.6 | 58.2 |
| Pembina C. I. 229 | 13332 | 260 | 225 | 330 | 265 | 1080 | 27.0 | 58.5 |
| Thatcher | 10003 | 340 | 295 | 260 | 265 | 1160 | 29.0 | 59.0 |
| Rescue N1315 x G.B. | B57-92 | 385 | 340 | 295 | 320 | 1340 | 33.5 | 58.5 |
| Conley | 13157 | 340 | 250 | 255 | 305 | 1150 | 28.8 | 58.3 |
| Centana | 12974 | 430 | 300 | 310 | 300 | 1340 | 33.5 | 59.5 |
| Rescue | 12435 | 340 | 285 | 380 | 265 | 1270 | 31.8 | 60.0 |
| Thatcher ³ x Rescue | B57-196 | 325 | 295 | 270 | 345 | 1235 | 30.9 | 59.0 |
| Lake | 13413 | 370 | 245 | 225 | 245 | 1085 | 27.1 | 58.5 |
| Rescue N1315 x G.B. | B57-173 | 370 | 325 | 365 | 250 | 1310 | 32.8 | 57.0 |
| Minn. Sel II-53-404 | 13465 | 340 | 285 | 230 | 295 | 1150 | 28.8 | 60.0 |
| Chinook | 13220 | 325 | 310 | 310 | 230 | 1175 | 29.4 | 59.5 |
| Canthatch C.T. 233 | 13345 | 286 | 335 | 270 | 255 | 1146 | 28.7 | 59.1 |
| Rescue x 1831, B 51-9 | 13304 | 390 | 370 | 360 | 270 | 1390 | 34.8 | 60.0 |
| Minn. Sel. II-53-525 | 13466 | 340 | 370 | 345 | 345 | 1400 | 35.0 | 58.1 |
| Ceres | 6900 | 332 | 275 | 282 | 275 | 1164 | 29.1 | 61.2 |
| II-44-29 x Lee ³ II-53-567 | 13416 | 305 | 285 | 290 | 315 | 1195 | 29.9 | 59.2 |
| 1953 x Lee, B 52-91 | 13242 | 280 | 300 | 280 | 330 | 1190 | 29.8 | 60.0 |

Note: Thatcher is used as a check in this nursery.

Mean Yield..... 30.4
 S. E. \bar{x} 2.01061
 L. S. D. NS
 C. V. 6.62%

| Analysis of Variance | | |
|----------------------|------|-------------|
| Source | D.F. | Mean Square |
| Replication | 3 | 7383.67 |
| Varieties | 21 | 2262.81 |
| Error | 63 | 1617.02 |
| Total | 87 | |
| | | F |
| | | 4.57** |
| | | 1.40 N.S. |

Table X. Agronomic data from irrigated advanced yield spring wheat nursery at Creston, Montana in 1960. Four row plots, four replications.

| Variety or Cross | C. I. or N. No. | Head- ing Date | Head- ing Ht. | Lod- ging % | Loose Smut | Replications | | | | Total Grams / A. | Ave. Bu. in | Bu. Wt. lbs. |
|--------------------------------|-----------------|----------------|---------------|-------------|------------|--------------|-----|-----|-----|------------------|-------------|--------------|
| | | | | | | I | II | III | IV | | | |
| Lee | 12488 | 7-6 | 48 | 9 | | 470 | 439 | 520 | 440 | 1869 | 46.7 | 58.0 |
| Thatcher x Lee | B 55-5 | 7-7 | 44 | 2 | x | 460 | 470 | 480 | 475 | 1885 | 47.1 | 58.5 |
| II-44-29 x Lee ³ | 13458 | 7-8 | 48 | 63 | | 520 | 400 | 460 | 490 | 1870 | 46.8 | 58.0 |
| Thatcher ² x Rescue | B57-191 | 7-9 | 48 | 63 | | 577 | 510 | 490 | 570 | 2147 | 53.7 | 58.0 |
| Selkirk | 13100 | 7-8 | 45 | 30 | | 545 | 430 | 573 | 560 | 2108 | 52.7 | 58.5 |
| Pembia C. I. 229 | 13332 | 7-7 | 46 | 17 | | 530 | 430 | 480 | 440 | 1880 | 47.0 | 58.5 |
| Thatcher | 10003 | 7-7 | 47 | 14 | | 576 | 390 | 615 | 440 | 2021 | 50.5 | 58.4 |
| Rescue-N1315 x G B | B57-92 | 7-8 | 48 | 96 | | 575 | 548 | 540 | 475 | 2138 | 53.5 | 57.4 |
| Conley | 13157 | 7-9 | 48 | 15 | | 485 | 385 | 480 | 485 | 1835 | 45.9 | 58.6 |
| Centana | 12974 | 7-9 | 48 | 56 | | 560 | 410 | 455 | 490 | 1915 | 47.9 | 60.0 |
| Rescue | 12435 | 7-9 | 49 | 90 | | 500 | 515 | 560 | 415 | 1990 | 49.8 | 58.9 |
| Thatcher ³ x Rescue | B57-196 | 7-9 | 46 | 20 | | 575 | 520 | 475 | 545 | 2115 | 52.9 | 59.0 |
| Lake | 13413 | 7-12 | 47 | 54 | | 490 | 355 | 470 | 490 | 1805 | 45.1 | 59.5 |
| Rescue N1315 x G B | B57-173 | 7-8 | 46 | 83 | | 450 | 485 | 510 | 475 | 1920 | 48.0 | 57.5 |
| Minn. Sel. II-53-404 | 13465 | 7-6 | 45 | 50 | | 535 | 475 | 605 | 610 | 2225 | 55.6 | --- |
| Chinook | 13220 | 7-8 | 52 | 72 | | 475 | 395 | 445 | 560 | 1875 | 46.9 | 59.0 |
| Canthatch C. T. 233 | 13345 | 7-7 | 43 | 16 | | 480 | 415 | 495 | 490 | 1880 | 47.0 | 59.4 |
| Rescue x 1831, B51-9 | 13304 | 7-11 | 49 | 94 | | 595 | 535 | 545 | 510 | 2185 | 54.6 | 59.2 |
| Minn. Sel. II-53-525 | 13466 | 7-8 | 45 | 55 | | 565 | 520 | 510 | 510 | 2105 | 52.6 | 59.5 |
| Ceres | 6900 | 7-9 | 50 | 76 | | 575 | 450 | 375 | 543 | 1943 | 48.6 | 61.0 |
| II-44-29 x Lee ³ | 13416 | 7-7 | 50 | 44 | | 525 | 480 | 495 | 480 | 1980 | 49.5 | 58.5 |
| 1953 x Lee B52-91 | 13242 | 7-6 | 46 | 2 | | 585 | 500 | 630 | 500 | 2215 | 55.4 | 60.0 |

Note: Thatcher is used as a check

Mean Yield..... 49.9
 S. E. \bar{x} 2.36859
 L. S. D. (5%)..... 6.7
 C. V. 4.74%

| Analysis of Variance | | |
|----------------------|------|-------------|
| Source | D.F. | Mean Square |
| Replications | 3 | 20458.67 |
| Varieties | 21 | 4547.81 |
| Error | 63 | 2244.095 |
| Total | 87 | |

F 9.12**
 2.03*

Table XI. Agronomic data from Uniform Western Regional White Wheat nursery (dryland) at Creston, Montana in 1960. Four row plots, four replications.

| Variety or Cross | C. I. or N. No. | Height in Inches | Strip Rust 1-4 | Lodging % | Harvested: August 18, 1960 | | | Size of Plot: 16 feet | | |
|----------------------------|-----------------|------------------|----------------|-----------|----------------------------|-----|-----|-----------------------|------------------------|------|
| | | | | | I | II | III | Total Grams /acre | Ave. Bu. Wt. in Pounds | |
| Baart | 1697 | 43 | 4 | 20 | 455 | 375 | 335 | 1165 | 29.1** | 60.5 |
| Onas | 6221 | 37 | 4 | 25 | 430 | 425 | 395 | 1250 | 31.3** | 58.5 |
| Kenya x Lemhi ⁶ | 13435 | 39 | 4 | 60 | 440 | 390 | 305 | 1135 | 28.4* | 58.0 |
| Kenhi | 13268 | 39 | 3 | 25 | 475 | 370 | 266 | 1111 | 27.8* | 56.5 |
| Idaed 59 | 13631 | 25 | 3 | 25 | 465 | 350 | 457 | 1272 | 31.8** | 61.0 |
| Idaed 59-B | 13632 | 33 | 3 | --- | 445 | 365 | 340 | 1150 | 28.8** | 60.6 |
| Lemhi | 11415 | 36 | 4 | 75 | 270 | 270 | 170 | 710 | 17.8 | --- |
| Lemhi 53 | 13258 | 40 | 4 | 75 | 410 | 335 | 370 | 1115 | 27.9* | 57.5 |
| Idaed | 11706 | 35 | 3 | 10 | 330 | 405 | 360 | 1095 | 27.4* | 59.4 |
| Federation | 4734 | 39 | 3 | 30 | 420 | 425 | 380 | 1225 | 30.6** | 59.0 |
| Kenya x Lemhi ⁶ | 13630 | 42 | 4 | 65 | 440 | 415 | 365 | 1220 | 30.5** | 58.5 |
| Thatcher | 10003 | 38 | 0 | --- | 298 | 345 | 375 | 1018 | 25.5 | 59.3 |
| Onas 53 | 13257 | 40 | 3 | 35 | 510 | 440 | 365 | 1315 | 32.9** | 59.2 |

Note: Lemhi is used as a check

* Varieties yielding significantly more than the check (5%)

** Varieties yielding significantly more than the check (1%)

| | |
|-----------------------|--------|
| Mean Yield..... | 37.9 |
| S. E. \bar{x} | 2.7469 |
| L. S. D. (5%)..... | 8.0 |
| L. S. D. (1%)..... | 10.9 |
| C. V. | 7.25% |

Analysis of Variance

| Source | D. F. | Mean Square | F |
|--------------|-------|-------------|--------|
| Replications | 2 | 15767.5 | 6.97** |
| Varieties | 12 | 7134.167 | 3.15** |
| Error | 23 | 2263.696 | |
| Total | 37 | | |

Table XII. Agronomic data from irrigated off-station spring wheat nursery grown in Ravalli County on the Bitterroot Stock Farm, Corvallis, Montana in 1960. Single row plots, four replications.
 Planted: April 28, 1960
 Harvested: September 1, 1960
 Size of plot: 16 sq. ft.

| Variety or Cross | C.I. or N. No. | Replications | | | | Total Grams | Average Bu/acre | Bu. Wt. in pounds |
|---------------------------------------|----------------|--------------|-----|-----|-----|-------------|-----------------|-------------------|
| | | I | II | III | IV | | | |
| Kenya x Lemhi ⁶ , 52Ab9702 | 13435 | 510 | 210 | 295 | 390 | 1405 | 35.1 | 59.6 |
| Thatcher x Lee | B55-4 | 270 | 310 | 255 | 290 | 1125 | 28.1 | 61.5 |
| Centana | 12974 | 255 | 370 | 265 | 305 | 1195 | 29.9 | 61.2 |
| Lemhi | 11415 | 425 | 330 | 225 | 245 | 1225 | 30.6 | --- |
| 1953 x Lee B52-91 | 13242 | 340 | 350 | 235 | 225 | 1150 | 28.8 | 61.3 |
| Ceres | 6900 | 260 | 440 | 260 | 290 | 1250 | 31.3 | 62.0 |
| Lemhi 53 | 13258 | 410 | 260 | 410 | 320 | 1400 | 35.0 | 59.0 |
| Kenhi | 13268 | 388 | 250 | 230 | 355 | 1223 | 30.6 | 59.2 |
| Rescue x 1831, B51-9 | 13304 | 315 | 290 | 300 | 345 | 1250 | 31.3 | 59.5 |
| Thatcher | 10003 | 250 | 245 | 240 | 215 | 950 | 23.8 | 59.9 |

Mean Yield..... 30.4
 S. E. \bar{x} 3.48813
 L. S. D. NS
 C. V. 11.46%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|-----|
| Replications | 3 | 8536.30 | --- |
| Varieties | 9 | 4328.777 | --- |
| Error | 27 | 4866.818 | --- |
| Total | 39 | | |

Table XIII. Agronomic data from irrigated spring wheat nursery grown in Lake County on the Walter Mangles farm at Polson, Montana in 1960. Single row plots, four replications.
 Planted: May, 1960 Harvested: August 19, 1960 Size of plot: 16 sq. ft.

| Variety or Cross | C. I. Number | Grams Per Plot | | | | Total Grams | Ave. Bu/A |
|---|--------------|----------------|------------------|-----|-----|-------------|-----------|
| | | I | II | III | IV | | |
| Kenya x Lemhi ⁶ , 52Ab9702 (W) | 13435 | 215 | 165 | 160 | 115 | 655 | 16.4 |
| Thatcher x Lee | B55-4 | 170 | 280 | 110 | 106 | 666 | 16.7 |
| Centana | 12974 | 145 | 150 | 165 | 135 | 595 | 14.9 |
| Lemhi (W) | 11415 | 182 | 205 | 155 | 135 | 677 | 16.9 |
| 1953 x Lee, B52-91 | 13242 | 205 | 235 | 190 | 90 | 720 | 18.0 |
| Ceres | 6900 | 85 | 255 | 135 | 115 | 590 | 14.8 |
| Lemhi 53 (W) | 13258 | 125 | 235 | 115 | 140 | 615 | 15.4 |
| Kenhi (W) | 13268 | 175 | 195 | 140 | 100 | 610 | 15.3 |
| Rescue x 1831, B51-9 | 13304 | 185 | 207 ¹ | 120 | 95 | 607 | 15.2 |
| Thatcher | 10003 | 140 | 210 | 160 | 80 | 590 | 14.8 |

¹ Calculated missing plot

Analysis of Variance

| | | | |
|--------------|------|-------------|---------|
| Source | D.F. | Mean Square | F |
| Replications | 2 | 27465.638 | 14.13** |
| Varieties | 9 | 492.958 | |
| Error | 17 | 1944.1456 | |
| Total | 38 | | |

Mean Yield..... 15.8
 S. E. x. 2.2046
 L. S. D. (5%)..... NS
 C. V. 13.94%

Table XIV. Agronomic data from dryland spring wheat nursery grown in Mineral County on the Charles Frey ranch, Tarkio, Montana in 1960. Single row plots, three replications.

Planted: April 28, 1960 Harvested: August 19, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. or N. No. | Replications | | | Total Grams | Average Bushel Per Acre |
|---------------------------------------|----------------|--------------|----|-----|-------------|-------------------------|
| | | I | II | III | | |
| Kenya x Lemhi ⁶ , 52Ab9702 | 13435 | 25 | 30 | 20 | 75 | 2.4 |
| Thatcher x Lee | B55-4 | 15 | 60 | 35 | 110 | 3.7 |
| Centana | 12974 | 25 | 45 | 20 | 90 | 3.0 |
| Lemhi | 11415 | 30 | 75 | 45 | 150 | 5.0 |
| 1953 x Lee B52-91 | 13242 | 35 | 45 | 10 | 90 | 3.0 |
| Ceres | 6900 | 35 | 65 | 35 | 135 | 4.5 |
| Lemhi 53 | 13258 | 55 | 35 | 40 | 130 | 4.3 |
| Kenhi | 13268 | 50 | 70 | 25 | 145 | 4.8 |
| Rescue x 1831, B51-9 | 13304 | 45 | 50 | 25 | 120 | 4.0 |
| Thatcher | 10003 | 35 | 35 | 35 | 105 | 3.5 |

Mean Yield..... 3.8
 S. E. \bar{x}7088
 L. S. D. (5%).. NS
 C. V. 18.49%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 2 | 1293.335 | 8.58 |
| Varieties | 9 | 212.9633 | 1.41 |
| Error | 18 | 150.7406 | |
| Total | 29 | | |

Table XV. Agronomic data from Idaho Wheats Selection nursery at Creston, Montana in 1960. Four row plots, three replications.

| Variety or Cross | 1959 | | Head- ing Date | Stripe Rust % | Lodg- ing % | Ht. in In. | Plot Yield | | | Ave. Bu in lbs. | | |
|---|-----------|-------------|----------------------|---------------------|-------------------|------------------|-------------|----------------|------------|-----------------------|------|------|
| | R. No. | Ida. No. | | | | | in grams | Total Grams | Bu. /A. | | | |
| F ₄ -(Prem. x Fed) x Idaed ² | 2 | 1332 | 7-9 | 1 | 25 | 35 | 430 | 420 | 460 | 1310 | 43.7 | 61.5 |
| F ₄ -Fontana x Idaed ² | 15 | 1345 | 7-9 | 4 | 48 | 46 | 485 | 280 | 355 | 1120 | 37.3 | 59.4 |
| F ₆ -Timstein (gold) x Idaed | 20 | 1350 | 6-30 | 4 | 48 | 43 | 595 | 560 | 455 | 1610 | 53.7 | 61.0 |
| F ₄ -12633-1 x Lemhi ⁴ | 31 | 1361 | 7-14 | 4 | 72 | 44 | 290 | 305 | 325 | 920 | 30.7 | 59.3 |
| F ₄ -12633-1 x Lemhi ⁴ | 34 | 1364 | 7-8 | 1 | 63 | 43 | 477 | 430 | 355 | 1262 | 42.1 | 58.5 |
| F ₄ -(Eureka x Lemhi) x Idaed | 5 | 1335 | 7-7 | 2 | 27 | 41 | 555 | 526 | 480 | 1561 | 52.0 | 60.5 |
| F ₆ -Lee x Lemhi | 28 | 1358 | 7-9 | 3 | 62 | 47 | 505 | 572 | 455 | 1532 | 51.2 | 59.1 |
| F ₆ -Kenya 117A x Dicklow | 19 | 1349 | 7-16 | 2 | 100 | 51 | 500 | 330 | 535 | 1365 | 45.5 | 55.0 |
| F ₅ -(Premier x Fed ²) x Idaed | 1 | 1331 | 7-10 | 2 | 33 | 50 | 460 | 575 | 425 | 1460 | 48.7 | 61.5 |
| F ₄ -(C.I. 12633-1) x Lemhi | 30 | 1360 | 7-13 | 4 | 48 | 42 | 365 | 376 | 325 | 1066 | 35.5 | 57.5 |

Scale 0-4

Analysis of Variance

| Source | D. F. | Mean Square | F |
|--------------|-------|-------------|--------|
| Replications | 2 | 6110.40 | 1.44 |
| Varieties | 9 | 17656.5333 | 4.15** |
| Error | 18 | 4251.6222 | |
| Total | 29 | | |

| Mean Yield..... | 44.0 |
|-----------------------|--------|
| S. E. \bar{x} | 3.7646 |
| L. S. D. (5%)..... | 11.2 |
| L. S. D. (1%)..... | 15.3 |
| C. V. | 8.55% |

Winter Barley

Only one nursery of winter barley was grown this past season. It was located on the Station in field number E-3. Sixteen entries, replicated three times, made up this trial.

Yields are lower than average, as are bushel weights of most entries. Olympia is the highest yielding numerically, however, the analysis of variance indicates there are not any significant differences between entries. Table XVI shows the data for this experiment.

Table XVI. Agronomic data from dryland winter barley grown at Creston, Montana, 1959-60. Four row plots, three replications. Planted: September 25, 1959 Harvested: August 3, 1960 Size of Plot: 16 ft.

| Variety or Cross | C. I. No. | Head- ing Date | Head- ing Ht. | Lodg- ing % | Plot yield in grams | | | Total Grams | Ave. Bu. /A. | Bu Wt in lbs. |
|------------------|-----------|----------------|---------------|-------------|---------------------|-----|-----|-------------|--------------|---------------|
| | | | | | I | II | III | | | |
| Tenn. Upright | 10436 | 6-10 | 35 | | 505 | 430 | 490 | 1425 | 59.4 | 49.5 |
| Svalof 42-7 | 7187 | 6-15 | 33 | | 445 | 420 | 580 | 1445 | 60.2 | 48.5 |
| O.A.C. Strain 4 | 10096 | 6-13 | 32 | | 430 | 435 | 430 | 1295 | 54.0 | 48.0 |
| Kearney | 7580 | 6-10 | 32 | 40 | 355 | 390 | 460 | 1205 | 50.2 | 51.0 |
| Winter Club | 592 | 6-22 | 34 | | 285 | 640 | 420 | 1345 | 56.0 | 48.0 |
| CCX-242 | 9176 | 6-15 | 35 | | 390 | 600 | 485 | 1475 | 61.5 | 49.2 |
| CCX-349-9 | | 6-16 | 34 | | 445 | 610 | 550 | 1605 | 66.9 | 50.5 |
| Ellis | 9529 | 6-17 | 33 | | 425 | 625 | 575 | 1625 | 67.7 | 50.0 |
| CCX-51-471 | | 6-17 | 34 | 5 | 500 | 470 | 440 | 1410 | 58.8 | 48.2 |
| CCX-54-3 | | 6-14 | 33 | | 480 | 510 | 465 | 1455 | 60.6 | 49.0 |
| CCX-55-5 | | 6-16 | 33 | | 330 | 360 | 440 | 1130 | 47.1 | 46.5 |
| Alpine | 9578 | 6-24 | 37 | | 500 | 570 | 425 | 1495 | 62.3 | 46.6 |
| Ohio Winter | 7072 | 6-12 | 33 | 6 | 540 | 540 | 550 | 1630 | 67.9 | 49.0 |
| Olympia | 6107 | 6-14 | 32 | | 580 | 555 | 540 | 1675 | 69.8 | 48.0 |
| CCX Bulk | 6625 | 6-17 | 33 | | 420 | 460 | 445 | 1325 | 55.2 | 46.5 |
| KTY 56-74 | 10542 | 6-18 | 30 | | 525 | 450 | 490 | 1465 | 61.0 | 49.5 |

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 2 | 13377.08 | 2.85 |
| Varieties | 15 | 7856.632 | 1.65 |
| Error | 30 | 4761.5277 | |
| Total | 47 | | |

Mean Yield..... 59.9
 S. E. \bar{x} 4.9799
 L. S. D. (5%).. NS
 C. V. 8.31%

Spring Barley

Work on barley this season has been directed toward two-row barley varieties. Some factors have been studied to determine their effect on yield of a variety using isogenic lines. The different yield nurseries and studies conducted are listed here-in with an explanation of each.

Dryland Interstate and Station

This nursery was located on the Station in field number A-la. Twenty-two entries in four replications were included in this test. Ten of the entries were of the two-row type.

Yields were lower than normal for this rotation, the mean being only 46.0 bushels per acre. Statistically, there was no difference found between varieties. Two-row entries had a higher test weight than found in the six-row lines. Table XVII shows complete data for this nursery.

Irrigated Interstate and Station

Field number Y-5 was the location of this nursery on the Station. It contained twenty-five entries, replicated five times. Some of the entries in this nursery are the same as in the above nursery.

Yields were fair and test weights very good in most entries, only four were below the U.S. standard of 48 pounds per bushel. Svalof was the highest yielding with 78.4 bushels per acre, however, Unitan, the check was comparable, yielding 73.0 bushels per acre. Loose smut was found in several of the entries and lodging was severe in some varieties. With a C.V. of 7.02% this can be considered a good test. Table XVIII shows complete data for this nursery.

Dryland Advance Yield

The purpose of this nursery is to test material advanced from interstate nurseries which show promise, and also produce sufficient seed for malting tests. It was located in field number A-la on the Station. Ten entries, seven of which were two-row types, were included in the test.

Yields were fair but lower than average. Dekap was the only entry which lodged severely. Test weights were all above the U.S. standard. When analyzed statistically, there were no significant differences due to varieties. The differences in yield that do exist are because of replication. See Table XIX.

Irrigated Malting and Advanced Yield

fair yields for irrigation. Freja is used as a check. Ingrid, Svalof, and Firlbecks III are significantly better in yield than the check. Test weights are all high except entry number one. Mean for this nursery is 80.2 bushels per acre.

Off-Station

The off-station nurseries contained ten entries planted in four replications. They were located in three counties, two on irrigated land and one on dryland. Discussion of each follows below.

Ravalli County - This plot was located on the Bitterroot Stock Farm near Corvallis. Soil, water, and plot conditions for this nursery are the same as for the spring wheat nursery, which is included earlier in this report.

For irrigation, these yields are quite low. A high C.V. was calculated indicating that plot conditions were very uneven and stands quite poor. Because of the high C.V., little faith can be placed in the data. See Table XXI.

Mineral County - The Charles Frey ranch was the location of the nursery in the afore named county. Extreme dry conditions during the growing season accounts for the low yields in this nursery. The C.V. (21.17%) is very high, making the data unreliable for inclusion in a summary of data. See Table XXII, which gives data and a mean yield of 6.3 bushels per acre.

Lake County - This nursery was grown on the Walter Mangles farm near Polson. The section on spring wheat gives plot and climatic information for this nursery. No data was secured because of hail and error during harvesting and the cleaning process.

White Lemma Mutants

This study was designed to study the effect of yield, quality, and incidence of seed borne disease organism on varieties with the White Lemma factor as compared to the normal variety. It was conducted under both dry and irrigated conditions. The irrigated nursery was grown in field number Y-5 and the dryland in field number E-2, both on the Station. Quality and disease readings are not made a part of this report, because the information has not been secured from cooperating agencies as of this date. Therefore, the only information included is yield data.

In the irrigated test, a difference in yield of eight bushels is required for significance. A total of eight bushels is noted in the Titan normal and Titan mutant. The normal being higher in yield than the mutant. This is also true of Liberty, but the difference is not significant. See Table XXIII.

The dryland trial records data which is non-significant, however, we do find 4.5 bushels difference in the Titan strains, and the Liberty strains

being the same. However, it is doubtful that this data is of value as far as yields are concerned.

Glossy Mutants versus Normal Green

This study was designed to study the effect of the mutant on the yield of five varieties of barley. This was set up as a Latin Square design to compare glocus versus normal and glocus versus normal x variety. A complete analysis is included in this report.*

Table XXV gives yield data on this nursery. It will be noted that in all cases, the normal genetic material was higher in yield than the mutant type with Compana being the exception. Little difference is noted in test weights where this information was secured. In heading dates and heading heights, little variation is found between the normal and the mutant.

* A complete statistical analysis was not completed at printing time of this report.

Table XVII. Agronomic data from dryland interstate and station barley nursery at Creston, Montana in 1960. Four row plots, four replications. Randomized block design. Planted: April 22, 1960 Harvested: August 8, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C. I. or N. No. | Ht. in In. | Lodging % | Plot Yield in grams | Total Grams | Average Bushel /acre | Bu. Wt. in pounds |
|---------------------|-----------------|------------|-----------|---------------------|-------------|----------------------|-------------------|
| | | | | I II III IV | | | |
| Lico x Ogalitsu | 56-7469-12 | 24 | | 340 435 470 360 | 1605 | 50.2 | 48.5 |
| Titan | 7055 | 27 | | 285 320 410 330 | 1345 | 42.0 | 50.1 |
| Aberdeen Sel. | 51-3425 | 28 | | 300 170 310 340 | 1120 | 35.0 | 49.0 |
| Unitan | 10421 | 27 | | 395 480 350 375 | 1600 | 50.0 | 49.0 |
| Lico x Ogalitsu | 56-7570-23 | 28 | 5 | 370 400 360 320 | 1450 | 45.3 | 48.0 |
| Compana | 5438 | 22 | 10 | 285 390 380 400 | 1455 | 45.5 | 51.5 |
| Piroline | 9558 | 21 | | 330 445 365 360 | 1500 | 46.9 | 52.5 |
| Ingrid | 10083 | 22 | | 355 410 420 435 | 1620 | 50.6 | 51.2 |
| Freja | 7130 | 23 | | 355 265 410 470 | 1500 | 46.9 | 50.5 |
| Glacier x Compana | 10861 | 26 | | 360 350 400 360 | 1470 | 46.0 | 48.5 |
| Hein Flo 254/53 | 225035 | 22 | | 320 350 320 280 | 1270 | 39.7 | 52.5 |
| Betzes | 6398 | 23 | | 395 355 380 345 | 1475 | 46.1 | 53.0 |
| Vantage | 7324 | 27 | | 395 390 330 345 | 1460 | 45.6 | 50.0 |
| C.I. 5461, F35 Bulk | 9183 | 27 | | 480 375 380 360 | 1595 | 49.9 | 46.0 |
| Dakap | 3351 | 21 | | 480 435 375 400 | 1690 | 52.8 | 53.0 |
| Halsa II | 10420 | 24 | | 365 300 425 470 | 1560 | 48.8 | 52.5 |
| Svalof 50-109 | 10524 | 19 | | 360 455 325 355 | 1495 | 46.7 | 48.4 |
| Lico x Ogalitsu | 56-7570-19 | 24 | | 275 325 410 355 | 1365 | 42.7 | 49.5 |
| Hein Flo 299/53 | 225036 | 23 | | 305 325 255 380 | 1265 | 39.5 | 50.5 |
| Firlbecks III | 10088 | 21 | | 230 410 325 385 | 1350 | 42.2 | 51.5 |
| Hungarian Malting | | 23 | | 340 490 330 402 | 1562 | 48.8 | 52.4 |
| Betzes Erectoides | 238666 | 22 | | 375 405 505 365 | 1650 | 51.6 | 53.0 |

Mean Yield..... 46.0
 S. E. X. 3.4925
 L. S. D. (5%)..... NS
 C. V. 7.59%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 3 | 3380.5267 | 1.08 |
| Varieties | 21 | 4990.3524 | 1.60 |
| Error | 63 | 3120.6575 | |
| Total | 87 | | |

Table XVIII. Agronomic data from irrigated interstate and station barley nursery at Creston, Montana in 1960. Four row plots, ten feet long. Randomized block design. Planted: May 2, 1960 Harvested: August 22, 1960 Size of plot: 16 square feet

| Variety or Cross | C. I. or N. No. | Head- ing Date | Ht. in In. | Lodg- ing % | Loose Smut | Plot yield in grams | | | | | Total Grams | Bu Wt in Lbs. | |
|-------------------------|-----------------|----------------|------------|-------------|------------|---------------------|-----|------------------|-----|------------------|-------------|---------------|------------|
| | | | | | | I | II | III | IV | V | | Ave. Bu /A. | Bu in Lbs. |
| Ingrid | 10083 | 7-6 | 30 | 31 | | 533 ¹ | 470 | 520 | 490 | 740 | 2753 | 68.8 | 54.5 |
| Hein Flo 254/53 | 225035 | 6-26 | 32 | 13 | x | 430 | 615 | 595 | 580 | 535 | 2755 | 68.9 | 54.0 |
| Freja | 7130 | 7-2 | 30 | 67 | | 250 | 446 | 565 | 524 | 440 ¹ | 2225 | 55.6** | 53.2 |
| Betztes Erectoides | 6398 | 7-2 | 34 | 53 | | 500 | 510 | 560 | 435 | 470 | 2475 | 61.9 | 53.5 |
| Betztes | 10088 | 7-3 | 34 | 64 | x | 490 | 550 | 510 | 430 | 620 | 2600 | 65.0 | 52.5 |
| Firlbecks III | 10420 | 7-2 | 35 | 3 | | 530 | 610 | 640 | 630 | 600 | 3010 | 75.3 | 53.5 |
| Haisa II | 7324 | 7-6 | 37 | 37 | | 445 | 530 | 530 | 630 | 550 | 2685 | 67.1 | 54.0 |
| Vantage | 51-3425 | 6-28 | 42 | 10 | x | 360 | 435 | 472 ¹ | 425 | 540 | 2232 | 55.8* | 51.5 |
| Aberdeen Sel. | 9183 | 7-2 | 40 | 50 | x | 345 | 435 | 640 | 455 | 405 | 2280 | 57.0* | 50.0 |
| C.I. 5461, F35 Bulk | 56-7470-19 | 6-26 | 42 | 55 | x | 460 | 475 | 645 | 590 | 596 | 2766 | 69.2 | 47.5 |
| Lico x Ogalitsu | 10861 | 6-30 | 39 | 32 | x | 480 | 505 | 535 | 545 | 540 | 2605 | 65.1 | 48.5 |
| Glacier x Compans | 10421 | 6-26 | 39 | 35 | x | 605 | 510 | 510 | 510 | 525 | 2660 | 66.5 | 44.0 |
| Unitan | 56-7570-23 | 6-25 | 44 | 33 | x | 520 | 520 | 625 | 480 | 495 | 2640 | 66.0 | 49.5 |
| Lico x Ogalitsu | 3351 | 6-30 | 37 | 91 | | 405 | 495 | 570 | 450 | 440 | 2360 | 59.0* | 52.5 |
| Dekap | 10524 | 7-6 | 33 | 26 | x | 615 | 590 | 650 | 592 | 690 | 3137 | 78.4 | 53.0 |
| Svalof 50-109 | 5438 | 7-6 | 36 | 76 | x | 490 | 550 | 490 | 420 | 665 | 2615 | 65.4 | 51.5 |
| Compans | 7055 | 6-27 | 46 | 1 | | 370 | 390 | 360 | 360 | 330 | 1810 | 45.3* | 52.0 |
| Titan | 238666 | 7-6 | 35 | 30 | | 500 | 600 | 585 | 527 | 600 | 2812 | 70.3 | 54.0 |
| Hungarian Malting | 7243 | 6-25 | 34 | 4 | x | 610 | 360 | 745 | 340 | 195 | 2250 | 56.3* | 47.5 |
| Gem | 10118 | 7-3 | 41 | 42 | | 705 | 430 | 575 | 620 | 736 | 3066 | 76.7 | 46.0 |
| Utah 570-8 | 225036 | 6-26 | 36 | 8 | | 490 | 540 | 555 | 495 | 480 | 2560 | 64.0 | 55.0 |
| Hein Flo 299/53 | 9558 | 7-9 | 37 | 35 | | 465 | 450 | 610 | 385 | 455 | 2365 | 59.1* | 61.5 |
| Utah hullless composite | 56-7469-12 | 7-2 | 37 | 29 | x | 600 | 605 | 500 | 640 | 550 | 2895 | 72.4 | 54.0 |
| Piroline | | 6-2 | 35 | 8 | x | 580 | 370 | 510 | 510 | 575 | 2545 | 63.6 | 51.0 |
| Lico x Ogalitsu | | | | | | | | | | | | | |

¹ Calculated missing plot
 * Unitan is used as check in this nursery
 * Varieties yielding significantly less than the check (5%)
 ** Varieties yielding significantly less than the check (1%)
 Analysis of Variance
 Source D.F. Mean Square F
 Replications 4 20744.29 3.11
 Varieties 24 18781.3783 2.81
 Error 93 6672.8090
 Total 121

Mean Yield..... 65.0
 S. E. \bar{x} 4.5679
 L. S. D. (5%).. 12.9
 L. S. D. (1%).. 17.0
 C. V. 7.02%

Table XIX. Agronomic data from dryland advanced yield barley nursery at Creston, Montana in 1960. Eight-row plots, ten feet long, three replications. Randomized block design. Planted: April 22, 1960 Harvested: August 8, 1960 Size of plot: 16 square feet

| Variety or Cross | C.I. or N. No. | Heading Height | Lodging % | Plot yield in grams | | | Average Bu/acre | Bu Wt in Pounds | |
|------------------|----------------|----------------|-----------|---------------------|-----|-----|-----------------|-----------------|------|
| | | | | I | II | III | | | |
| Betztes | 6398 | 29 | 10 | 385 | 435 | 592 | 1412 | 58.9 | 51.4 |
| Unitan | 10421 | 33 | 7 | 350 | 495 | 510 | 1355 | 56.5 | 49.0 |
| Dekap | 3351 | 29 | 47 | 365 | 455 | 300 | 1120 | 46.7 | None |
| Firlbecks III | 10088 | 29 | | 290 | 365 | 470 | 1125 | 46.9 | 51.0 |
| Piroline | 9558 | 28 | | 325 | 405 | 555 | 1285 | 53.6 | 53.4 |
| Vantage | 7324 | 37 | | 330 | 380 | 560 | 1270 | 52.9 | 49.8 |
| Svalof 50-109 | 10524 | 25 | | 440 | 485 | 520 | 1445 | 60.2 | 49.0 |
| Freja | 7130 | 29 | 10 | 390 | 465 | 495 | 1350 | 56.3 | 51.6 |
| Compana | 5438 | 29 | 7 | 390 | 365 | 555 | 1310 | 54.6 | 53.0 |
| Titan | 7055 | 37 | 2 | 260 | 285 | 460 | 1005 | 41.9 | 50.3 |

Mean Yield..... 52.8
 S. E. X. 4.3564
 L. S. D. (5%)... NS
 C. V. 8.24%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 2 | 56268.135 | 15.45** |
| Varieties | 9 | 6664.30 | 1.83 |
| Error | 18 | 3641.4667 | |
| Total | 29 | | |

Table XX. Agronomic data from irrigated malting and advanced yield nursery grown at Creston, Montana in 1960. Eight-row plots, ten feet long, three replications. Randomized block design.

Planted: May 6, 1960 Harvested: August 22, 1960 Size of Plot: 16 square feet

| Variety or Cross | C. I. or N. No. | Head- ing Date | Head- ing Ht. | Loose Smut | Plot yield in grams | | | Total Grams | Ave. Bu./ Acre | Bu. Wt. in Pounds |
|-------------------|-----------------|----------------------|---------------------|---------------|------------------------|------------------|-----|----------------|----------------------|-------------------------|
| | | | | | I | II | III | | | |
| Glacier x Compana | 10861 | 7-4 | 39 | x | 540 | 750 | 565 | 1855 | 77.3 | 47.4 |
| Unitan | 10421 | 6-29 | 36 | | 660 | 650 | 580 | 1890 | 78.8 | 51.0 |
| Freja | 7130 | 7-7 | 32 | x | 625 | 500 | 540 | 1665 | 69.4 | 51.8 |
| Betzes | 6398 | 7-7 | 31 | | 660 | 575 | 530 | 1765 | 73.6 | 52.0 |
| Ingrid | 10083 | 7-9 | 32 | | 860 | 805 | 750 | 2415 | 100.7* | 53.9 |
| Svalof 50-109 | 10524 | 7-9 | 28 | | 690 | 650 | 865 | 2205 | 91.9* | 52.0 |
| Vantage | 7324 | 7-3 | 42 | | 420 | 695 | 490 | 1605 | 66.9 | 51.5 |
| Firlbecks III | 10088 | 7-6 | 33 | x | 770 | 768 ¹ | 715 | 2253 | 93.9* | 53.1 |
| Compana | 5438 | 7-1 | 29 | x | 550 | 530 | 585 | 1665 | 69.4 | 50.5 |

¹ Calculated missing plot

Freja is used as the check variety

* Varieties yielding significantly more than the check

Mean Yield..... 80.2
S. E. X. 6.4146
L. S. D. (5%).... 19.3
C. V. 8.00%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|-------|
| Replications | 2 | 2550.66 | |
| Varieties | 8 | 28975.1475 | 3.67* |
| Error | 15 | 7895.2013 | |
| Total | 25 | | |

Table XXI. Agronomic data from irrigated off-station barley nursery grown in Ravalli County on the Bitterroot Stock Farm, Corvallis, Montana in 1960. Single row plots, four replications.

Planted: April 28, 1960 Harvested: September 1, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. or N. No. | Plot Yield in Grams | | | | Total Grams | Average Bu/Acre | Bu. Wt. in Pounds |
|------------------|----------------|---------------------|-----|-----|-----|-------------|-----------------|-------------------|
| | | I | II | III | IV | | | |
| Unitan | 10421 | 220 | 330 | 190 | 230 | 970 | 30.3 | 47.3 |
| Firlbecks III | 10088 | 395 | 425 | 410 | 225 | 1455 | 45.5 | 52.3 |
| Ingrid | 10083 | 550 | 425 | 455 | 415 | 1845 | 57.7 | 52.9 |
| Betztes | 6398 | 225 | 310 | 175 | 345 | 1055 | 33.0 | 52.0 |
| Freja | 7130 | 245 | 110 | 330 | 275 | 960 | 30.0 | 50.6 |
| Haisa II | 10420 | 645 | 185 | 375 | 352 | 1557 | 48.7 | 51.8 |
| Vantage | 7324 | 340 | 425 | 325 | 280 | 1370 | 42.8 | 49.0 |
| Compana | 5438 | 270 | 215 | 200 | 100 | 785 | 24.5 | 50.0 |
| Piroline | 9558 | 464 | 490 | 100 | 415 | 1469 | 45.9 | 53.2 |
| Svalof 50-109 | 10524 | 240 | 200 | 355 | 260 | 1055 | 33.0 | 51.0 |

Vantage is the check variety in the nursery

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|--------|
| Replications | 3 | 10534.4933 | |
| Varieties | 9 | 27983.0811 | 2.46** |
| Error | 27 | 11379.1767 | |
| Total | 39 | | |

Mean Yield..... 39.1
 S. E. \bar{x} 6.6692
 L. S. D. (5%).... 19.3
 C. V. 17.04%

Table XXIII. Agronomic data from dryland off-station barley nursery grown in Mineral County on the Charles Frey ranch at Tarkio, Montana in 1960. Single row plots, four replications.
 Planted: April 28, 1960 Harvested: August 19, 1960 Size of plot: 16 ft.

| Variety or Cross | C.I. or N. No. | Plot Yield in Grams | | | Total Grams | Average Bushel/Acre |
|------------------|----------------|---------------------|-----|-----|-------------|---------------------|
| | | I | II | III | | |
| Unitan | 10421 | 35 | 115 | 70 | 220 | 9.2 |
| Firlbecks III | 10088 | 50 | 45 | 35 | 130 | 5.4 |
| Ingrid | 10083 | 60 | 45 | 30 | 135 | 5.6 |
| Betzes | 6398 | 45 | 50 | 45 | 140 | 5.8 |
| Freja | 7130 | 45 | 75 | 40 | 160 | 6.7 |
| Haisa II | 10420 | 40 | 35 | 20 | 95 | 4.0 |
| Vantage | 7324 | 50 | 85 | 35 | 170 | 7.1 |
| Compana | 5438 | 25 | 100 | 25 | 150 | 6.3 |
| Piroline | 9558 | 30 | 85 | 45 | 160 | 6.7 |
| Svalof 50-109 | 10524 | 50 | 65 | 25 | 140 | 5.8 |

| Analysis of Variance | | | | Mean Yield..... | 6.3 |
|----------------------|------|-------------|------|-----------------------|--------|
| | | | | S. E. \bar{x} | 1.3239 |
| | | | | L. S. D. | NS |
| | | | | C. V. | 21.17% |
| Source | D.F. | Mean Square | F | | |
| Replications | 2 | 3090.0 | 9.19 | | |
| Varieties | 9 | 346.33 | 1.03 | | |
| Error | 18 | 336.28 | | | |
| Total | 29 | | | | |

Table XXIII. Data from test of White Lemma Mutants for yield, quality, and incidence of seed borne disease organisms, two-row plots in a split plot design. (Irrigated) Creston, Montana in 1960.

Planted: May 2, 1960 Harvested: August 22, 1960 Size of Plot: 16 sq. ft.

| Variety | Plot Yield in Grams | | | | | Total Grams | Average Bu/acre | Bu. Wt. in pounds |
|---------------------|---------------------|-----|-----|-----|-----|-------------|-----------------|-------------------|
| | I | II | III | IV | V | | | |
| Liberty | 360 | 330 | 415 | 405 | 397 | 1907 | 47.7 | 51.0 |
| White Lemma Liberty | 310 | 290 | 350 | 420 | 360 | 1730 | 43.3 | 48.5 |
| Titan | 385 | 365 | 405 | 372 | 235 | 1762 | 44.1 | 52.4 |
| Grandma Titan | 250 | 295 | 265 | 330 | 305 | 1445 | 36.1 | 50.4 |

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|-------|
| Replications | 4 | 2907.55 | 1.36 |
| Varieties | 3 | 7475.60 | 3.49* |
| Error | 12 | 2145.35 | |
| Total | 19 | | |

Mean Yield..... 42.8
 S. E. \bar{x} 2.5901
 L. S. D. (5%)..... 8.0
 C. V. 6.05%

Table XXIV. Data from test of White Lemma Mutants for yield, quality, and incidence of seed borne disease organisms, two-row plots in a split plot design (Dryland) at Creston, Montana in 1960.

Planted: April 21, 1960 Harvested: August 8, 1960 Size of Plot: 16 ft.

| Variety | Plot Yield in Grams | | | | | Total Grams | Average Bu/acre |
|---------------------|---------------------|-----|-----|-----|-----|-------------|-----------------|
| | I | II | III | IV | V | | |
| Liberty | 140 | 85 | 95 | 105 | 115 | 540 | 13.5 |
| White Lemma Liberty | 85 | 110 | 115 | 123 | 105 | 538 | 13.5 |
| Titan | 115 | 140 | 160 | 130 | 105 | 650 | 16.3 |
| Grandma Titan | 105 | 110 | 55 | 100 | 100 | 470 | 11.8 |

Analysis of Variance

| <u>Source</u> | <u>D.F.</u> | <u>Mean Square</u> | <u>F</u> |
|---------------|-------------|--------------------|----------|
| Replications | 4 | 51.45 | |
| Varieties | 3 | 1109.5333 | 2.14 |
| Error | 12 | 517.45 | |
| Total | 19 | | |

Mean Yield..... 13.7
 S. E. X. 1.272
 L. S. D. NS
 C. V. 9.29%

Table XXV. Data from Glossy Mutants versus Normal Green barley. Yield and quality tests. Four-row plots, ten feet long and one foot apart in a Latin Square design. Dryland at Creston, Montana in 1960.

Planted: April 21, 1960 Harvested: August 3, 1960 Size of Plot: 16 square feet

| Variety | Heading Date | Heading Height | Plot Yield in Grams | | | | | Total Grams | Ave. Bu/A | |
|----------|----------------|----------------|---------------------|-----|-----|-----|-----|-------------|-----------|--------|
| | | | I | II | III | IV | V | | Bu/A | in lbs |
| Betzes | Normal 7-4 | 16 | 105 | 160 | 160 | 110 | 60 | 595 | 14.9 | |
| | Glossy 7-4 | 14 | 90 | 115 | 90 | 105 | 120 | 520 | 13.0 | |
| Compana | Normal 6-30 | 14 | 85 | 125 | 65 | 155 | 100 | 530 | 13.3 | |
| | Glossy 6-30 | 16 | 120 | 110 | 90 | 150 | 110 | 580 | 14.5 | |
| Pirolina | Normal 7-1 | 14 | 125 | 135 | 110 | 190 | 160 | 720 | 18.0 | 46.0 |
| | Glossy 7-4 | 15 | 115 | 135 | 115 | 155 | 180 | 700 | 17.5 | 46.5 |
| Hanna | Normal 7-4 | 16 | 130 | 160 | 225 | 140 | 150 | 805 | 20.1 | 47.5 |
| | Glossy 7-4 | 16 | 170 | 130 | 195 | 155 | 145 | 795 | 19.9 | 46.0 |
| Vantage | Normal 7-4 | 16 | 85 | 120 | 150 | 75 | 85 | 515 | 12.9 | |
| | Glossy 7-5 | 14 | 85 | 120 | 130 | 70 | 100 | 505 | 12.6 | |

Table XXVI. Data from Glossy Mutants versus Normal Green barley. Yield and quality tests. Four-row plots, ten feet long and one foot apart in a Latin Square design. Irrigated at Creston, Montana in 1960.

Planted: May 2, 1960 Harvested: August 22, 1960 Size of Plot: 16 square feet

| Variety | Heading Date | Loose Smut | Plot Yield in Grams | | | | Total Grams | Average Bu/acre | Bu. Wt. in pounds |
|----------|--------------|------------|---------------------|-----|-----|-----|-------------|-----------------|-------------------|
| | | | I | II | III | IV | | | |
| Betzes | Normal 7-6 | x | 580 | 505 | 535 | 570 | 2190 | 66.0 | 53.0 |
| | Glossy 7-5 | x | 555 | 560 | 580 | 565 | 2260 | 68.1 | 53.2 |
| Compans | Normal 7-2 | x | 465 | 483 | 551 | 400 | 1899 | 57.2 | 52.0 |
| | Glossy 7-2 | x | 435 | 455 | 455 | 425 | 1770 | 53.3 | 51.0 |
| Pirolina | Normal 7-7 | x | 640 | 550 | 570 | 668 | 2428 | 73.2 | 52.5 |
| | Glossy 7-7 | | 585 | 565 | 500 | 610 | 2260 | 68.1 | 54.0 |
| Hanna | Normal 7-7 | | 315 | 380 | 390 | 415 | 1500 | 45.2 | 52.5 |
| | Glossy 7-7 | x | 355 | 420 | 370 | 315 | 1460 | 44.0 | 52.5 |
| Vantage | Normal 7-4 | | 335 | 492 | 555 | 620 | 2002 | 60.3 | 53.0 |
| | Glossy 7-4 | | 350 | 385 | 555 | 651 | 1941 | 58.5 | 53.0 |

Oats

Oats work this year was limited to the testing of varieties under both dry and irrigated conditions. The Montana irrigated and dryland nursery, the advanced yield nursery, and off-station nurseries were grown the past season. A discussion of each follows here-in.

Montana Irrigated

This nursery was grown on the Station in field number Y-5. The entries in this nursery include all the material included in the Uniform Northwestern oat nursery. Thirty-two entries make up this nursery. Three replications are used.

Yields are about average for the Station. There were no varieties which were significantly higher in yield than Park, but C. I. 5347 and C. I. 5346 were higher in yield numerically than Park. Scotch Club was the lowest in yield and the latest maturing variety. 58AB2773 and Cody share top place in this nursery. In Table XXII are found complete data on this nursery.

Montana Dryland

Located in field number E-2, this nursery contains thirty-two entries, some of which were also included in the irrigated tests. As in the above test, three replications are used.

This oats trial was subjected to extreme drought conditions in June and July, thus a low mean yield of 14.8 bushels per acre is recorded. This is due in part to a hail storm on August 3, in which about a fifty per cent loss was sustained. Scotch Club, a late maturing variety, was the lowest yielding entry. A C.V. of 10.12% would tend to leave a question as to the reliability of this test. Table XXVIII gives data on yield, heading date, and height.

Advanced Yield Dryland

This nursery, grown in eight-row plots, was selected from promising material in the Montana nursery. It was subjected to the same adverse conditions as described above for the Montana dryland nursery.

Results obtained indicate no difference between varieties when analyzed statistically. This could be considered a fair test, and under similar conditions it would be expected that these varieties would always be about equal in yield. See Table XXIX.

Off-station

Three off-station nurseries were harvested this year. Their location, condition as to climate, irrigation, and other factors are discussed in the spring wheat section of this report. Twelve entries were included in each nursery.

Ravalli County - The nursery was located on the Bitterroot Stock Farm near Corvallis. Yields are low for irrigated oats (see wheat report). When analyzed statistically, no significance was found between varieties as it pertains to yield. See Table XXX.

Lake County - Grown on the Walter Mangles farm near Pablo, Montana. The low mean of 19.5 is explained in the wheat section of this report. Cody was the only variety significantly higher in yield than Park. However, the high C.V. would tend to question this as being a real difference. See Table XXXI.

Mineral County - Grown on the Charles Frey Ranch, this nursery has an extremely low yield with the results being non-significant statistically. Table XXXII show results of the test in Mineral County.

Table XXVII. Agronomic data from Montana irrigated oat nursery, Creston, Montana in 1960. Four-row plots, three replications.

| Variety or Cross | C. I. No. | Harvested: August 8, 1960 | Heading Date | Heading Height | Plot Yield in grams | | | | Total Grams | Ave. Bu/A | Bu Wt in lbs |
|--|-----------|---------------------------|--------------|----------------|---------------------|-----|------------------|------|-------------|-----------|--------------|
| | | | | | I | II | III | IV | | | |
| Ottawa 3928-5-7 | 5961 | | 7-5 | 46 | 410 | 540 | 545 | 1495 | 93.5* | 37.0 | |
| Burnett | 6537 | | 7-6 | 49 | 435 | 524 | 630 | 1589 | 99.3 | 40.4 | |
| (Roxton x R.L. 1276) x (Ajax x R.L. 1276) | 5958 | | 7-12 | 45 | 560 | 590 | 575 | 1725 | 107.8 | 37.5 | |
| R.L. 1273 x Spooner | 6939 | | 7-2 | 49 | 490 | 460 | 500 | 1450 | 90.6* | 38.0 | |
| Clinton "59" | 4259 | | 7-6 | 42 | 567 ¹ | 565 | 550 | 1682 | 105.2 | 37.3 | |
| Markton | 2053 | | 7-11 | 47 | 645 | 455 | 605 | 1705 | 106.6 | 37.0 | |
| Cody | 3916 | | 7-12 | 43 | 680 | 690 | 735 ¹ | 2105 | 131.6 | 38.0 | |
| Simcoe | 6767 | | 7-10 | 52 | 590 | 485 | 635 | 1710 | 106.9 | 37.5 | |
| Clinton x Overland ² | 5345 | | 7-11 | 46 | 635 | 455 | 605 | 1695 | 106.0 | 35.0 | |
| Park 6611 | 6611 | | 7-13 | 46 | 590 | 615 | 615 | 1820 | 113.8 | 39.5 | |
| C.I. 4189 x Overland | 7263 | | 7-13 | 42 | 635 | 550 | 650 | 1835 | 114.7 | 39.0 | |
| Victory | 1145 | | 7-15 | 48 | 585 | 450 | 575 | 1610 | 100.7 | 36.0 | |
| Rodney | 6661 | | 7-6 | 44 | 565 | 580 | 580 | 1725 | 107.9 | 36.8 | |
| Bannock | 2592 | | 7-12 | 45 | 795 | 475 | 690 | 1960 | 122.5 | 40.0 | |
| (H-J x B-R x SF) x Overland | 56AB6538 | | 7-15 | 43 | 630 | 580 | 715 | 1925 | 120.4 | 38.0 | |
| (C.I. 6740 x Imp. Garry) x (Bonda x H-J x SF) x Mo 0-205 | 58AB2782 | | 7-14 | 42 | 640 | 635 | 605 | 1880 | 117.5 | 39.6 | |
| " " | 58AB2784 | | 7-14 | 42 | 658 | 660 | 480 | 1798 | 112.4 | 36.2 | |
| " " | 58AB2773 | | 7-14 | 45 | 710 | 625 | 775 | 2110 | 131.9 | 32.2 | |
| Overland | 4181 | | 7-11 | 46 | 565 | 665 | 700 | 1930 | 120.7 | 39.6 | |
| Imp. Garry | 6662 | | 7-10 | 50 | 610 | 645 | 650 | 1905 | 119.1 | 38.5 | |
| Weibulls 16004 | 7257 | | 7-15 | 49 | 580 | 685 | 605 | 1870 | 116.9 | 34.4 | |
| Marne | 5163 | | 7-13 | 47 | 655 | 665 | 715 | 2035 | 127.2 | 37.7 | |
| Oneida | | | 7-12 | 43 | 560 | 490 | 555 | 1605 | 100.3 | 36.6 | |

Planted: May 2, 1960

Harvested: August 8, 1960

Size of Plot: 16 square feet

Continued ---

Table XXVII. (Continued)

| Variety or Cross | C. I. No. | Heading Date | Heading Height | Plot Yield in Grams | Total Grams | Ave. Bu/A | Bu Wt in lbs |
|---------------------------------|-----------|--------------|----------------|---------------------|-------------|-----------|--------------|
| | | | | I | II | III | |
| Bridger | 2611 | 7-15 | 48 | 585 | 570 | 555 | 1710 |
| Mission | 2588 | 7-8 | 43 | 485 | 475 | 565 | 1525 |
| Gopher | 2027 | 7-7 | 39 | 515 | 520 | 500 | 1535 |
| Clinton x Overland ² | 5346 | 7-14 | 43 | 635 | 640 | 725 | 2000 |
| Sun II | 4962 | 7-15 | 52 | 675 | 620 | 630 | 1925 |
| C.I. 4189 x Overland | 6613 | 7-14 | 43 | 700 | 605 | 760 | 2065 |
| C.I. 4189 x Overland | 5347 | 7-14 | 46 | 645 | 682 | 685 | 2012 |
| Bridger x Overland | 50-100-15 | 7-16 | 45 | 785 | 625 | 685 | 2095 |
| Scotch Club | 193027 | 7-20 | 46 | 490 | 370 | 395 | 1255 |

Mean Yield..... 111.9
 S. E. \bar{x} 6.6265
 L. S. D. (5%)..... 18.7
 L. S. D. (1%)..... 24.9
 C. V. 5.92%

Park is the check variety
 * Varieties yielding significantly less than the check (5%)
 ** Varieties yielding significantly less than the check (1%)

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|--------|
| Replications | 2 | 21005.3 | 5.61** |
| Varieties | 31 | 15264.9129 | 4.08** |
| Error | 60 | 3744.635 | |
| Total | 93 | | |

Table XXVIII. Agronomic data from dryland Montana oat nursery at Creston, Montana in 1960. Four-row plots, three replications.

| Variety or Cross | C. I. No. | Harvested: August 8, 1960 | | Size of Plot: 16 square feet | | | Total Grams | Average Bu/acre |
|--|-----------|---------------------------|----------------|------------------------------|-----|-----|-------------|-----------------|
| | | Date | Heading Height | I | II | III | | |
| Ottawa 3928-5-7 | 5961 | 6-28 | 22 | 80 | 55 | 55 | 190 | 11.9 |
| Burnett | 6537 | 7-1 | 23 | 110 | 95 | 85 | 290 | 18.1 |
| (Roxton x R.L. 1276) x (Ajax x R.L. 1276) | 5958 | 7-2 | 21 | 100 | 70 | 85 | 255 | 15.9 |
| R. L. 1273 x Spooner | 6939 | 7-3 | 21 | 95 | 80 | 80 | 255 | 15.9 |
| Clinton 59 | 4259 | 7-1 | 23 | 85 | 60 | 75 | 220 | 13.8 |
| Markton | 2053 | 7-4 | 22 | 105 | 80 | 85 | 270 | 16.9 |
| Cody | 3916 | 7-6 | 19 | 70 | 50 | 85 | 205 | 12.8 |
| Simcoe | 6767 | 7-4 | 22 | 60 | 50 | 55 | 165 | 10.3 |
| Clinton x Overland ² | 5345 | 7-5 | 22 | 85 | 85 | 65 | 235 | 14.7 |
| Park | 6611 | 7-6 | 21 | 100 | 80 | 100 | 280 | 17.5 |
| C.I. 4189 x Overland | 7263 | 7-5 | 21 | 70 | 70 | 55 | 195 | 12.2 |
| Victory | 1145 | 7-7 | 25 | 85 | 110 | 95 | 290 | 18.1 |
| Rodney | 6661 | 6-30 | 21 | 85 | 85 | 85 | 255 | 15.9 |
| Barnock | 2592 | 7-5 | 22 | 85 | 80 | 105 | 270 | 16.9 |
| (H-J x B.R. x S.F.) x Overland | 56AB6538 | 7-12 | 22 | 75 | 85 | 80 | 240 | 15.0 |
| (C.I. 6740 x Imp. Garry) x (Bonda x H-J x S.F.) x Mo 0-205 | 58AB2782 | 7-6 | 23 | 80 | 95 | 80 | 255 | 15.9 |
| " " " " " " | 58AB2784 | 7-7 | 24 | 60 | 85 | 100 | 245 | 15.3 |
| " " " " " " | 58AB2777 | 7-6 | 20 | 60 | 75 | 100 | 235 | 14.7 |
| Overland | 4181 | 7-3 | 26 | 65 | 75 | 90 | 230 | 14.4 |
| Imp. Garry | 6662 | 7-2 | 24 | 50 | 55 | 80 | 185 | 11.6 |
| Weibulls 16004 | 7257 | 7-9 | 23 | 70 | 70 | 95 | 235 | 14.7 |
| Marne | 5163 | 7-7 | 21 | 75 | 70 | 110 | 255 | 15.9 |
| Oneida | | 7-5 | 25 | 75 | 65 | 75 | 215 | 13.4 |

Continued ---

Table XXVIII. (Continued)

| Variety or Cross | C. I. No. | Heading | | Plot Yield in Grams | | | Total Grams | Average Bu/acre |
|---------------------------------|-----------|---------|--------|---------------------|-----|-----|-------------|-----------------|
| | | Date | Height | I | II | III | | |
| Mission | 2588 | 7-2 | 21 | 55 | 70 | 100 | 225 | 14.1 |
| Gopher | 2027 | 7-2 | 19 | 65 | 60 | 45 | 170 | 10.6 |
| Clinton x Overland ² | 5346 | 7-6 | 20 | 85 | 65 | 90 | 240 | 15.0 |
| Sun II | 4962 | 7-8 | 20 | 70 | 65 | 90 | 225 | 14.1 |
| Scotch Club | 193027 | 7-19 | 16 | 35 | 50 | 45 | 130 | 8.1 |
| Andrew x Clinton | 5657 | 7-1 | 21 | 85 | 70 | 100 | 255 | 15.9 |
| Andrew x Mission | 50-12-46 | 7-6 | 23 | 100 | 105 | 125 | 330 | 20.6 |
| Andrew x Mission | 50-12-18 | 6-26 | 21 | 95 | 90 | 155 | 340 | 21.3 |
| Clinton x Mission | 50-1-10 | 6-27 | 18 | 75 | 45 | 65 | 185 | 11.6 |

Mean Yield..... 14.8
 S. E. \bar{x} 1.4968
 L. S. D. (5%)..... 4.4
 L. S. D. (1%)..... 5.8
 C. V. 10.12%

1 Calculated missing plot

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 2 | 1214.323 | 6.36 |
| Varieties | 31 | 683.5686 | 3.58 |
| Error | 61 | 191.060 | |
| Total | 94 | | |

Table XXIX. Agronomic data from the Advanced Yield Dryland oat nursery at Creston, Montana in 1960. Eight-row plots, four replications.

| Variety or Cross | C.I. No. | Heading Date | Heading Height | Plot Yield in Grams | | | | Total Grams | Average Bu/acre | Bu Wt in lbs |
|---------------------------------|----------|--------------|----------------|---------------------|-----|-----|-----|-------------|-----------------|--------------|
| | | | | I | II | III | IV | | | |
| Clinton x Overland ² | 5346 | 7-5 | 25 | 220 | 155 | 200 | 230 | 805 | 18.9 | 33.5 |
| Mission | 2588 | 7-4 | 27 | 150 | 140 | 255 | 160 | 705 | 16.5 | 29.5 |
| Gopher | 2027 | 7-2 | 19 | 140 | 175 | 145 | 150 | 610 | 14.3 | 25.6 |
| Park | 6611 | 7-5 | 23 | 200 | 160 | 185 | 190 | 735 | 17.2 | 31.5 |
| Sun II | 4962 | 7-8 | 21 | 165 | 135 | 250 | 170 | 720 | 16.9 | 28.8 |
| Weibulls 16004 | 7257 | 7-10 | 21 | 155 | 125 | 225 | 255 | 760 | 17.9 | 29.0 |
| Andrew x Clinton | 5658 | 7-2 | 27 | 165 | 200 | 205 | 165 | 735 | 17.2 | 32.5 |
| C.I. 4189 x Overland | 5347 | 7-5 | 23 | 140 | 155 | 145 | 195 | 635 | 14.9 | 29.1 |

Mean Yield..... 16.7
 S. E. \bar{x} 1.6005
 L. S. D. NS
 C. V. 9.57%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 3 | 2370.573 | 2.03 |
| Varieties | 7 | 1478.9063 | 1.27 |
| Error | 21 | 1165.067 | |
| Total | 31 | | |

Table XXX. Agronomic data from off-station irrigated oat nursery grown in Ravalli County on the Bitterroot Stock Farm at Corvallis, Montana in 1960. Single row plots, four replications.

Planted: April 28, 1960 Harvested: September 1, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. No. | Plot Yield in Grams | | | | Total Grams | Average Bu/acre | Bu. Wt. in pounds |
|---------------------------------|----------|---------------------|-----|-----|-----|-------------|-----------------|-------------------|
| | | I | II | III | IV | | | |
| Park | 6611 | 305 | 430 | 275 | 485 | 1495 | 70.1 | 35.5 |
| Rodney | 6661 | 480 | 400 | 380 | 440 | 1700 | 79.7 | 35.2 |
| Imp. Garry | 6662 | 300 | 405 | 495 | 325 | 1525 | 71.5 | 34.9 |
| Mission | 2588 | 375 | 400 | 350 | 370 | 1495 | 70.1 | 36.1 |
| Gopher | 2027 | 360 | 305 | 515 | 430 | 1610 | 75.5 | 34.9 |
| Clinton x Overland ² | 5346 | 415 | 365 | 240 | 290 | 1310 | 61.4 | 33.0 |
| Sun II | 4962 | 610 | 475 | 200 | 535 | 1820 | 85.3 | 36.6 |
| Ajax | 4157 | 215 | 450 | 385 | 375 | 1425 | 66.8 | 34.5 |
| Exeter | 4158 | 280 | 470 | 310 | 255 | 1315 | 61.6 | 37.0 |
| Cody | 3916 | 480 | 450 | 225 | 330 | 1485 | 69.6 | 36.0 |
| Overland | 4181 | 460 | 250 | 490 | 230 | 1430 | 67.0 | 36.5 |
| Bridger | 2611 | 415 | 295 | 470 | 510 | 1690 | 79.2 | 36.5 |

Mean Yield..... 71.5
 S.E. \bar{x} 9.9699
 L. S. D. (5%).. NS
 C. V. 13.94%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|-----|
| Replications | 3 | 2400.00 | --- |
| Varieties | 11 | 6019.3182 | --- |
| Error | 33 | 11309.4697 | --- |
| Total | 47 | | |

Table XXXI. Agronomic data from off-station irrigated oat nursery grown in Lake County on the Walter Mangles farm at Pablo, Montana in 1960. Single row plots, four replications.

Planted: May 4, 1960 Harvested: August 19, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. No. | | Plot Yield in Grams | | | | Total Grams | Average Bu/acre | Bu. Wt. in pounds |
|---------------------------------|----------|-----|---------------------|-----|-----|-----|-------------|-----------------|-------------------|
| | I | II | III | IV | IV | | | | |
| Park | 6611 | 130 | 120 | 50 | 95 | 395 | 18.5 | 25.0 | |
| Rodney | 6661 | 45 | 135 | 50 | 105 | 335 | 15.7 | | |
| Imp. Garry | 6662 | 105 | 125 | 30 | 145 | 405 | 19.0 | | |
| Mission | 2588 | 180 | 125 | 55 | 125 | 485 | 22.7 | 29.4 | |
| Gopher | 2027 | 110 | 130 | 70 | 150 | 460 | 21.6 | 25.5 | |
| Clinton x Overland ² | 5346 | 165 | 125 | 55 | 160 | 505 | 23.7 | 26.0 | |
| Sun II | 4962 | 115 | 110 | 25 | 105 | 355 | 16.6 | 25.5 | |
| Ajax | 4157 | 120 | 155 | 100 | 110 | 485 | 22.7 | | |
| Exeter | 4158 | 140 | 75 | 20 | 115 | 350 | 16.4 | | |
| Cody | 3916 | 160 | 170 | 85 | 130 | 545 | 25.5 | 23.6 | |
| Overland | 4181 | 75 | 110 | 55 | 150 | 390 | 18.3 | 25.5 | |
| Bridger | 2611 | 70 | 60 | 35 | 115 | 280 | 13.1 | | |

Mean Yield..... 19.5
 S. E. \bar{x} 2.4109
 L. S. D. (5%).... 7.0
 C. V. 12.38%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|-------|
| Replications | 3 | 14242.3613 | 21.54 |
| Varieties | 11 | 1599.8106 | 2.42 |
| Error | 33 | 661.3005 | |
| Total | 47 | | |

Table XXXII . Agronomic data from off-station dryland oat nursery grown in Mineral County on the Charles Frey Ranch at Tarkio, Montana in 1960. Single row plots, three replications.

Planted: April 28, 1960 Harvested: August 19, 1960 Size of Plot: 16 sq. ft.

| Variety or Cross | C.I. No. | Plot Yield in Grams | | | Total Grams | Average Bu/acre |
|---------------------------------|----------|---------------------|----|-----|-------------|-----------------|
| | | I | II | III | | |
| Park | 6611 | 65 | 55 | 55 | 175 | 10.9 |
| Rodney | 6661 | 75 | 35 | 50 | 160 | 10.0 |
| Imp. Garry | 6662 | 70 | 65 | 60 | 195 | 12.2 |
| Mission | 2588 | 75 | 85 | 55 | 215 | 13.4 |
| Gopher | 2027 | 75 | 55 | 50 | 180 | 11.3 |
| Clinton x Overland ² | 5346 | 35 | 60 | 35 | 130 | 8.1 |
| Sun II | 4962 | 50 | 35 | 35 | 120 | 7.5 |
| Ajax | 4157 | 90 | 60 | 35 | 185 | 11.6 |
| Exeter | 4158 | 80 | 55 | 45 | 180 | 11.3 |
| Cody | 3916 | 50 | 55 | 45 | 150 | 9.4 |
| Overland | 4181 | 55 | 60 | 40 | 155 | 9.7 |
| Bridger | 2611 | 40 | 55 | 25 | 120 | 7.5 |

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|-------|
| Replications | 2 | 1127.0834 | 8.42* |
| Varieties | 11 | 301.7046 | 2.25 |
| Error | 22 | 133.9015 | |
| Total | 35 | | |

| | |
|-----------------------|--------|
| Mean Yield..... | 10.2 |
| S. E. \bar{x} | 1.2527 |
| L. S. D. | NS |
| C. V. | 12.28% |

Seed Production

Foundation seed production of Westmont was done on the Station in field number F-3. This field was seeded with breeders seed in 35-inch rows. It was cultivated and sprayed for weed control. Hail on August 3 reduced the yield about fifty per cent. From this small plot, 326 pounds of seed were obtained.

Six-tenths of an acre of foundation Centana was seeded in field number Y-7. The field was rogued for wild oats, but a final inspection was never made. Two hundred and fifty-five pounds of seed were harvested and needs to be cleaned and a germination and purity test made.

A small plot of foundation Lemhi was grown in rotation A. Weeds were a problem in this plot, namely, sow thistle. Part of the plot was mowed because of weeds and a poor stand. Stripe rust was quite severe. Two hundred and fifty-one pounds were harvested. A germination and purity check had not been made on this material at this writing.

TITLE: FORAGE INVESTIGATIONS

PROJECT NUMBER: 5022

PERSONNEL: Leader - Vern R. Stewart
Cooperators - S. A. Thies and C. W. Roath

FUNDS: State

LOCATION: Field Number Y-6

PROBABLE DURATION: Indefinite

EXPERIMENTAL DATA: On corn silage

INTRODUCTION

This portion of the forage investigations project will be concerned only with silage corn and sunflower production. The breakdown of funds will not be attempted in this report, because it has already been calculated for all forage work on the Station. Thus, this report will be concerned only with a small per cent of the forage investigation on the Station.

Seed for the corn variety nursery is supplied by the many seed corn companies in the United States. For each entry in the nursery, a fee is paid to the Experiment Station. The Northwestern Montana Branch Station only gets a portion of these monies with the remainder going to the Main Station at Bozeman.

MATERIALS AND METHODS

The variety nursery this year was grown in two-row plots with forty inches between rows and the plot was eighteen feet long. It was laid out in a triple lattice design with four replications. A total of sixteen entries were included in the test.

Seeding was done with a belt seeder and a given number of kernels seeded per row. The plot was irrigated three times during the growing season. Cultivation was inadequate, due to the lack of machinery, namely, a cultivator. The plot was hoed by hand to remove the weeds. For control of thistle, 2,4-D, at one-half pound per acre, was applied.

Plots were harvested by hand, weighed with a spring scale and sling. A small sample was selected and weighed to be used in calculating the percentage of dry matter. These samples were allowed to air dry. They were then chopped and oven dried and final weight on a total dry matter basis was calculated. These data are reported on a twelve per cent moisture corrected basis.

The residue of the plot was chopped and placed in the soil for general

farm feeding.

RESULTS AND DISCUSSION

Hail on August 3 did some damage to the corn, but it recovered fairly well. Yields were quite good. This can be attributed to the very warm days in July and August which were ideal for corn.

P.A.G. 62 was the highest yielding variety or line in the nursery, with a total yield of 6.87 tons per acre. The mean was 4.80 tons per acre. This could be considered a fairly reliable test when the statistical analysis is studied. Unfortunately, there is a large difference due to replications, but the varietal difference was also found to be significant. Table XXXVIII shows complete data of this study.

Table XXXVIII. Yield data from irrigated silage corn variety trial at Creston, Montana in 1960. Two plots, four replications. Planted: May 25, 1960 Harvested: September 7, 1960 Size of plot: 106.667 sq.ft.

| Entry | Dry Weight in pounds per plot | | | | Total Pounds | Correct to |
|------------------------|-------------------------------|-------|-------|-------|--------------|----------------------------|
| | I | II | III | IV | | 12% Moisture Tons Per Acre |
| Haapalo Sweet Dent #50 | 15.90 | 18.65 | 19.08 | 20.67 | 74.30 | 4.25 |
| Dekalb 45 | 16.94 | 21.16 | 24.38 | 21.92 | 84.40 | 4.83 |
| Dekalb 46 | 13.47 | 17.70 | 16.45 | 12.68 | 60.30 | 3.45 |
| Dekalb 57 | 12.46 | 12.76 | 15.41 | 14.93 | 55.56 | 3.18 |
| Dekalb 238 | 19.40 | 28.44 | 27.96 | 26.02 | 101.82 | 5.82 |
| P. A. G. 55 | 21.76 | 36.75 | 33.05 | 28.54 | 120.10 | 6.87 |
| P. A. G. 62 | 17.47 | 22.04 | 26.92 | 18.42 | 84.85 | 4.85 |
| P. A. G. 323 | 25.82 | 22.62 | 25.66 | 23.10 | 97.20 | 5.55 |
| P. A. G. 418 | 21.68 | 25.49 | 23.83 | 27.97 | 98.97 | 5.66 |
| P. A. G. 434 | 21.78 | 27.78 | 21.46 | 27.30 | 98.32 | 5.62 |
| P. A. G. 485 | 19.24 | 19.79 | 20.61 | 20.06 | 79.70 | 4.56 |
| Idahybrid 216 | 19.03 | 22.44 | 22.62 | 21.36 | 85.45 | 4.88 |
| Idahybrid 330 | 19.29 | 24.02 | 23.66 | 26.75 | 93.72 | 5.35 |
| Mont. 101 | 8.50 | 9.00 | 20.47 | 15.35 | 53.32 | 3.05 |
| Mont. 102 | 8.60 | 17.35 | 8.90 | 14.68 | 49.53 | 2.82 |
| Dekalb 1051 | 20.62 | 25.04 | 25.78 | 26.07 | 97.51 | 5.58 |
| Dekalb 222 | 21.00 | 19.84 | 17.09 | 20.27 | 78.20 | 4.47 |
| AES 101 | 22.97 | 17.98 | 21.78 | 21.58 | 84.31 | 4.82 |
| AES 201 | 18.50 | 18.99 | 20.14 | 23.41 | 81.04 | 4.64 |
| Funk's G-6 | 24.76 | 28.96 | 24.43 | 22.49 | 100.64 | 5.76 |

| Analysis of Variance | | | | Mean Yield..... 4.80 | |
|----------------------|------|-------------|---------|-----------------------|-------|
| Source | D.F. | Mean Square | F | S. E. \bar{x} | .3208 |
| Replications | 3 | 57.2533 | 7.37** | L. S. D. (5%).. | .90 |
| Varieties | 19 | 85.5687 | 11.01** | L. S. D. (1%).. | 1.19 |
| Error | 57 | 7.7714 | | C. V. | 6.68% |
| Total | 79 | | | | |

EXPERIMENTAL DATA: Sunflowers

INTRODUCTION

Sunflowers will be the only crop considered in this part of the forage project. Funds, and other consideration of the forage project, can be found in other parts of this annual report.

At an annual Planning Conference, the subject of sunflowers for silage was suggested. It was felt the potential of this crop as a silage crop should be studied. Therefore, the following experiment was designed and results reported for the same.

MATERIAL AND METHODS

Seed was supplied by the Agronomy Department at Bozeman. Planting technique and care of plots are similar, as explained for corn earlier in this report, except no herbicides were used in weed control.

RESULTS

Green weights were the only data secured from this nursery. Hail did considerable damage to the sunflowers. They did not recover from this injury. Some plants were broken off completely by the hail. Table XXXIV gives the non-significant data for this test. To be comparable with corn, there should have been dry samples obtained.

Table XXXIV. Yield data from the sunflower nursery grown at Creston, Montana in 1960. Two-row plots, four replications.

Planted: May, 1959 Harvested: September 7, 1960 Size of Plot: 106.67 sq.ft.

| Entry | Plot yields in pounds ¹ / _— | | | | Total Pounds | Tons /Acre |
|---------------|---|-----|-----|-----------------|--------------|------------|
| | I | II | III | IV | | |
| Montana No. 1 | 57 | 99 | 148 | 95 ² | 399 | 20.4 |
| Montana No. 2 | 110 | 58 | 130 | 105 | 403 | 20.6 |
| Advent | 88 | 66 | 80 | 80 | 314 | 16.0 |
| Manchurian | 136 | 186 | 96 | 154 | 572 | 29.2 |
| Advance | 120 | 116 | 81 | 86 | 403 | 20.6 |
| Greystrip | 130 | 145 | 169 | 115 | 559 | 28.5 |

¹ All weights on a total green matter basis

² Calculated missing plot

Mean Yield... 22.5
 S. E. \bar{x} 3.199
 L. S. D. NS
 C. V. 14.22%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 3 | 166.48 | --- |
| Varieties | 5 | 2593.168 | 2.64 |
| Error | 14 | 981.8971 | |
| Total | 22 | | |

TITLE: Weed Investigations

PROJECT NUMBER: 5021

PERSONNEL: Leader - Vern R. Stewart
Consultants - L. Baker and C. W. Roath

FUNDS: State - \$1656.33

LOCATION: Off-station

PROBABLE DURATION: Indefinite

EXPERIMENTAL DATA:

INTRODUCTION

The weed control studies in this report will concern only the use of herbicides. A study by Graham, for control of weeds using fertilizer, is included in that section of the annual report authored by him.

Wheat thief, a hard to control winter annual in winter wheat, is still a major weed problem in the winter wheat producing areas of Northwestern Montana. Very little success has been achieved in control of this weed. Data from one study is made a part of this annual report.

MATERIALS AND METHODS

Three herbicides, at three different rates, were used in the studies located on the Gilbertson farm Northwest of Kalispell and on the Clarence Sheldon farm, Route four, Kalispell. In some cases, a spreader or additive was added to the chemical. The additive used was synthetic polymus of normal and iso-olefins (alkydaryl polyoxethylene glycols, free fatty acids-petroleum oils). Eight ounces per one hundred gallons of water were used in this study.

Plots were fifteen feet long and five feet wide. Application was made with a mechanized sprayer mounted on a garden tractor. Temperature and moisture conditions are not recorded.

Harvesting was done by hand. A square yard was taken from each plot for yield determination.

RESULTS AND DISCUSSION

An observation of these plots during the summer indicated some control of wheat thief using herbicides. The rates with the additives

seemed to give the best control. No weed counts were made in either plot.

The trial on the Sheldon farm was not harvested, because the farmer had cut into the plot and Station personnel were not informed.

The experiment on the Gilbertson farm gives some yield data that may or may not be of value. Yields were reduced significantly with one pound of 2,4-D ester with and without additives. Because of the high C.V., a question should be raised about its reliability. See Table XXXV.

Table XXXV. Control of wheat thief, Lithospernum arvense, with the use of certain herbicides in Westmont winter wheat. Located on the Gilbertson farm at Kalispell, Montana in 1960. Size of Plot: 9 sq. ft.

| Treatment | Plot Yield | | | Total Grams | Ave. Bu./acre |
|--|------------|-----|-----|-------------|---------------|
| | I | II | III | | |
| 2,4-D Amine .5#/a | 70 | 60 | 110 | 240 | 14.2 |
| 2,4-D Amine 1.0#/a | 45 | 100 | 60 | 205 | 12.2 |
| 2,4-D Amine + additive 1#/a | 60 | 65 | 50 | 175 | 10.4 |
| 2,4-D Ester .5#/a | 80 | 60 | 70 | 210 | 12.5 |
| 2,4-D Ester 1.0#/a | 25 | 20 | 45 | 90 | 5.3* |
| 2,4-D Ester + additive 1#/a | 45 | 25 | 55 | 125 | 7.4* |
| 2,4-D Low Vol. Ester .5#/a | 65 | 105 | 80 | 250 | 14.8 |
| 2,4-D Low Vol. Ester 1.0#/a | 45 | 45 | 70 | 160 | 9.5 |
| 2,4-D Low Vol. Ester + additive 1.0#/a | 65 | 60 | 105 | 230 | 13.6 |
| Check | 85 | 50 | 105 | 240 | 14.3 |

* Treatment significantly lower in yield than the check 5%

Mean Yield..... 11.4
 S. E. \bar{x} 1.9344
 L. S. D. (5%)... 5.7
 C. V. 16.95%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 2 | 880.8350 | 2.48 |
| Treatment | 9 | 967.1300 | 2.73 |
| Error | 18 | 354.9072 | |
| Total | 29 | | |

TITLE: Preliminary Investigations

PROJECT NUMBER: 5028

PERSONNEL: Leader - Vern R. Stewart
Cooperators - C. W. Roath
V. E. Iverson
M. Afanasiev
R. F. Eslick

FUNDS: State -- \$1523.33

LOCATION: Station

PROBABLE DURATION: Indefinite

EXPERIMENTAL DATA:

INTRODUCTION

The purpose of this project is to investigate and study crops that may have an economic value in Northwestern Montana. Because of restricted acreage of some of the more commonly grown crops, this research becomes one of great importance to the economy of Northwestern Montana.

Crops studied this past season were Agrotana; Calendula and others; flax; mint; and mustard. Except for the Agrotana, the oil properties of these crops are the main factors being considered in these plants.

MATERIALS AND METHODS

Materials for all these crops were supplied by cooperators at the Main Station in Bozeman. Seeding was done with the usual nursery equipment, except mint. Technique of the mint operation will be given under the mint section which follows later in this report. Weed control was all mechanical with no herbicides being used in any of the above crops. The oil crops (Calendula and others) were harvested when ripe. This was also true for flax and mustard.

RESULTS AND DISCUSSION

The results in this section will be reported on an individual crop basis. A discussion on some techniques will be included plus yield data and other information secured.

Agrotana

Agrotana, a wheat grass-wheat hybrid, was grown in field E-3. It was seeded in the fall of 1959 to check for winter habit. Winter wheat was used as a check on the lines. Two varieties of winter

wheat and thirteen Agrotana lines made up the nursery, which was in a randomized block design.

All of the Agrotana lines were very late in maturity. At date of harvest, many of them were still high in moisture. They were all very difficult to thresh. A high incidence of covered smut was found in all lines. There was considerable difference found between Agrotana lines and no Agrotana line was equal to either wheat variety. Yogo was found to be significantly higher in yield than Karmont in this test. Table XXXVI gives complete data for this trial.

Table XXXVI. Yield data from Agrotana - Fall seed, 1959, Creston, Montana. Four-row plots, three replications.

Planted: September 25, 1959 Harvested: September 21, 1960
Size of Plot: 16 square feet

| Selection Number | Plot Yield in Grams | | | Total Grams | Average Pound Per Acre |
|------------------|---------------------|-----|-----|-------------|------------------------|
| | I | II | III | | |
| 56-11-2 | 85 | 70 | 155 | 310 | 620 |
| 56-13-4 | 125 | 110 | 85 | 320 | 640 |
| 56-15-3 | 160 | 60 | 75 | 295 | 590 |
| 56-19-15 | 80 | 75 | 105 | 260 | 520 |
| 56-20-5 | 100 | 135 | 125 | 360 | 720 |
| 56-21-14 | 150 | 135 | 115 | 400 | 800 |
| 56-23-7 | 140 | 150 | 160 | 450 | 900 |
| 56-24-11 | 120 | 150 | 145 | 415 | 830 |
| 56-24-14 | 100 | 140 | 145 | 385 | 770 |
| 56-25-7 | 40 | 80 | 40 | 160 | 320 |
| 56-26-5 | 70 | 65 | 75 | 210 | 420 |
| 56-28-1 | 180 | 185 | 105 | 470 | 940 |
| 56-29-8 | 60 | 80 | 90 | 230 | 460 |
| Yogo | 415 | 540 | 430 | 1385 | 2770 |
| Karmont | 405 | 355 | 265 | 1025 | 2051 |

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 2 | 520.915 | |
| Varieties | 14 | 35896.4286 | 26.17** |
| Error | 28 | 1371.7204 | |
| Total | 44 | | |

Mean Yield..... 890.
S. E. \bar{x} 128.3419
L. S. D. (5%). 372.
L. S. D. (1%). 500.
C. V. 14.42%

Calendula and Others

This group of plants is grown primarily for testing as potential oil crops. It is our purpose to check maturity and Agronomic characteristics. Oil percentage and iodine numbers will also be determined. They are, however, not included in this report.

Two nurseries were seeded in the spring of 1960. One under dryland conditions and one under irrigation. Both nurseries had forty-seven entries. Not all entries were identical for both. Single row plots were used. There was no statistical design for the experiments.

Stands were poor in both nurseries. Observations indicated no germination of seed as cause of this poor stand. Weeds were quite bad in the irrigated nursery and considerable time was spent in removing them.

The Calendulas as genus were late in maturity. Flowers continued to bloom following frost, which killed other crop plants. Seeds were very uneven in ripening, making harvesting and threshing very difficult. Yield data given is not an indication of potential. Seed of the entire row was harvested. From the Agronomic point, this genus does not look to be a very high potential as a crop.

Some of the Candy Tuft lines did produce mature seed as did Saporaria vascauia lines. Table XXXVII and XXXVIII give data secured on these potential oil crops.

Table XXXVII. Evaluation of some oil crops which may be of value in industry. Dryland

| Crop | Type | Variety | Mont. No. | Per Cent Stand | Flow- ering Date | Wt. in Grams |
|-------------------------|----------------|------------------|------------|----------------|------------------------|--------------------|
| Calendula | Pacific Beauty | Persimmon | 283 | 75 | | 3.2 |
| " | " | Mixture | 282 | 50 | | 8.5 |
| " | " | Lemon | 281 | 95 | | 6.5 |
| " | " | Apricot | 285 | 50 | | 2.7 |
| " | " | Cream | 300 | 65 | | |
| " | Crested | Orange | 284 | 55 | | 4.8 |
| " | " | Yellow | 290 | 95 | 7-20 | 35.8 |
| " | " | Mixture | 280 | 90 | 7-20 | 22.5 |
| " | " | Mixed | 298 | 70 | | 1.1 |
| " | Giant Double | Mixture | 279 | 75 | | 26.0 |
| " | Bedding | Mixture | 286 | 70 | | 31.2 |
| " | Dwarf Bedding | Lemon | 287 | 60 | | 3.5 |
| " | " | Orange | 275 | 70 | | 10.0 |
| " | " | Lemon | 276 | 70 | | 4.5 |
| " | " | Orange | 277 | 90 | | 8.7 |
| " | " | Masterpiece | 278 | 80 | | 26.9 |
| " | " | Gold | 288 | 65 | | 6.3 |
| " | " | Mixture | 289 | 60 | | 22.7 |
| " | " | Art Shades | 301 | 75 | | 8.7 |
| " | " | Sunshine | 297 | 30 | | 7.5 |
| " | " | Yellow | 299 | 50 | | 10.0 |
| " | " | Mixed | 273 | 70 | 7-8 | 11.0 |
| " | " | Mixed | 274 | 50 | 7-16 | 44.9 |
| Dimorphothea aurantiaca | | Glistening White | | | | 94.2 |
| " | | | P.I.226649 | 10 | | |
| Mantha species | | White | P.I.114610 | 65 | 7-9 | 28.8 |
| Lallemantia iberica | | Blue | P.I.114389 | 20 | 7-8 | |
| " | | India | P.I.248891 | | | |
| Guizotia abyssinica | | India | P.I.248889 | | | |
| " | | India | P.I.248890 | | | |
| " | | | | | | |

Continued ---

Table XXXVII. (continued)

| Crop | Type | Variety | Mont. No. | Per Cent Stand | Flow- ering Date | Wt. in Grams ¹ |
|------------------------------------|------|----------------------|-----------|----------------|------------------------|---------------------------------|
| Candy Tuft | | Lavendar | 291 | 10 | 7-14 | |
| " | | Dwarf Fairy Mix | 292 | 65 | 7-8 | |
| " | | Flesh Pink | 293 | 5 | 7-14 | |
| " | | Rose Cardinal | 294 | 65 | 7-8 | 4.4 |
| " | | White | 295 | .5 | 7-14 | |
| " | | Formula Mix | 296 | 70 | 7-8 | 2.9 |
| " | | Honesty | 303 | 50 | | |
| Lunaria annua | | Night Scented Stocks | 302 | 95 | 7-8 | |
| Matthiola bicornis | | | 58-8013 | 50 | | 2.4 |
| Commercial Oriental Yellow (check) | | | Moccasin | 0 | | 3.4 |
| Sisymbrium altissimum | | | Moccasin | 20 | 7-5 | 10.4 |
| Thlaspi arvense | | | Moccasin | .1 | | 10.0 |
| Camelina microcarpa | | | Moccasin | 30 | | |
| Conringa orientalis | | | Moccasin | 0 | | |
| Amaranthus retroflexus | | Bozeman | 0 | 0 | | |
| Descurainia sophia | | Moccasin | 0 | 0 | | |
| Saporaria vaccaria | | Moccasin | 2 | 2 | 7-9 | |
| " | | 58-8140 | 5 | 5 | 7-8 | 7.9 |
| " | | 58-8158 | 20 | 20 | 7-8 | |

¹ Figure is the total weight obtained from the row, approximately eighteen feet long, before cleaning.

Table XXXVIII. Evaluation of some oil crops which may be of value in industry. Irrigated

| Crop | Type | Variety | Mont. No. | Per Cent Stand | Flow- ering Date | Wt. in Grams |
|-------------------------|----------------|------------------|--------------|----------------|------------------------|--------------------|
| Calendula | Pacific Beauty | Persimmon | 283 | 90 | 7-20 | 102.0 |
| " | " | Mixture | 282 | 85 | 7-20 | 57.2 |
| " | " | Lemon | 281 | 95 | 7-20 | 102.9 |
| " | " | Apricot | 285 | 90 | 7-18 | 44.7 |
| " | " | Cream | 300 | 95 | 7-20 | 80.5 |
| " | Crested | Orange | 284 | 100 | 7-13 | 140.0 |
| " | " | Yellow | 290 | 100 | 7-13 | 144.0 |
| " | " | Mixture | 280 | 95 | 7-11 | 144.0 |
| " | Giant Double | Mixed | 298 | 80 | 7-19 | 90.0 |
| " | Bedding | Mixture | 279 | 90 | 7-18 | 170.5 |
| " | Dwarf Bedding | Lemon | 286 | 60 | 7-19 | 118.4 |
| " | " | Orange | 287 | 95 | 7-17 | 94.2 |
| " | " | Lemon | 275 | 60 | 7-18 | 140.0 |
| " | " | Orange | 276 | 70 | 7-18 | 91.0 |
| " | " | Masterpiece | 277 | 75 | 7-14 | 100.0 |
| " | " | Gold | 278 | 85 | 7-18 | 130.4 |
| " | " | Mixture | 288 | 70 | 7-18 | 71.7 |
| " | " | Art Shades | 289 | 75 | 7-17 | 173.4 |
| " | " | Sunshine | 301 | 70 | 7-18 | 52.0 |
| " | " | Yellow | 297 | 45 | 7-18 | 77.5 |
| " | " | Mixed | 299 | 85 | 7-18 | 35.4 |
| Dimorphothea aurantiaca | " | Mixed | 273 | 0 | 7-16 | 12.0 |
| " | " | Glistening White | 274 | 20 | | |
| Mantha species | " | White | P. I. 226649 | 0 | | |
| Lallemantia iberica | " | Blue | P. I. 114610 | 0 | | |
| " | " | India | P. I. 114389 | 1 | 2 | 7-11 |
| Guizotia abyssinica | " | India | P. I. 248891 | 60 | | 90.7 |
| " | " | India | P. I. 248889 | 60 | | 110.9 |
| " | " | India | P. I. 248890 | 2 | | 84.3 |

Continued ---

Table XXXVIII. (continued)

| Crop | Type | Variety | Mont. No. | Per Cent Stand | Flow- ering Date | Wt. in Grams ¹ |
|------------------------------------|------|----------------------|-----------|----------------|------------------------|---------------------------------|
| Candy Tuft | | Lavendar | 291 | 10 | 7-11 | 30.1 |
| " | | Dwarf Fairy Mix | 292 | 0 | | |
| " | | Flesh Pink | 293 | 0 | | |
| " | | Rose Cardinal | 294 | 0 | | |
| " | | White | 295 | 0 | | |
| " | | Formula Mix | 296 | 0 | | |
| Lunaria annua | | Honesty | 303 | 0 | | |
| Matthiola bicornis | | Night Scented Stocks | 302 | 0 | | |
| Commercial Oriental Yellow (check) | | | 58-8013 | 0 | | |
| Sisymbrium altissimum | | | Moccasin | 0 | | |
| Thlaspi arvense | | | Moccasin | 0 | | |
| Camelina microcarpa | | | Moccasin | 0 | | |
| Conringa orientalis | | | Moccasin | 3 | 7-9 | 11.3 |
| Amaranthus retroflexus | | | Bozeman | 0 | | |
| Descurainia sophia | | | Moccasin | 0 | | |
| Saporaria vaccaria | | | Moccasin | 60 | 7-17 | 20.6 |
| " | | | 58-8140 | 5 | 7-11 | |
| " | | | 58-8158 | 100 | 7-10 | 34.7 |

¹ Figure is the total weight obtained from a row approximately eighteen feet long, before cleaning.

² Number of plants.

Flax

Flax is an oil crop producing linseed oil with linseed meal as a by-product. It is a crop adapted to the upper mid-west in the United States. Weather data indicated, in some seasons, early maturing varieties may be adapted to Northwestern Montana.

Seed for this experiment was supplied by the Montana Vegetable Oil Company. Six entries were included in the nursery in a three replication randomized block design.

Yields were somewhat below the average for Minnesota, which is used as a standard. Rajah was the highest yielding entry. It is early in maturity but low in both oil content and quality. There were maturity differences in lines, but this was not recorded. Yields of all lines were found to be non-significant when analyzed statistically. Table XXXIX gives complete data for this study.

Table XXXIX. Agronomic and yield data from flax nursery at Creston, Montana in 1960. Four row plots, five replications. Planted: May 6, 1960 Harvested: August 11, 1960 Size of plot: 16 sq.ft.

| Variety | Plot Yield in Grams | | | | | Total Grams | Average Pounds Per Acre |
|---------|---------------------|-----|-----|-----|-----|-------------|-------------------------|
| | I | II | III | IV | V | | |
| Dakota | 85 | 95 | 100 | 115 | 125 | 520 | 624 |
| Arrow | 85 | 100 | 105 | 105 | 105 | 500 | 600 |
| B 5128 | 75 | 115 | 110 | 110 | 110 | 520 | 624 |
| Rajah | 100 | 90 | 125 | 105 | 105 | 525 | 630 |
| Bison | 95 | 85 | 95 | 100 | 125 | 500 | 600 |
| Bolley | 80 | 85 | 110 | 100 | 120 | 495 | 594 |

| Analysis of Variance | | | | Mean Yield..... 612 |
|----------------------|------|-------------|------|--------------------------------|
| Source | D.F. | Mean Square | F | S. E. \bar{x} 27.3187 |
| Replications | 4 | 747.0825 | 7.21 | L. S. D. (5%)... NS |
| Varieties | 5 | 34.00 | | C. V. 4.46% |
| Error | 20 | 103.5835 | | |
| Total | 29 | | | |

Mint

Mint as a potential crop in Northwestern Montana was added to the list because of interest shown and the production of it in neighboring states to the west.

Field number Y-9 (Z-1) was the location of this test on the Station. It was summer fallowed before putting in mint root stocks. It was located in the irrigated section of the Station.

Root stocks were secured, without cost to the Station, from Mr. Donald Deihl of Sandpoint, Idaho. The method of planting was as follows: using a three-bottom moldboard plow, a furrow was made three to six inches, then this was covered with the plow making the row about forty-two inches. Soil conditions were very moist at the time of seeding. Root stocks were believed to be in excellent condition. Seeding date was April 16, 1960.

The plot was irrigated three times during the growing season. Cultivations were made with the attempt to row the planting.

Stands were very poor with only about the first six rows making a stand of any kind. Because of this condition, only six rows were left and will be used as a seed stock source in 1961.

No yield data or oil percentage were secured this season.

Mustard

Of all the crops listed in this report, mustard shows the most promise as an oil crop in Northwestern Montana. Weather records indicate that a crop of mustard could be harvested without too much difficulty.

This crop is handled the same as small grains with the exception of herbicides for weed control.

Two nurseries were grown this season, one on dryland and one under irrigation. Both contained the same number of entries. The mean yield for the irrigated nursery was 977 pounds per acre compared with dryland of 983 pounds per acre. The irrigated nursery was later in maturity than dryland. No significance was found in the irrigated nursery and three entries were lost because of stand. Commercial Oriental was the highest yielding entry in the dryland trial. Table XL and XLI give detail of these two studies.

Table XI. Agronomic data from irrigated mustard yield nursery. Four row plots, four replications. Creston, Montana in 1960.

Planted: May 6, 1960 Harvested: September 12, 1960 Size of Plot: 16 sq. ft.

| Variety | Selection Number | Plot Yield in Grams | | | | Total Grams | Ave. Lbs. / Acre |
|------------------------|------------------|---------------------|-----|-----|------------------|-------------|------------------|
| | | I | II | III | IV | | |
| Increase B, Yellow | Bulk | 280 | 160 | 165 | 150 | 755 | 1133 |
| Montana Early | 58-8012 | 205 | 165 | 195 | 160 | 725 | 1088 |
| German Yellow Oriental | M-Assoc. | 230 | 175 | 160 | 165 | 730 | 1096 |
| Oriental | 49-5934-2 | 140 | 200 | 165 | 130 | 635 | 953 |
| Commercial Oriental | 58-8013 | 125 | 260 | 155 | 135 | 675 | 1013 |
| Commercial Brown | 58-8015 | 190 | 180 | 160 | 160 | 690 | 1036 |
| Brown Selection | 48-6647 | 155 | 160 | 115 | 115 ¹ | 545 | 818 |
| Triesta | 58-8014 | 150 | 70 | 120 | 115 | 455 | 683 |

¹ Calculated missing plot

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|------|
| Replications | 3 | 2859.375 | 2.18 |
| Varieties | 7 | 2662.0536 | 2.03 |
| Error | 21 | 1308.7798 | |
| Total | 31 | | |

| | |
|--------------------|----------|
| Mean Yield..... | 977 |
| S. E. X. | 108.5675 |
| L. S. D. (5%)..... | NS |
| C. V. | 11.11% |

Table XII. Agronomic data from dryland mustard yield nursery. Four row plots, four replications at Creston, Montana in 1960. Planted: April 22, 1960 Harvested: August 5, 1960 Size of Plot: 16 sq. ft.

| Variety | Selection Number | Date of Flowering | Shattering | Plot Yield in Grams | | | | Average Pounds Per Acre | |
|------------------------|------------------|-------------------|------------|---------------------|-----|-----|-----|-------------------------|------|
| | | | | I | II | III | IV | | |
| Increase B, Yellow | Bulk | 6-15 | 2 | 210 | 195 | 120 | 145 | 670 | 1006 |
| Montana Early | 58-8012 | 6-14 | 2 | 215 | 195 | 135 | 150 | 695 | 1043 |
| German Yellow Oriental | M-Assoc. | 6-13 | 3 | 185 | 170 | 155 | 190 | 700 | 1050 |
| Oriental | 49-5934-2 | 6-22 | 1 | 225 | 210 | 150 | 145 | 730 | 1096 |
| Commercial Oriental | 58-8013 | 6-20 | 2 | 245 | 215 | 225 | 230 | 915 | 1373 |
| Commercial Brown | 58-8015 | 6-21 | 0 | 255 | 265 | 195 | 165 | 880 | 1321 |
| Brown Selection | 48-6647 | 6-24 | 1 | 225 | 220 | 160 | 160 | 765 | 1148 |
| Triesta | 58-8014 | 6-21 | 3 | 150 | 170 | 80 | 115 | 515 | 773 |
| Sarson Yellow | 58-8161 | 6-24 | 2 | 105 | 65 | 110 | 75 | 355 | 533 |
| Sarson Brown | 58-8202 | 6-16 | 0 | 150 | 170 | 130 | 120 | 570 | 856 |
| Sweet German Rape | | 6-23 | 0 | 130 | 115 | 80 | 85 | 410 | 615 |

1 0 = no shattering
 4 = severe shattering
 2 Cut early

Mean Yield..... 983
 S. E. X. 65.4182
 L. S. D. (5%)..... 189
 L. S. D. (1%)..... 254
 C. V. 6.66%

Analysis of Variance

| Source | D.F. | Mean Square | F |
|--------------|------|-------------|---------|
| Replications | 3 | 7246.0227 | 15.25** |
| Varieties | 10 | 7916.35 | 16.66** |
| Error | 30 | 475.1894 | |
| Total | 43 | | |

Part III

1960

ANNUAL RESEARCH REPORT

NORTHWESTERN MONTANA BRANCH

of

MONTANA AGRICULTURAL EXPERIMENT STATION

Kalispell, Montana

by

Donald Graham

Assistant in Soils

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TITLE: Crop Responses to Irrigation Rates and Frequencies Based on Free Water Evaporation Rates.

PROJECT NUMBER: 5019

PERSONNEL: Don Graham, other station personnel.

OBJECTIVES:

Studies on sprinkler irrigation rates and frequencies were initiated at the Northwest Montana Branch Station in 1950. At the conclusion of the first six years of study, indications were that for most crops irrigation schedules which applied 3 inches of water every 15 days, were the most effective.

However, annual variations in the trial results suggested that a study based upon daily free water evaporation rates might improve irrigation schedules. This method takes current weather conditions into consideration.

EXPERIMENTAL DESIGNS AND PROCEDURES:

In 1955, the experiment was changed and emphasis was placed on studying in the results of irrigation frequencies which were based upon evaporation rates.

An evaporation tank, 6 ft. in diameter and approximately 2 ft. deep, was installed to measure free water evaporation. The evaporation tank was buried in the soil so that the surface of the water was approximately at ground level. The tank is located about 300 yards from the experimental plots.

Five crops, hay, pasture, small grain, potatoes, and corn were used in the experiment.

Three irrigation procedures were established on each of the crops.

Frequency A - apply 2 inches of water when evaporation minus rainfall equals 2 inches.

Frequency B - apply 3 inches of water when evaporation minus rainfall equals 3 inches.

Frequency C - apply 3 inches of water when .2 inch per day accumulation minus rainfall equals 3 inches.

A summary of three years data was included in the 1959 Northwest Branch Station Annual Report. This summary indicated that all crops, with the exception of potatoes, produced the most economic yields on the irrigation schedules based on evaporation readings.

In 1960, the experiment was enlarged to include three rates of water for each of the frequencies. Soil moisture samples were taken at four depths

and three locations within each plot, immediately before and 48 hours after each irrigation. Soil moisture information will be presented later in the report. (1961)

The treatments involved were:

Frequency A - When evaporation minus rainfall equals 2 inches

1. light rate - $1\frac{1}{2}$ inches water applied (A-light)
2. actual rate - 2 inches water applied (A-actual)
3. heavy rate - $2\frac{1}{2}$ inches water applied (A-heavy)

Frequency B - When evaporation minus rainfall equals 3 inches.

1. light rate - $2\frac{1}{2}$ inches water applied (B-light)
2. actual rate - 3 inches water applied (B-actual)
3. heavy rate - $3\frac{1}{2}$ inches water applied (B-heavy)

Frequency C - When .2 inch per day accumulation minus rainfall equals 3 inches.

1. light rate - $2\frac{1}{2}$ inches water applied (C-light)
2. actual rate - 3 inches water applied (C-actual)
3. heavy rate - $3\frac{1}{2}$ inches water applied (C-heavy)

The crops under investigation were alfalfa-orchard grass hay, red clover-orchard grass pasture, Netted gem potatoes, and Freja barley. Corn was deleted due to an extremely poor stand.

The irrigation season for each crop varies and is as follows:

Hay and pasture, May 1 to September 1
Grain, seeding to heading
Potatoes, emergence to maturity

This means that evaporation records for each crop were begun on the first day of its respective season and irrigation ceased on the last day.

The dates of irrigations for each crop and frequency were as follows:

Hay and pasture

Frequency A - June 27, July 11, July 19, July 25, Aug. 21
Frequency B - July 1, July 19, Aug. 16, Aug. 26
Frequency C - June 4, June 18, July 5, July 23, Aug. 16, Aug. 22

Grain

Frequency A - June 28, July 11
Frequency B - July 5
Frequency C - June 10, June 30, July 14

Potatoes

Frequency A - July 5, July 15, July 26, Aug. 17
Frequency B - July 11, July 22, Aug. 22
Frequency C - June 30, July 7, July 27, Aug. 22

Table I shows the amount of water applied during the season on each plot. Frequency C applies the most water to all crops.

Table I. Inches of Water Applied During Season

| Treatment | Hay and Pasture | Grain | Potatoes |
|-----------|-----------------|-------|----------|
| A-light | 7½ | 3 | 6 |
| A-actual | 10 | 4 | 8 |
| A-heavy | 12½ | 5 | 10 |
| B-light | 10 | 2½ | 7½ |
| B-actual | 12 | 3 | 9 |
| B-heavy | 14 | 3½ | 10½ |
| C-light | 15 | 7½ | 10 |
| C-actual | 18 | 9 | 12 |
| C-heavy | 21 | 10½ | 14 |

RESULTS:

Yields were determined from three randomly selected locations in each plot and the average for each plot appears in Table II. The highest yield on all crops was obtained by frequency A and B. Crops apparently differ in their response.

Table II. Average Yield per Treatment

| Treatment | Hay T/A | Pasture T/A | Grain Bu/A | Potatoes Cwt/A | Potatoes No. 1 Cwt/Acre |
|-----------|------------|----------------|---------------|-------------------|----------------------------|
| A-light | 5.05 | 3.15 | 42.0 | 115.9 | 43.7 |
| A-actual | 5.23 | 3.15 | 59.7 | 113.1 | 43.3 |
| A-heavy | 5.15 | 3.18 | 63.6 | 90.1 | 31.4 |
| B-light | 5.83 | 3.45 | 43.6 | 162.0 | 60.6 |
| B-actual | 6.30 | 3.98 | 52.6 | 110.7 | 50.3 |
| B-heavy | 4.21 | 3.62 | 44.2 | 72.9 | 35.5 |
| C-light | 4.79 | 2.89 | 50.7 | 155.9 | 93.6 |
| C-actual | 4.60 | 2.86 | 56.5 | 117.7 | 52.7 |
| C-heavy | 4.41 | 2.07 | 50.1 | 100.5 | 37.5 |

The average yield for all rates within each frequency is shown in Table III for each crop. There is an indication that hay and pasture yields were highest with frequency B, grain yields with frequency A and potato yields with frequency C.

Table III. Average Yield per Frequency

| | Hay T/A | Pasture T/A | Grain Bu/A | Potatoes Cwt/A |
|-------------|------------|----------------|---------------|-------------------|
| Frequency A | 5.14 | 3.16 | 55.1 | 106.4 |
| Frequency B | 5.45 | 3.68 | 46.8 | 115.2 |
| Frequency C | 4.60 | 2.61 | 52.4 | 126.2 |

The average yield per irrigation rate shows that all crops except potatoes, produced best yields at rates equal to evaporation. (Table IV). Potatoes appeared to respond negatively to increasing rates.

Table IV. Average Yield per Rate

| Rate | Hay T/A | Pasture T/A | Grain Bu/A | Potatoes Cwt/A |
|--------|------------|----------------|---------------|-------------------|
| light | 5.22 | 3.16 | 45.4 | 144.6 |
| actual | 5.38 | 33.3 | 56.3 | 113.8 |
| heavy | 4.59 | 2.96 | 52.6 | 87.8 |

Table V shows the yield obtained from each irrigation application. Frequency B was apparently most efficient in producing yield per applications.

Table V. Yield per Irrigation Application

| Treatment | Hay T/A | Pasture T/A | Grain Bu/A | Pota toes Cwt/A |
|-----------|------------|----------------|---------------|--------------------|
| A-light | 1.01 | .63 | 21.0 | 28.9 |
| A-actual | 1.05 | .63 | 29.9 | 28.3 |
| A-heavy | 1.03 | .64 | 32.8 | 22.5 |
| B-light | 1.46 | .86 | 43.6 | 54.0 |
| B-actual | 1.58 | 1.00 | 52.6 | 46.9 |
| B-heavy | 1.05 | .91 | 44.2 | 24.3 |
| C-light | .80 | .48 | 16.9 | 38.9 |
| C-actual | .77 | .48 | 18.8 | 29.3 |
| C-heavy | .74 | .35 | 16.7 | 25.1 |

Precipitation during the 1960 growing season was less than normal. The only appreciable rainfall during the irrigation season aside from several rains in May, was 1.96 inches on Aug. 1-4.

Table VI. Weather Data

| Month | Total Prec. | Greatest Daily Prec. | Date | Rainfall .10 or more | Rainfall .5 or more | Rainfall 1.00 or more |
|--------|-------------|----------------------|------|----------------------|---------------------|-----------------------|
| May | 3.27 | .82 | 21 | 8 days | 2 days | 0 |
| June | .69 | .21 | 14 | 3 days | 0 | 0 |
| July | .13 | .11 | 31 | 1 day | 0 | 0 |
| August | 2.43 | 1.58 | 2 | 6 days | 1 day | 1 day |
| Total | 6.52 | | | 18 days | 3 days | 1 day |

SUMMARY:

- (1) Hay and pasture responded quite similarly and the best yields were obtained when 3 inches of water was applied each time 3 inches evaporated.
- (2) Barley production was highest when 2 or $2\frac{1}{2}$ inches of water was applied each time 2 inches evaporated.
- (3) When $2\frac{1}{2}$ inches of water was applied as 3 inches evaporated potato yields were highest. With each frequency, potato yields decreased as application rates were increased.

Evaporation by 7 Day Periods over 6 Years

| Date | 1960 | 1959 | 1958 | 1957 | 1956 | 1955 | Weekly Ave. | Daily Ave. |
|--------------|-------|-------|-------|-------|-------|------|-------------|------------|
| May | | | | | | | | |
| 1-7 | .46 | .35 | 1.88 | 1.27 | .27 | | 84.6 | .121 |
| 8-14 | .87 | 1.01 | .76 | 1.09 | .56 | | 85.8 | .123 |
| 15-21 | .50 | .51 | 1.26 | .69 | 1.14 | | 82.0 | .117 |
| 22-28 | .57 | .88 | 1.33 | .68 | .74 | | 84.0 | .120 |
| 29-June 4 | .90 | .99 | 1.42 | 1.18 | .89 | | 107.6 | .154 |
| 5-11 | 1.21 | .72 | 1.05 | .48 | .76 | | 84.4 | .121 |
| 12-18 | .75 | .89 | 1.15 | .51 | .65 | | 79.0 | .113 |
| 19-25 | .66 | .95 | 1.18 | .54 | .73 | | 81.2 | .116 |
| 26-July 2 | 1.16 | .76 | 1.57 | 1.16 | .95 | | 112.0 | .160 |
| 3-9 | 1.24 | 1.27 | .88 | 1.01 | .51 | .49 | 90.0 | .129 |
| 10-16 | 1.46 | 1.39 | 1.44 | 1.18 | .81 | .87 | 119.2 | .170 |
| 17-23 | 1.66 | 1.48 | 1.62 | 1.31 | 1.29 | 1.48 | 147.3 | .210 |
| 24-30 | 1.55 | 1.63 | 1.40 | 1.49 | 1.59 | .94 | 143.3 | .205 |
| 31-Aug. 6 | .85 | 1.55 | 1.18 | 1.67 | .53 | 1.25 | 117.2 | .167 |
| 7-13 | 1.09 | 1.47 | 1.17 | 1.27 | .79 | 1.38 | 119.5 | .171 |
| 14-20 | 1.02 | 1.09 | 1.35 | .99 | 1.29 | 1.55 | 121.5 | .174 |
| 21-27 | .80 | .55 | 1.45 | 1.22 | .75 | 1.41 | 103.0 | .147 |
| Season Total | 16.75 | 17.51 | 22.10 | 17.68 | 14.28 | | | |

TITLE: Preliminary Investigations

PROJECT NUMBER: 5028

PERSONNEL: Leader - Don Graham
Cooperators - Vern R. Stewart and E. L. Sharp

FUNDS: State

LOCATION: Field R-2

PROBABLE DURATION: Three years

EXPERIMENTAL DATA: Tillage study

INTRODUCTION

A severe root rot infection of Fusarium roseum was found in the oat nurseries on the Station in field A-2 in 1958. Dr. Sharp was consulted about this condition. In 1959, studies were designed and established to study this acute problem.

The study that follows was designed to study two organisms on two crops, namely, Helminthosporium sativum on barley and Fusarium roseum on oats.

MATERIALS AND METHOD

Field plots were established at the Northwestern Branch Experiment Station, Creston, to test the influence of various cultural practices and seed treatments on the development of root and foot rots of barley and oats. The main fungus incitants for barley and oat root rots were Helminthosporium sativum and Fusarium roseum, respectively.

For cultural treatments, the following categories were investigated:

- Plowing method
 - stubble mulch cultivation (SM)
 - deep plowing (DP)
 - burning plus deep plowing (B / DP)
- Soil compaction
 - soil packed (P)
 - soil not packed (NP)
- Planting date
 - planted early - April 24 (E)
 - planted late - May 11 (L)
- Seeding depth
 - seeds at 3" depth (3")
 - seeds at 1" depth (1")

RESULTS AND DISCUSSION

The 1960 results on barley appear to follow the same trend as was observed in the 1959 trial. Little difference was found between deep plowing and burn plus deep plowing. Early plantings were higher in yield, non-packed soil increased yields as did the deeper seeding depth - Table I. In the oat test, Table II, deep plowing plus burning gave the highest yields. The late date of planting in 1960 gave a higher yield, which is different than was found in 1959. No difference was found in the depth of seeding. Non-packed soil was highest yielding as it was in 1959. Disease readings in both tests appear to be related directly with yield.

Tables III through X show data on all phases of this research problem. Tables I and II are summary tables of the fore-going listed table for barley and oats, respectively.

Table I. Cereal Foot and Root Rot Studies.
Influence of various cultural practices on disease incidence and yield. (Barley)

| Comparison | Disease Rating | Yield | |
|---------------------|----------------|----------|---------|
| | | grs/plot | bu/acre |
| Tillage Method | | | |
| Stubble Mulch | 31 | 194 | 12.0 |
| Deep Plowing | 23 | 255 | 15.8 |
| Burn / Deep Plowing | 25 | 298 | 18.6 |
| Planting Date | | | |
| Late | 29 | 226 | 14.0 |
| Early | 23 | 270 | 16.8 |
| Soil Compaction | | | |
| Packed | 26 | 223 | 13.8 |
| Not Packed | 25 | 275 | 17.1 |
| Seeding Depth | | | |
| 1" Deep | 26 | 237 | 14.7 |
| 3" Deep | 26 | 261 | 16.2 |

Table II. Cereal Foot and Root Rot Studies.
Influences of various cultural practices on disease incidence and yield. (Oats)

| Comparison | Disease Rating | Yield | |
|---------------------|----------------|----------|---------|
| | | grs/plot | bu/acre |
| Tillage Method | | | |
| Stubble Mulch | 7 | 184 | 17.3 |
| Deep Plowing | 5 | 206 | 19.3 |
| Burn / Deep Plowing | 7 | 241 | 22.6 |
| Planting Date | | | |
| Late | 5 | 228 | 21.4 |
| Early | 8 | 192 | 18.0 |
| Soil Compaction | | | |
| Packed | 6 | 196 | 18.4 |
| Not Packed | 7 | 224 | 21.0 |
| Seeding Depth | | | |
| 1" Deep | 6 | 206 | 19.3 |
| 3" Deep | 6 | 206 | 19.3 |

Table III. Cereal Foot and Root Rot Studies.
Compare packed and non-packed soil. (Barley)

| Treatment | Soil Packed | | Soil Not Packed | |
|--------------------------|-------------|-------|-----------------|-------|
| | Disease | Yield | Disease | Yield |
| Planted April 24 | | | | |
| Stubble Mulch 1" D | 38 | 120 | 32 | 208 |
| 3" D | 36 | 172 | 35 | 159 |
| Deep Plowing 1" D | 24 | 259 | 20 | 238 |
| 3" D | 30 | 257 | 27 | 275 |
| Burn / Deep Plowing 1" D | 26 | 220 | 20 | 242 |
| 3" D | 28 | 280 | 34 | 289 |
| Planted May 11 | | | | |
| Stubble Mulch 1" D | 21 | 131 | 35 | 264 |
| 3" D | 24 | 232 | 24 | 265 |
| Deep Plowing 1" D | 31 | 156 | 17 | 345 |
| 3" D | 22 | 203 | 13 | 309 |
| Burn / Deep Plowing 1" D | 28 | 312 | 25 | 350 |
| 3" D | 22 | 333 | 17 | 361 |
| Total | | | | |
| | 330 | 2675 | 299 | 3305 |
| Average | | | | |
| | 26 | 223 | 25 | 275 |
| Average bu/acre | | | | |
| | | 13.9 | | 17.2 |

Table IV. Cereal Foot and Root Rot Studies.
Compare packed and not packed soil. (Oats)

| Treatment | Soil Packed | | Soil Not Packed | |
|--------------------------|-------------|-------|-----------------|-------|
| | Disease | Yield | Disease | Yield |
| Planted April 24 | | | | |
| Stubble Mulch 1" D | 3 | 224 | 4 | 217 |
| 3" D | 1 | 185 | 5 | 212 |
| Deep Plowing 1" D | 5 | 224 | 3 | 206 |
| 3" D | 7 | 270 | 3 | 234 |
| Burn / Deep Plowing 1" D | 4 | 220 | 9 | 245 |
| 3" D | 9 | 254 | 5 | 245 |
| Planted May 11 | | | | |
| Stubble Mulch 1" D | 10 | 174 | 11 | 134 |
| 3" D | 6 | 145 | 13 | 182 |
| Deep Plowing 1" D | 4 | 124 | 10 | 257 |
| 3" D | 6 | 100 | 5 | 233 |
| Burn / Deep Plowing 1" D | 2 | 190 | 8 | 261 |
| 3" D | 9 | 239 | 8 | 272 |
| <hr/> | | | | |
| Total | 66 | 2349 | 84 | 2698 |
| Average | 6 | 196 | 7 | 224 |
| Average bu/acre | | 18.4 | | 21.0 |

Table V. Cereal Foot and Root Rot Studies.
Compare seeding depths (Barley)

| Treatment | Planted 1" Deep | | Planted 3" Deep | |
|---------------------|-----------------|-------|-----------------|-------|
| | Disease | Yield | Disease | Yield |
| Soil Packed | | | | |
| Planted April 24 | | | | |
| Stubble Mulch | 38 | 120 | 36 | 172 |
| Deep Plowing | 24 | 259 | 30 | 257 |
| Burn / Deep Plowing | 26 | 220 | 28 | 280 |
| Planted May 11 | | | | |
| Stubble Mulch | 21 | 131 | 24 | 232 |
| Deep Plowing | 31 | 156 | 22 | 203 |
| Burn / Deep Plowing | 28 | 312 | 22 | 333 |
| Soil Not Packed | | | | |
| Planted April 24 | | | | |
| Stubble Mulch | 32 | 208 | 35 | 159 |
| Deep Plowing | 20 | 238 | 27 | 275 |
| Burn / Deep Plowing | 20 | 242 | 34 | 289 |
| Planted May 11 | | | | |
| Stubble Mulch | 35 | 264 | 24 | 265 |
| Deep Plowing | 17 | 345 | 13 | 309 |
| Burn / Deep Plowing | 25 | 350 | 17 | 361 |

Continued --

Table V. (Continued)

| | | | | |
|-----------------|-----|------|-----|------|
| Total | 317 | 2845 | 312 | 3135 |
| Average | 26 | 237 | 26 | 261 |
| Average bu/acre | | 14.8 | | 16.3 |

Table VI. Cereal Foot and Root Rot Studies.
Compare seeding depths (Oats)

| Treatment | Planted 1" Deep | | Planted 3" Deep | |
|---------------------|-----------------|-------|-----------------|-------|
| | Disease | Yield | Disease | Yield |
| Soil Packed | | | | |
| Planted April 24 | | | | |
| Stubble Mulch | 3 | 224 | 1 | 185 |
| Deep Plowing | 5 | 224 | 7 | 270 |
| Burn / Deep Plowing | 4 | 220 | 9 | 254 |
| Planted May 11 | | | | |
| Stubble Mulch | 10 | 174 | 6 | 145 |
| Deep Plowing | 4 | 124 | 6 | 100 |
| Burn / Deep Plowing | 2 | 190 | 9 | 239 |
| Soil Not Packed | | | | |
| Planted April 24 | | | | |
| Stubble Mulch | 4 | 217 | 5 | 212 |
| Deep Plowing | 3 | 206 | 3 | 234 |
| Burn / Deep Plowing | 9 | 245 | 5 | 245 |
| Planted May 11 | | | | |
| Stubble Mulch | 11 | 134 | 13 | 182 |
| Deep Plowing | 10 | 257 | 5 | 233 |
| Burn / Deep Plowing | 8 | 261 | 8 | 272 |
| Total | 73 | 2476 | 77 | 2471 |
| Average | 6 | 206 | 6 | 206 |
| Average bu/acre | | 19.3 | | 19.3 |

Table VII. Cereal Foot and Root Rot Studies.
Compare planting dates (Barley)

| Treatment | Planted April 24 | | Planted May 11 | | |
|---------------------|------------------|-------|----------------|-------|-----|
| | Disease | Yield | Disease | Yield | |
| Soil Packed | | | | | |
| Stubble Mulch | 1" D | 38 | 120 | 21 | 131 |
| | 3" D | 36 | 172 | 24 | 232 |
| Deep Plowing | 1" D | 24 | 259 | 31 | 156 |
| | 3" D | 30 | 257 | 22 | 203 |
| Burn / Deep Plowing | 1" D | 26 | 220 | 28 | 312 |
| | 3" D | 28 | 280 | 22 | 333 |
| Soil Not Packed | | | | | |
| Stubble Mulch | 1" D | 32 | 208 | 35 | 264 |
| | 3" D | 35 | 159 | 24 | 265 |

Continued ---

Table VII. (Continued)

| Treatment | Planted April 24 | | Planted May 11 | |
|--------------------------|------------------|-------|----------------|-------|
| | Disease | Yield | Disease | Yield |
| Deep Plowing 1" D | 20 | 238 | 17 | 345 |
| 3" D | 27 | 275 | 13 | 309 |
| Burn / Deep Plowing 1" D | 20 | 242 | 25 | 350 |
| 3" D | 34 | 289 | 17 | 361 |
| Total | 350 | 2719 | 279 | 3231 |
| Average | 29 | 226 | 23 | 270 |
| Average bu/acre | | 14.1 | | 17.4 |

Table VIII. Cereal Foot and Root Rot Studies.
Compare planting dates (Oats)

| Treatment | Planted April 24 | | Planted May 11 | |
|--------------------------|------------------|-------|----------------|-------|
| | Disease | Yield | Disease | Yield |
| Soil Packed | | | | |
| Stubble Mulch 1" D | 3 | 224 | 10 | 174 |
| 3" D | 1 | 185 | 6 | 145 |
| Deep Plowing 1" D | 5 | 224 | 4 | 124 |
| 3" D | 7 | 270 | 6 | 100 |
| Burn / Deep Plowing 1" D | 4 | 220 | 2 | 190 |
| 3" D | 9 | 254 | 9 | 239 |
| Soil Not Packed | | | | |
| Stubble Mulch 1" D | 4 | 217 | 11 | 134 |
| 3" D | 5 | 212 | 13 | 182 |
| Deep Plowing 1" D | 3 | 206 | 10 | 257 |
| 3" D | 3 | 234 | 5 | 233 |
| Burn / Deep Plowing 1" D | 9 | 245 | 8 | 261 |
| 3" D | 5 | 245 | 8 | 272 |
| Total | 58 | 2736 | 92 | 2311 |
| Average | 5 | 228 | 8 | 192 |
| Average bu/acre | | 21.4 | | 18.0 |

Table IX. Cereal Foot and Root Rot Studies.
Tillage method - compare plowing method (Barley)

| Treatment | Stubble Mulch | | Deep Plowing | | Burn & Deep Plowing | |
|--------------------|---------------|-------|--------------|-------|---------------------|-------|
| | Disease | Yield | Disease | Yield | Disease | Yield |
| Planted April 24 | | | | | | |
| Packed 1" Deep | 38 | 120 | 24 | 259 | 26 | 220 |
| Packed 3" Deep | 36 | 172 | 30 | 257 | 28 | 280 |
| Not Packed 1" Deep | 32 | 208 | 20 | 238 | 20 | 242 |
| Not Packed 3" Deep | 35 | 159 | 27 | 275 | 34 | 289 |

Continued ---

Table IX. (Continued)

| Treatment | Stubble Mulch Disease | Mulch Yield | Deep Plowing Disease | Deep Plowing Yield | Burn & Deep Plowing Disease | Deep Plowing Yield |
|--------------------|--------------------------|----------------|-------------------------|-----------------------|--------------------------------|-----------------------|
| Planted May 11 | | | | | | |
| Packed 1" Deep | 21 | 131 | 31 | 156 | 28 | 312 |
| Packed 3" Deep | 24 | 232 | 22 | 203 | 22 | 333 |
| Not Packed 1" Deep | 35 | 264 | 17 | 345 | 25 | 350 |
| Not Packed 3" Deep | 24 | 265 | 13 | 309 | 17 | 361 |
| <hr/> | | | | | | |
| Total | 245 | 1551 | 184 | 2042 | 200 | 2387 |
| Average | 31 | 194 | 23 | 255 | 25 | 298 |
| Average bu/acre | | 12.1 | | 15.9 | | 18.6 |

Table X. Cereal Foot and Root Rot Studies.
Tillage Method - compare plowing method (Oats)

| Treatment | Stubble Mulch Disease | Mulch Yield | Deep Plowing Disease | Deep Plowing Yield | Burn & Deep Plowing Disease | Deep Plowing Yield |
|--------------------|--------------------------|----------------|-------------------------|-----------------------|--------------------------------|-----------------------|
| Planted April 24 | | | | | | |
| Packed 1" Deep | 3 | 224 | 5 | 224 | 4 | 220 |
| Packed 3" Deep | 1 | 185 | 7 | 270 | 9 | 254 |
| Not Packed 1" Deep | 4 | 217 | 3 | 206 | 9 | 245 |
| Not Packed 3" Deep | 5 | 212 | 3 | 234 | 5 | 245 |
| <hr/> | | | | | | |
| Planted May 11 | | | | | | |
| Packed 1" Deep | 10 | 174 | 4 | 124 | 2 | 190 |
| Packed 3" Deep | 6 | 145 | 6 | 100 | 9 | 239 |
| Not Packed 1" Deep | 11 | 134 | 10 | 257 | 8 | 261 |
| Not Packed 3" Deep | 13 | 182 | 5 | 233 | 8 | 272 |
| <hr/> | | | | | | |
| Total | 53 | 1473 | 43 | 1648 | 54 | 1926 |
| Average | 7 | 184 | 5 | 206 | 7 | 241 |
| Average bu/acre | | 17.3 | | 19.3 | | 22.6 |

EXPERIMENTAL DATA: Fungicides and insecticides

INTRODUCTION

In addition to the tillage study, fungicides were included in the study for control of root rot. Because considerable wire worm was found in the cereals in the test location, insecticides were included in the test.

MATERIALS AND METHODS

Fungicides and insecticides were applied on the seed as a seed treatment and applied to the soil before seeding. Plots were five rows eighteen feet long. The center row was harvested for yield. Disease readings were made on all treatments. Two crops (oats and barley) were grown. Six fungicides and four insecticides in conjunction with fungicides were used in this study.

RESULTS AND DISCUSSION

Highest yields of barley were obtained using 1 oz/100 lbs. of B-1843, lowest disease reading was obtained with 1563. Table XI. In oats, the fungicide Bayer 22555, 1 oz/100 lbs. gave the highest yield, but the lowest disease reading came from 2 oz/bu of 1563, which also was lowest in yield.

In the combination of fungicides-insecticides, oats treated with Bayer 22555 plus Lindane gave the highest yield and disease reading equal to the check. Table XIII. Bayer 22555 plus Aldrin seems to give the best result in the barley trial. Table XIV.

Table XI. Seed Treatment Tests - Fungicides (Barley)

| Treatment | Replication 1 | | Replication 2 | | Replication 3 | | Average | |
|---------------------------|----------------|-------|----------------|-------|----------------|-------|----------------|-------|
| | Disease Rating | Yield | Disease Rating | Yield | Disease Rating | Yield | Disease Rating | Yield |
| B-1843 | | | | | | | | |
| 1 oz/100 lbs. | 38 | 247 | 38 | 178 | 39 | 132 | 38 | 186 |
| 2 oz/100 lbs. | 27 | 192 | 29 | 143 | 43 | 126 | 33 | 154 |
| 3 oz/100 lbs. | 44 | 110 | 41 | 180 | 50 | 127 | 45 | 142 |
| Bayer 22555 | | | | | | | | |
| 1 oz/100 lbs. | 30 | 146 | 31 | 169 | 34 | 125 | 32 | 147 |
| 2 oz/100 lbs. | 18 | 121 | 41 | 159 | 24 | 152 | 28 | 144 |
| 3 oz/100 lbs. | 22 | 173 | 24 | 175 | 50 | 156 | 32 | 168 |
| Ceresan M | | | | | | | | |
| $\frac{1}{2}$ oz/bu. | 18 | 113 | 39 | 154 | 29 | 113 | 29 | 127 |
| 1 oz/bu. | 22 | 130 | 47 | 199 | 42 | 130 | 37 | 153 |
| $1\frac{1}{2}$ oz/bu. | 35 | 121 | 42 | 143 | 42 | 127 | 40 | 130 |
| SD-4741 | | | | | | | | |
| $\frac{1}{2}$ lb/100 lbs. | 33 | 113 | 14 | -- | 43 | 132 | 30 | 123 |
| 1 lb/100 lbs. | 33 | 124 | 42 | 209 | 38 | 109 | 38 | 147 |
| 2 lb/100 lbs. | 42 | 75 | 38 | 182 | 45 | 86 | 38 | 114 |
| 2129 | | | | | | | | |
| $\frac{1}{2}$ oz/bu. | 21 | 167 | 39 | 170 | 24 | 132 | 28 | 156 |
| 1 oz/bu. | 28 | 88 | 27 | 167 | 23 | 186 | 26 | 147 |
| 2 oz/bu. | 25 | 138 | 32 | 150 | 49 | 68 | 35 | 119 |

Continued ---

Table XI. (Continued)

| Treatment | Replication 1 | | Replication 2 | | Replication 3 | | Average | |
|-----------|----------------|-------|----------------|-------|----------------|-------|----------------|-------|
| | Disease Rating | Yield | Disease Rating | Yield | Disease Rating | Yield | Disease Rating | Yield |
| 1563 | | | | | | | | |
| 1 oz/bu. | 32 | 195 | 24 | 238 | 29 | 113 | 28 | 182 |
| 2 oz/bu. | 17 | 154 | 34 | 166 | 32 | 145 | 28 | 155 |
| 3 oz/bu. | 30 | 108 | 29 | 156 | 15 | 192 | 25 | 152 |
| Check | 23 | 107 | 39 | 176 | 45 | 113 | 36 | 132 |

Table XII. Seed Treatment Tests - Fungicides (Oats)

| Treatment | Replication 1 | | Replication 2 | | Replication 3 | | Average | |
|---------------------------|----------------|-------|----------------|-------|----------------|-------|----------------|-------|
| | Disease Rating | Yield | Disease Rating | Yield | Disease Rating | Yield | Disease Rating | Yield |
| B-1843 | | | | | | | | |
| 1 oz/100 lbs. | 10 | 132 | 2 | 180 | 9 | 163 | 7 | 158 |
| 2 oz/100 lbs. | 10 | 122 | 9 | 166 | 8 | 139 | 9 | 142 |
| 3 oz/100 lbs. | 9 | 137 | 13 | 140 | 14 | 147 | 12 | 141 |
| Bayer 22555 | | | | | | | | |
| 1 oz/100 lbs. | 12 | 151 | 3 | 148 | 15 | 182 | 10 | 160 |
| 2 oz/100 lbs. | 10 | 169 | 6 | 214 | 10 | 136 | 9 | 173 |
| 3 oz/100 lbs. | 8 | 150 | 12 | 125 | 9 | 167 | 10 | 147 |
| Ceresan M | | | | | | | | |
| $\frac{1}{2}$ oz/bu. | 8 | 109 | 5 | 158 | 15 | 175 | 9 | 147 |
| 1 oz/bu. | 10 | 159 | 9 | 177 | 8 | 157 | 9 | 164 |
| $1\frac{1}{2}$ oz/bu. | 20 | 168 | 4 | 157 | 17 | 163 | 14 | 163 |
| SD-4741 | | | | | | | | |
| $\frac{1}{2}$ lb/100 lbs. | 10 | 103 | 6 | 192 | 8 | 164 | 8 | 153 |
| 1 lb/100 lbs. | 19 | 160 | 6 | 153 | 4 | 169 | 10 | 161 |
| 2 lb/100 lbs. | 12 | 124 | 10 | 146 | 4 | 171 | 9 | 147 |
| 2129 | | | | | | | | |
| $\frac{1}{2}$ oz/bu. | 21 | 108 | -- | 100 | -- | 78 | 21 | 95 |
| 1 oz/bu. | 14 | 127 | -- | 94 | -- | 89 | 14 | 103 |
| 2 oz/bu. | 10 | 122 | -- | 108 | -- | 81 | 10 | 104 |
| 1563 | | | | | | | | |
| 1 oz/bu. | 20 | 115 | -- | 111 | -- | 105 | 20 | 110 |
| 2 oz/bu. | 7 | 76 | -- | 133 | -- | 66 | 7 | 92 |
| 3 oz/bu. | 18 | 115 | -- | 103 | -- | 62 | 18 | 93 |
| Check | 13 | 162 | 8 | 125 | 8 | 136 | 10 | 141 |

Table XIII. Seed Treatments - Fungicides - Insecticides (Oats)

| Treatment | Rep. I | | Rep. II | | Rep. III | | Average | | |
|------------------------|--------|----------|---------|----------|----------|----------|---------|-------|------|
| | Dis- | Yield | Dis- | Yield | Dis- | Yield | Dis- | Yield | |
| | ease | Grams | ease | Grams | ease | Grams | ease | grs/ | bu/ |
| | Rating | Per Plot | Rating | Per Plot | Rating | Per Plot | Rating | Plot | Acre |
| Bayer 22555-Lindane | | | | | | | | | |
| 1 oz/bu. | 16 | 97 | - | 101 | - | 89 | 16 | 96 | 18.0 |
| 2 oz/bu. | 20 | 131 | - | 139 | - | 68 | 20 | 113 | 21.2 |
| 3 oz/bu. | 15 | 134 | - | 138 | - | 73 | 15 | 115 | 21.6 |
| Bayer 22555-Aldrin | | | | | | | | | |
| 1 oz/bu. | 23 | 128 | - | 137 | - | 62 | 23 | 109 | 20.4 |
| 2 oz/bu. | 19 | 110 | - | 104 | - | 65 | 19 | 93 | 17.4 |
| 3 oz/bu. | 10 | 102 | - | 88 | - | 69 | 10 | 86 | 16.1 |
| Bayer 22555-Heptachlor | | | | | | | | | |
| 1 oz/bu. | 11 | 115 | - | 117 | - | 65 | 11 | 99 | 18.7 |
| 2 oz/bu. | 14 | 141 | - | 92 | - | 74 | 14 | 102 | 19.2 |
| 3 oz/bu. | 12 | 111 | - | 97 | - | 80 | 12 | 96 | 18.0 |
| Panodrin | | | | | | | | | |
| 2 oz/bu. | 5 | 118 | - | 125 | - | 73 | 5 | 105 | 19.7 |
| 3 oz/bu. | 18 | 137 | - | 82 | - | 64 | 18 | 94 | 17.7 |
| 4 oz/bu. | 8 | 143 | - | 113 | - | 61 | 8 | 106 | 19.9 |
| Check | 19 | 112 | - | 94 | - | 55 | 19 | 87 | 16.3 |

Table XIV. Seed Treatments - Fungicide-Insecticides (Barley)

| Treatment | Rep. I | | Rep. II | | Rep. III | | Average | | |
|------------------------|--------|-------|---------|-------|----------|-------|---------|-------|------|
| | Dis- | Yield | Dis- | Yield | Dis- | Yield | Dis | Yield | |
| | ease | Grams | ease | Grams | ease | Grams | ease | grs/ | bu/ |
| | Rating | Plot | Rating | Plot | Rating | Plot | Rating | Plot | Acre |
| Bayer 22555-Lindane | | | | | | | | | |
| 1 oz/bu. | 38 | 173 | 27 | 173 | 26 | 141 | 30 | 162 | 20.3 |
| 2 oz/bu. | 30 | 139 | 30 | 217 | 28 | 101 | 29 | 152 | 19.0 |
| 3 oz/bu. | 7 | 103 | 25 | 219 | 38 | 136 | 23 | 153 | 19.3 |
| Bayer 22555-Aldrin | | | | | | | | | |
| 1 oz/bu. | 18 | 122 | 37 | 204 | 27 | 173 | 27 | 166 | 20.8 |
| 2 oz/bu. | 17 | 151 | 32 | 170 | 32 | 153 | 27 | 158 | 19.8 |
| 3 oz/bu. | 28 | 150 | 21 | 226 | 25 | 147 | 25 | 174 | 21.8 |
| Bayer 22555-Heptachlor | | | | | | | | | |
| 1 oz/bu. | 14 | 108 | 34 | 193 | 37 | 152 | 28 | 151 | 18.9 |
| 2 oz/bu. | 27 | 186 | 9 | 183 | 16 | 141 | 17 | 170 | 21.3 |
| 3 oz/bu. | 44 | 161 | 29 | 232 | 41 | 127 | 37 | 173 | 21.6 |
| Panodrin | | | | | | | | | |
| 2 oz/bu. | 30 | 118 | 17 | 161 | 28 | 165 | 25 | 148 | 18.5 |
| 3 oz/bu. | 25 | 137 | 20 | 196 | 30 | 185 | 25 | 173 | 21.6 |
| 4 oz/bu. | 20 | 143 | 33 | 177 | 38 | 153 | 30 | 158 | 19.8 |
| Check | 32 | 140 | 25 | 170 | 21 | 125 | 26 | 145 | 18.1 |

TITLE: Effect of Certain Soil Fungicides on the Control of Potato Scab in Western Montana

PROJECT NUMBER: 5028

PERSONNEL: M. M. Afanasiev and Donald R. Graham

FUNDS: State

LOCATION: West end of X-3

DURATION: Three years

INTRODUCTION

Common scab of potatoes, which is caused by Streptomyces scabies, is an important disease of certain varieties of potatoes in Western Montana.

A great portion of commercial potatoes raised in Western Montana, is represented by Netted Gem variety which is resistant to scab. These potatoes are usually raised in long term rotations which also helps to keep potato scab disease under control. However, on a limited scale, some potatoes are raised for early market and for home use in small plots and home gardens. In this case, mostly early and rather susceptible to scab varieties of potatoes like Bliss Triumph, Pontiac, Irish Cobbler, and others are being raised. Susceptibility of these potato varieties to scab and the continuous growing in more or less the same locations favors the increase in scab disease to the point that most harvested tubers are worthless and not suitable for use.

MATERIALS AND METHODS

Since this is an important situation, experiments were conducted during the 1960 season at the Northwestern Montana Branch Station at Creston in an attempt to find a method to control this disease by the use of various fungicides and amendments.

The following materials were used for these treatments:

1. Pentachloronitrobenzene (PCNB) 20% in form of dust, supplied by Mathieson Chemical Corporation. This chemical was used in 50 and 100 pounds of active material.
2. Gypsum (18% sulphur) was applied at 5.5 and 11.0 tons per acre which contained one and two tons of sulphur, respectively.
3. UFC-85 (Urea-Formaldehyde Concentrate) liquid was supplied by Allied Chemical Corporation and was used on the basis of 150 gallons per acre and applied diluted with water in a ratio of one to four.

Continued ---

4. Vapam 4-S, manufactured by Stauffer Chemical Company, was used on the basis of 38 gallons of Vapam 4-S (31% of active material) per acre.
5. Ammonium sulphate fertilizer (20.5% N) was used on the basis of 250 pounds per acre.

A total of eight different treatments and a check were used in this test. The plot in which this test was made had been broken up after a second crop of red clover was removed in August of 1959. On May 3, 1960, the soil (fine sandy loam) of this plot was prepared and on the following day, all fungicides and amendments, except UFC-85, were broadcast or sprayed in triplicated plots (30' x 10') in a randomized block design. After the application of chemicals, the field was disced. The UFC-85 was applied immediately before planting on May 23. Each plot was equal to about 1/145 of an acre. Three rows of potatoes were planted in each plot. The middle row was planted with Bliss Triumph variety, one outside row with Norland and the other with Netted Gem variety.

Potatoes were dug on September 14 and only a row of Bliss Triumph variety, 26.5 feet long (1/500 of an acre) was harvested for analysis of the scab situation. Potatoes were graded for size and only number one size of tubers were read for scab. Tubers were graded into those free of scab and those covered with scab lesions. Scabby potatoes were divided on the basis of percentage of their surface covered by scab lesions: 0 to 5, 5 to 25, and 26 and over.

RESULTS AND DISCUSSION

The results of these tests are presented in Table XV. All values are given as averages of three replications.

In general, incidence of potato scab was quite high, however, its severity was only moderate. All soil treatments produced a slight reduction in incidence of scab, however, this reduction was not significant enough to make it practical. Potatoes grown in soil treated with 50 lbs. of PCNB and with 5.5 tons of gypsum with an addition of ammonium sulphate had the highest percentage of healthy tubers and those grown in the check soil the lowest.

It is planned to continue these tests in 1961 with some changes in the treatments to be used.

Table XV. Effect of Certain Soil Fungicides on the Control of Potato Scab in Western Montana. Northwestern Montana Branch Station at Creston, 1960

| Chemicals Used Per Acre | Disease Grades | | | | | | | | | | Yield Acre Basis Bu. | |
|---|---|------|-------|------|------|-----------------------|-----|-------|------|------|----------------------|-----|
| | Per Cent of Potato Tubers Surface Scabbed | | | | | Per Cent Basis | | | | | | |
| | Weight Basis | | | | | Total Deg. of Disease | | | | | | |
| | Total Deg. of Disease | | H. D. | | % | Total Deg. of Disease | | H. D. | | % | | |
| 1. PCNB-20% 50 lbs. active | 2.4 | 27.4 | 29.8 | 19.7 | 7.5 | 0.2 | 8.0 | 92.0 | 66.1 | 25.2 | 0.7 | 248 |
| 2. PCNB-20% 100 lbs. active | 1.9 | 33.5 | 35.4 | 25.0 | 8.1 | 0.4 | 5.4 | 94.6 | 70.6 | 22.9 | 1.1 | 295 |
| 3. Gypsum 5.5 tons | 2.4 | 36.7 | 39.1 | 28.7 | 7.8 | 0.2 | 6.1 | 93.9 | 73.4 | 20.0 | 0.5 | 326 |
| 4. Gypsum 11.0 tons | 1.6 | 33.3 | 34.9 | 24.0 | 9.0 | 0.3 | 4.6 | 95.4 | 68.8 | 25.8 | 0.8 | 291 |
| 5. UFC-85 150 gallons | 0.6 | 37.0 | 37.6 | 22.2 | 14.0 | 0.8 | 1.6 | 98.4 | 59.1 | 37.2 | 2.1 | 313 |
| 6. Vapam 4-S 28 g. (31% active) | 1.3 | 31.3 | 32.6 | 19.1 | 11.7 | 0.5 | 4.0 | 96.0 | 58.6 | 35.9 | 1.5 | 272 |
| 7. Gypsum 5.5 tons + 250 lbs. Am. Sulph. | 2.7 | 36.1 | 38.8 | 25.9 | 9.6 | 0.6 | 7.0 | 93.0 | 66.8 | 24.7 | 1.5 | 323 |
| 8. 250 pounds Am. Sulphate | 1.3 | 35.7 | 37.0 | 24.4 | 10.4 | 0.9 | 3.5 | 96.5 | 66.0 | 28.1 | 2.4 | 308 |
| 9. Check | 0.3 | 29.6 | 29.9 | 19.2 | 10.0 | 0.4 | 1.0 | 99.0 | 64.2 | 33.5 | 1.3 | 249 |

TITLE: A Study of Flathead County Soil in Relation to Their Inherent Fertility Levels

PROJECT NUMBER: 5020

PERSONNEL: Don Graham

FUNDS: State

INTRODUCTION

Over the past century, studies of physical properties of soils have culminated in the present concepts of soil classification in which soils are classified and mapped on the basis of outstanding physical characteristics such as depth, color texture, structure, slope, and others. Large areas of agricultural land in the United States have been mapped in detail and this information is used in many ways, including land evaluation, and prediction of erosion hazard and crop yield.

Another major use which could be made of soil survey information involves studying any possible correlation which may exist between the soil types and fertility status. A map of soils of any area which distinguishes soils of one fertility status from another with reasonable accuracy would prove invaluable in predicting fertilizer needs.

Little has been published on this kind of a study, probably since the approach requires a recent detailed soil survey and a large number of field trials or an extensive greenhouse study. Studies of this type are also hard to set up and interpret because of the large number of variables involved.

Flathead County, typical of the intermountain area, possesses an abnormal complexity of soils, including several great soil groups, in a relatively small area. This is indicated by a detailed soil survey of the county published in 1960.

Due to the extreme variability of soils, fertility studies become outstandingly complex. Studies of individual soil series are greatly hampered due to this characteristic.

MATERIALS AND METHODS

Since a farmer's field generally contains more than one soil type and because of the extreme number of different soils, similar soils have been classified into fourteen general groupings. These groups have been mapped and provide relatively large areas of individual groups. Whether soils which are physically similar are also of similar fertility status is a conclusion which will have to be shown by experimentation. As time and money permits, studies on individual soils will be carried out and, if necessary, the soil type components of the soil groups will be changed.

If the soil fertility status of soils within groups proves to be similar and if groups respond differently, this knowledge will be used along with soil tests in making more precise fertilizer recommendations.

Of the fourteen groups established, several are composed of relatively small areas or of non-agricultural land. Approximately forty per cent of the soils in the valley are unsuited to cultivation due to slope or shallow soils, and are presently in second-growth timber or native pasture. Naturally, no attempt will be made to study these soils.

Four groups were chosen for intensive study based on the proportionate area they represent and the importance of the agriculture practiced on them. These groups, the soils within them and the similarities and differences in these soils will be presented in outline form.

Group A

The soils of group A are among the most fertile in the area and have been classified as deep, well drained, black soils. They are included in the Chernozem great soils group. All textural classes of the soil series are included in each group. Likewise, in all groups, soils of slopes or other properties making them unsuitable for cultivation, will be ignored for the present.

Group A

- Creston silt loam
- Flathead very fine sandy loam
- Flathead fine sandy loam
- Flathead sandy loam
- Flathead-Creston loam
- Yeoman loam
- Yeoman gravelly loam
- Yeoman stony loam

All soils in Group A are deep, well drained, light to medium textured soils located on the east side of the valley. The native vegetation is a dense cover of tall grasses with Yeoman including transitional areas between grassland and forest. This may account for the fact that Yeoman has a dark grayish-brown surface while Flathead and Creston tend to be a little darker.

The parent material is commonly glacial stream terrace alluvium or till that originates mainly from gray, green, and reddish argillite, quartzite, and dolomitic limestone of the Belt formation.

The soils differ in that Flathead lacks the marked accumulation of calcium carbonate which occurs in the Creston and Yeoman soils. Yeoman and Flathead have thicker surface and subsoil horizons than the Creston soils. Most soils in the group are cultivated, but some woods and grassland are on the sandy knolls. The main crops are small grain and hay. Potatoes, peas, and specialty crops are also grown. Group A comprises approximately 21,500 acres in Flathead Valley.

Group B

Group B consists of deep, loamy, well drained, dark brown soils. These soils are classified in the Chestnut great soil group.

Group B

Kalispell loam
Kalispell silt loam
Kalispell fine sandy loam
Prospect loam
Prospect stony loam
Tally, Blanchard and Flathead complex

All soils in group B are deep, loamy, well drained, dark grayish brown soils developed under grass with scattered pine trees. Kalispell and Prospect appear to have a slightly heavier texture in the B horizon with a coarse blocky structure, while Tally, being lighter textured has no clay accumulation and drainage is somewhat excessive. Tally has been mapped in complexes with Blanchard and Flathead since the soils are so closely associated that it is not practical to map them separately. Blanchard is a sandy soil which occupies small dunes or knolls in the complex. About half of this soil has never been cultivated so little significance will be placed on it during the study. Flathead has already been mentioned in a previous group.

Most soils in this group have pronounced zones of lime carbonate accumulations, which are just below the subsoil. Kalispell is somewhat shallower than Prospect or Tally. The parent materials of the group are glacial stream alluvium or till from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all from the Belt formation.

A large amount of this group occurs in the west-central part of the valley, with the main crops being small grain and hay. This group consists of approximately 20,000 acres.

Group C

Soils of group C are deep, loamy, moderately well drained to imperfectly drained, gray and dark gray soils. These soils are grouped on the basis of drainage properties rather than morphological development, thus several great soil groups are included.

Group C

Somers silt loam
Somers silty clay loam
Somers silty clay
Swims silt loam
Swims silty clay loam
Corvallis silty clay loam
Stryker silt loam

Great soil group

Chestnut

Gray wooded

alluvium (azonal)

Gray wooded

Group C (continued)

Stryker silty clay
Stryker silt loam

Group C soils are heavier textured than the previous groups and are more poorly drained. These soils are developed under grass (Somers) and shrubs and trees (Corvallis, Stryker, and Swims). These soils are in the main, located on terraces of glacial lakes and streams, derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all from the Belt formation. Soils of this group have weak structural development and a moderately to strongly developed lime carbonate horizon at the top of the parent material. Certain of these soils show faint mottling in the lower horizons, indicating a drainage problem.

Somers series, one of the most important components of this group, has as inclusions in its mapping unit small areas of Tuffit and Demus soils which have a dense, strongly alkaline, claypanlike upper subsoil and moderately to strongly saline lower subsoils. As in previous cases, minor inclusions will be ignored for the time being.

Areas of Group C occur in the south-central portion of the valley, and are cultivated, with the exception of the low wet spots and alkali areas. The main crops are small grain, potatoes, and hay. This group consists of approximately 24,000 acres in Flathead Valley.

Group D

Soils of group D are deep, loamy, well drained, gray and grayish brown soils. This group consists of two soils which predominate over a large portion of the area bounded by the Flathead and Whitefish Rivers.

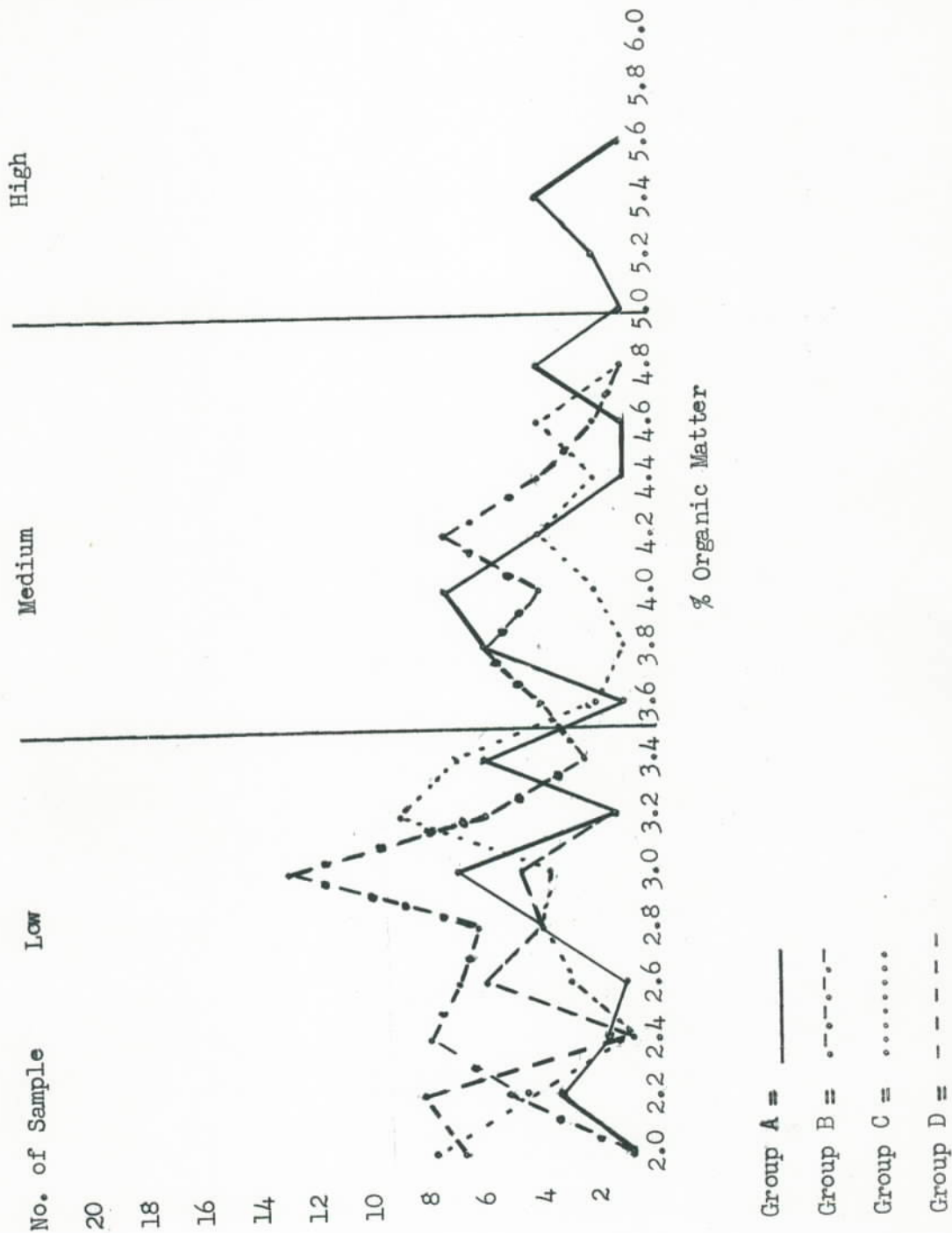
| | |
|------------------------------|------------------|
| Group D | Great soil group |
| Kiwanis silt loam | Regosol (azonal) |
| Kiwanis loam | |
| Kiwanis fine sandy loam | |
| Walters silt loam | Gray wooded |
| Walters very fine sandy loam | |

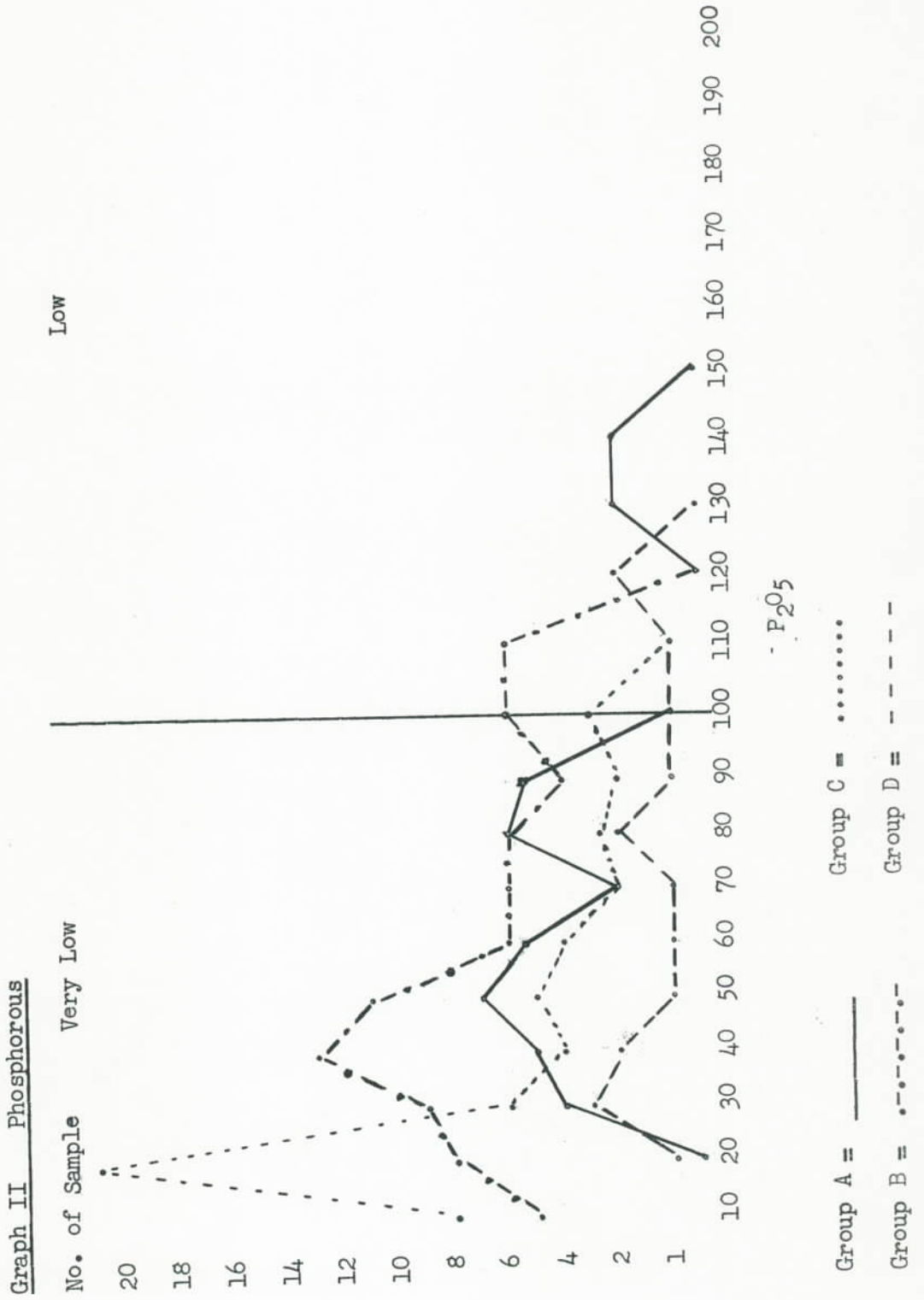
Kiwanis and Walters series are shallow to moderately deep loam soils developed in stratified medium and moderately coarse alluvium, mainly reworked glacial drift, which is derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all from the Belt formation. Kiwanis was developed under a grass vegetation, with moderate mixed stands of conifers and deciduous trees, while Walters was developed under a mixture of conifers and deciduous trees. Both soils show very little structural development but are calcareous in the lower horizons. Walters differs from Kiwanis mainly in having lighter colored and more acid surface soils.

Inclusion of Birch, a shallow, light colored sandy soil, are within certain Kiwanis mapping units since the two soils occur in such an intricate pattern that it is not feasible to map them separately.

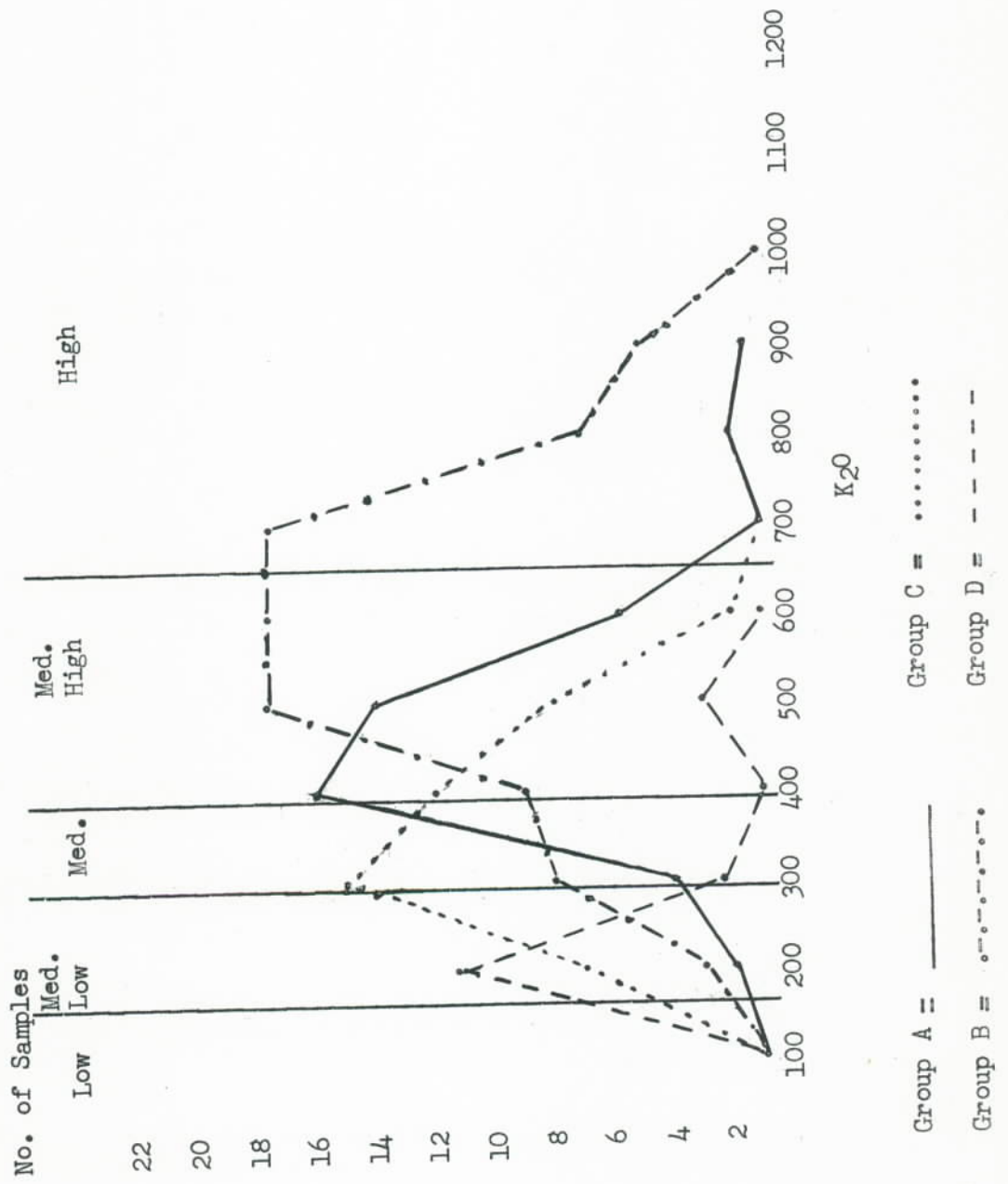
About half of this group has been cleared for cultivation and pasture and more is being cleared every year. The main crops are small grain, hay, and pasture. This group includes about 10,000 acres in Flathead County.

Graph I Organic Matter



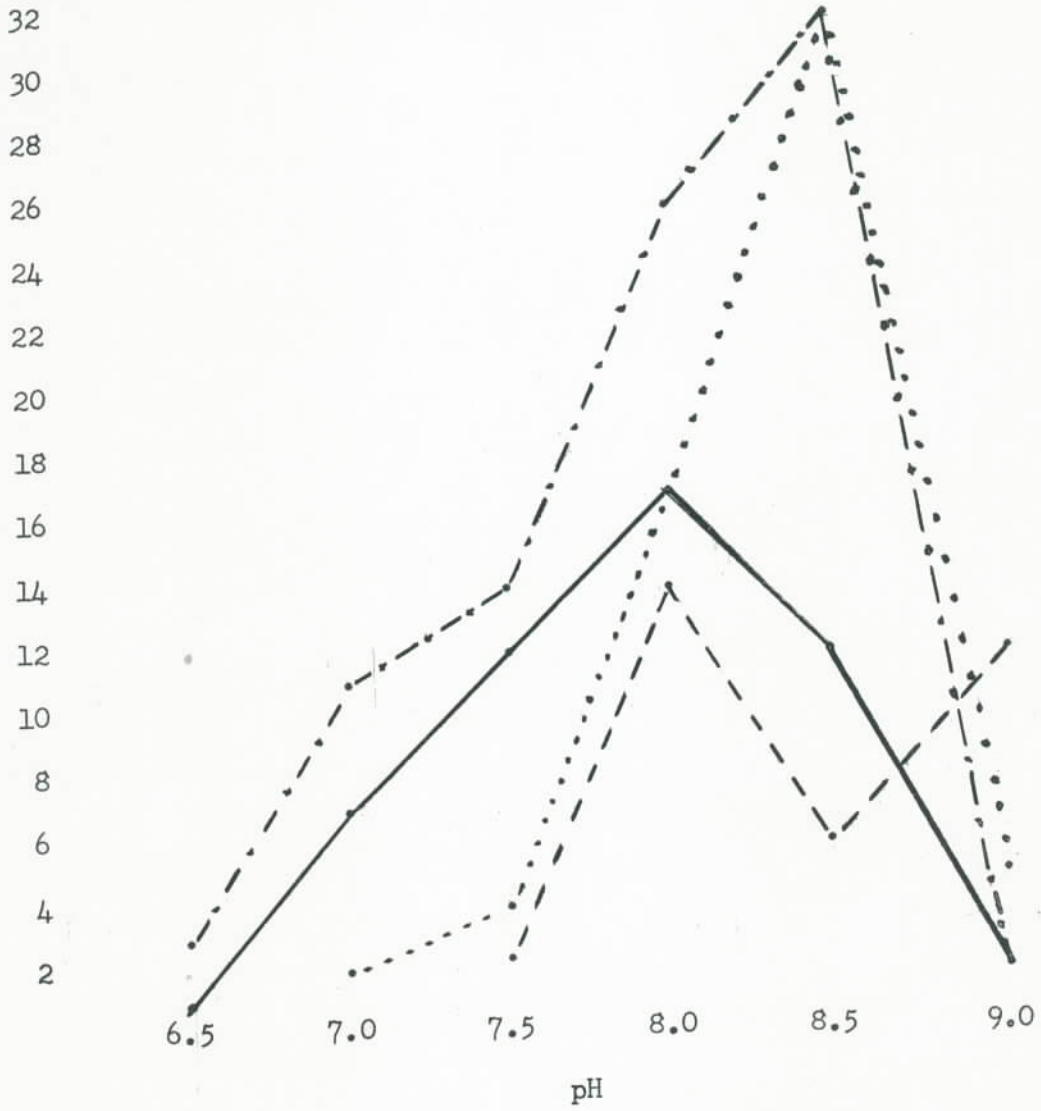


Graph III Potassium



Graph IV pH

No. of Samples



- Group A = _____
- Group B = -.-.-.-.-
- Group C =
- Group D = - - - - -

RESULTS AND DISCUSSION

During the spring and summer of 1960, over 900 soil samples were tested in Flathead County for organic matter, phosphorous, potassium, and pH. These soils were tested for farmers desiring fertilizer recommendations. In cases when the sample sites were located well within a particular group, the data was compiled and assumed to represent the fertility status of that soil group. The number of samples found within each group is as follows: Group A, 53 samples; Group B, 98 samples; Group C, 67 samples; and Group D, 34 samples.

A variety of management practices are represented in each of the groups and will definitely have some effect on the results. By studying a large number of samples from each group, individual management effects will be kept to a minimum.

Graph I shows the number of samples of each soil group which occur at each of several levels of organic matter. Each group showed a wide range of organic matter. Each group showed a wide range of organic matter content with no significant differences between groups, except that A had several samples of high organic matter.

A graph showing ranges of phosphorous levels for each of the groups shows the extreme deficiency of all soil groups, (graph II), with group C showing an extremely low level with 48 per cent of the samples reading less than thirty pounds of phosphorous per acre. This may not be significant in that a large share of all groups was well below adequate levels.

A study of the distribution of potassium between soil groups seems more significant (graph III). It may be seen that potassium tends to increase in the following order: Group D, Group C, Group A, and Group B. Essentially, no potassium fertilizer has been applied to any soil in the valley. Group C and Group D, being predominantly low in potassium, are the lighter colored or imperfectly drained soils, and haven't been as intensively farmed as Group A and B, which apparently are higher in potassium levels. It may be concluded that the potassium content, in this case, is an inherent property of soils. If this were not the case, the soils farmed more intensively (group A and B) should be depleted of potassium before less intensively farmed areas (group C and D).

In general, a study of pH among soil groups show that all groups tend to be somewhat alkaline with an average pH of all samples of 7.9. Groups C and D appear to have the highest readings.

TITLE: A Study of Fertility Levels of Eight Soil Types in Northwestern Montana

PROJECT NUMBER: 5020

PERSONNEL: Don Graham and Jack Cloninger

FUNDS: State

DURATION: Undetermined

LOCATION: Eight trials were located on sites selected by Jack Cloninger, Soil Scientist, S.C.S. representing eight major soil types in Northwestern Montana. These eight soils comprise of two from each of four of the soil groups which are described under the report entitled "Soil Groups in Northwestern Montana". Exact locations will appear under the discussion of each trial.

INTRODUCTION

Fertility investigations in Northwestern Montana are hampered by the large number of soils and climatic situations over a relatively small area.

Investigations are needed which determine the fertility status of individual soils in order to combine them into larger more practical units for the best soil management recommendations.

This study includes eight trials with twelve fertilizer treatments in three replications on each of twelve specific soil types. These soil types were selected, two from each of four pre-designated soil groups, on the basis of their proportionate extent and their agricultural importance in the area.

Locations were picked by Jack Cloninger so that the soil corresponded as closely as possible to the typical profile as described by the Soil Conservation Service.

The objective of the study was to distinguish any outstanding differences between series and to more adequately define a general recommendation for the area.

Most of this work was done on Flathead County soils because detailed soil mapping is complete in this area and because of its closeness to the Station. Concepts learned here will be applied to all areas of Northwestern Montana in the future.

MATERIALS AND METHODS

Sites were selected and soil tests were taken prior to the establishment of any of these trials. Soil test results appear in the table of results for each of the trials.

Relative values for organic matter and phosphorous are as follows:

| | | |
|--------------------------|---------------|--------------|
| Organic Matter (O.M.) | 5% and over | High |
| | 3.5 to 5% | Satisfactory |
| | 3.5 and under | Low |
| Phosphorous (P_2O_5) | 350 and over | High |
| | 300 - 350 | Medium |
| | 250 - 300 | Medium low |
| | 100 - 250 | Low |
| | 100 and under | Very low |

The soil types and a brief description of each are as follows:

The Creston series consists of deep, dark, friable, silty soils on the broad terraces in the east-central part of the upper Flathead Valley area. The parent material is silty, medium textured, water sorted material on out-wash fans and terraces that were formed by glacial streams when the glacier receded from the valley and mountain slopes. The native vegetation is a dense cover of tall grasses with a few scattered ponderosa pines. The dark surface soil is, on the average, about one foot thick. It is underlain by a dark brown layer six to ten inches thick. There is a rather abrupt transition between the dark brown layer and the underlying light colored, highly calcareous material. The Creston soils are well drained. They absorb water readily and little runoff occurs. Small amounts of water may accumulate in low spots following heavy rains or rapid melting of snow. These soils have a good supply of organic matter. No injurious salts are present at any depth. Fertilizer responses took place at four treatments and best yields occurred at thirty pounds of nitrogen and forty pounds of phosphorous per acre.

The Flathead series consists of deep, dark, well-drained, moderately sandy soils. These soils are mostly on the east side of the valley. The parent material is stream terrace alluvium that originated mainly from gray, green, and reddish argillite, quartzite, and dolomitic limestone of the Belt formation. The soils developed under tall grass. Scattered trees and small clumps of ponderosa pine are common to areas of these soils. The Flathead soils have a dark surface soil, one to two feet thick, and a nearly massive, brown, sandy subsoil. The brown, sandy parent material is calcareous and is about forty inches below the surface. Runoff is very slow, as nearly all rain is absorbed. Permeability is moderately rapid. Nearly all treatments responded significantly. The site was extremely dry and the average check plot yield was only 6.6 bushels per acre. No treatment was economically feasible in this trial, however, better moisture conditions may have greatly influenced results.

The Somers series consists of deep, fine to medium textured, moderately well-drained soils that are sandy below a depth of two or three feet. The soils are on the terraces of glacial

(Continued) Soil types and a brief description of each.

lakes and streams in the upper Flathead Valley area. The parent material was derived from argillite, quartzite, and dolomitic rocks, all of the Belt geological formation. These soils developed under grass and a scattering of ponderosa pine. The Somers soils have a gray surface soil, five to eight inches thick, a weak prismatic and blocky subsoil of about the same thickness and a moderately to strongly developed lime carbonate horizon at the top of the parent material. Statistical analysis showed that no treatment gave a real response, however, several gave an economical response.

The Swims series consists of deep, light colored, silty soils. These soils have developed in deep, light colored, medium textured, calcareous alluvium on high bottom lands and low terraces in the upper Flathead Valley area. The parent material was derived from argillite, quartzite, and dolomitic limestone, all of the Belt formation. It has been largely reworked from glacial drift. The soils developed under a moderate to dense forest, mainly ponderosa pine and hardwoods. In general, the Swims soils are in the southern part of the upper Flathead Valley area, where rainfall is too low to support a good forest. Established trees, however, draw moisture from the ground water which is generally within four to ten feet of the surface. The Swims soils have thin, dark gray H₁ horizons, light brownish-gray H₂ horizons, and weak, blocky subsoils. No response, neither statistical or economical, occurred in this trial.

The Kiwanis series consists of shallow, loamy soils developed in stratified, medium and moderately coarse, calcareous alluvium on high bottom lands or low terraces. The parent alluvium, largely reworked glacial drift, was derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The vegetation under which the soils developed was dominantly grass, but consisted also of moderate stands of conifers and of mixed stands of coniferous and deciduous trees and shrubs. The surface soil of the Kiwanis soils is dark loam with weak structure. It rests on the parent material which is also loamy. The trial on Kiwanis was extremely dry. No grain was produced in any plot and no yield data was determined.

The Walters series consists of moderately deep, light colored, moderately sandy soils on low terraces bordering the larger streams. These soils have developed in stratified, medium and moderately coarse alluvium, mainly reworked from glacial drift. The alluvium was derived from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The original vegetation was a mixture of coniferous and deciduous trees dominated by Douglas fir, larch, ponderosa pine, and lodgepole pine. The Walters series have a gray to brown surface soil about ten inches thick. They have a pale

(Continued) Soil types and a brief description of each.

brown loamy subsoil with only a weak structure. The Walters soils are more sandy below a depth of two feet and grade into stratified sandy loams and sands. These soils are well drained, and the moisture holding capacity is somewhat limited by coarse substrata. In places, the water table fluctuates and it may rise to within three or four feet of the surface in seasons of heavy rain, melting snow, and high water in streams. Only one treatment, thirty pounds of nitrogen and forty pounds of phosphorous was economically and statistically significant.

The Kalispell series consists of deep, medium textured, well drained soils that have developed on outwash fans, and glacial lake and stream terraces. The parent alluvium was derived largely from gray, green, and reddish argillite, quartzite, and dolomitic limestone, all of the Belt geological formation. The soils developed under a moderate cover of grass. Kalispell soils have dark grayish-brown surface soils and pale brown subsoils with a coarse, blocky structure. Pronounced zones of lime carbonate accumulations are just below the subsoil. Almost all treatments gave a statistically significant response. Moisture conditions were very poor and the average yield of check plots was only 2.5 bushels per acre.

The Tally series consists of moderately deep, moderately sandy soils over loose sand. They have developed in glacial outwash and old stream deposits on terraces and alluvial fans, mainly north and northwest of Kalispell. The terraces and fans apparently were originally nearly level but later were partly dissected by streams. Wind drifted the material before it was stabilized and caused the nearly level, undulating, and rolling topography on which the soils occur. The native vegetation was grasses, common to sandy areas and some sage. Soils of the Tally series have a dark, moderately sandy surface soil about ten inches thick. The subsoil is brown and moderately sandy and merges gradually with the loose sand substrata at depths of fifteen to thirty inches. These soils absorb nearly all precipitation, permeability is moderately rapid. Drainage is somewhat excessive. Two treatments, thirty pounds of nitrogen plus forty pounds of phosphorous and forty-five pounds of nitrogen plus forty pounds of phosphorous gave economic and statistical significant responses. This trial received one application of irrigation during the season.

One trial was conducted in Ravalli County on Burnt Forks loam. This series are deep, permeable soils that are high in natural fertility and have good water holding capacity. They developed from highly calcareous, friable, more or less cobbly deposits of sandy loam to clay loam overlying unconsolidated Tertiary formations. They occupy large areas on the smooth to rolling benchlands east of the Bitterroot River in the Hamilton-Stevensville section of the valley. The Burnt Fork soils have developed

(Continued) Soil types and a brief description of each.

under grass. The average annual rainfall is eleven to thirteen inches. They are normally developed soils that have no claypan or hardpan horizons. Most treatments yielded significantly over the no-fertilizer plots. Thirty pounds of nitrogen and forty pounds of phosphorous was the only combination rate which paid for itself.

RESULTS AND DISCUSSION

1960 was an unusually poor year for small grains in Northwestern Montana. A cool, rather late spring combined with a hot, dry summer reduced small grain production considerably in the area. This trend was reflected in the yield results of the trials.

However, all trials, except for Somers and Swims which were in the same group, gave significant responses. In almost every case, the treatment of thirty pounds nitrogen and forty pounds phosphorous gave the best response, both in terms of yield and height. No outstanding differences appeared to occur between groups excepting, perhaps, the group which Somers and Swims are members of.

Several years more study on a number of locations may **point** out whatever differences may exist between series.

The yield per replication, statistical analysis, economic data, soil type, and location of each trial are given in the following tables. Also included is a table of height and heading notes for most of the trials, taken once during the season.

Table XVI. Burnt Fork Loam

| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 | | |
|------------------------------------|--------------------------|---------|---------|---------|---------|------------------|------------------------|---------|------------------|---------|------------------|---------|----|----|----|--|--|
| | Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | | |
| | Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 40 | 40 | 40 | 80 | 80 | 80 | 40 | 80 | | |
| | | | | | | | <u>GRAMS FER. PLOT</u> | | | | | | | | | | |
| Replication 1 | 239 | 261 | 227 | 341 | 394 | 407 | 331 | 471 | 512 | 206 | 211 | 279 | | | | | |
| Replication 2 | 459 | 367 | 430 | 314 | 541 | 588 ¹ | 386 | 574 | 532 | 479 | 486 | 366 | | | | | |
| Replication 3 | 666 | 531 | 861 | 777 | 946 | 940 | 776 | 844 | 898 ¹ | 626 | 724 ¹ | 621 | | | | | |
| Bushels per acre | 31.4 | 36.6* | 34.9* | 32.9 | 43.3** | 44.5** | 34.4 | 43.5** | 44.6** | 30.2 | 32.7 | 29.1 | | | | | |
| Gross Income | \$18.84 | \$21.96 | \$20.94 | \$19.74 | \$25.98 | \$26.70 | \$20.64 | \$26.10 | \$26.76 | \$18.12 | \$19.62 | \$17.46 | | | | | |
| Cost of Fertilizer | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 | 8.00 | ----- | | | | | |
| Gross Income after Fer- tilizer | \$16.59 | \$17.46 | \$14.19 | \$13.49 | \$17.48 | \$15.95 | \$10.39 | \$13.60 | \$12.01 | \$14.12 | \$11.62 | \$17.46 | | | | | |
| Gain or Loss | -.87 | .00 | -3.27 | -3.97 | .02 | -1.51 | -7.07 | -3.86 | -5.45 | -3.34 | -5.84 | ----- | | | | | |

¹ Missing Plots

* Significant at 1%

** Significant at 5%

Location: Bitterroot Livestock Ranch - T6N R20W S1/4 corner Sec 21

Table XVII. Somers silty clay loam

| | <u>GRAMS PER PLOT</u> | | | | | | | | | | | | | | | | | |
|------------------------------------|-----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----|----|----|----|----|----|
| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 |
| Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 80 | 80 | 80 |
| Replication 1 | 191 | 241 | 435 | 316 | 461 | 457 | 507 | 580 | 550 | 515 | 403 | 314 | | | | | | |
| Replication 2 | 401 | 341 | 408 | 435 | 499 | 429 | 270 | 340 | 366 | 336 | 355 | 1444 | | | | | | |
| Replication 3 | 247 | 399 | 415 | 322 | 346 | 419 | 334 | 445 | 465 | 231 | 345 | 191 | | | | | | |
| Bushels per acre | 19.3 | 22.6 | 28.9 | 24.7 | 27.2 | 30.0 | 25.5 | 31.4 | 31.7 | 24.9 | 23.1 | 14.9 | | | | | | |
| Gross Income | \$11.58 | \$13.56 | \$17.34 | \$14.82 | \$16.32 | \$18.00 | \$15.30 | \$18.84 | \$19.02 | \$14.94 | \$13.86 | \$ 8.94 | | | | | | |
| Cost of Fertilizer | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 | 8.00 | ----- | | | | | | |
| Gross Income after Fer- tilizer | \$ 9.33 | \$ 9.06 | \$10.59 | \$ 8.57 | \$ 7.82 | \$ 7.25 | \$ 5.05 | \$ 6.34 | \$ 4.27 | \$10.94 | \$ 5.86 | \$ 8.94 | | | | | | |

Non-significant

Location: Pete Woll farm T27N R20W NW corner Sec 16

Soil Test Results:

pH - 7.6
 Conductivity - 16
 P₂O₅ - 76
 O.M. - 5.2%

Table XVIII. Flathead fine sandy loam

| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------|----------------|---------|---------|---------|---------|----------|---------|---------|----------|---------|---------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | GRAMS PER PLOT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 80 | 80 | 0 | | | | | | | | | | | | | | | | | | | | | | |
| Replication 1 | 123 | 163 | 176 | 180 | 202 | 218 | 161 | 184 | 196 | 181 | 143 | 102 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replication 2 | 144 | 161 | 223 | 154 | 195 | 205 | 160 | 194 | 300 | 119 | 156 | 112 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replication 3 | 115 | 131 | 249 | 137 | 216 | 267 | 150 | 106 | 191 | 136 | 111 | 74 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bushels per acre | 8.7 | 10.5* | 14.9** | 10.8* | 14.1** | 15.9** | 10.8* | 11.1* | 15.8** | 7.7 | 9.4 | 6.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gross Return | \$ 5.74 | \$ 6.93 | \$ 9.83 | \$ 7.13 | \$ 9.31 | \$ 10.49 | \$ 7.13 | \$ 7.33 | \$ 10.43 | \$ 5.08 | \$ 6.20 | \$ 4.36 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fertilizer Cost | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 | 8.00 | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gross Return after Fertilizer | \$ 3.49 | \$ 2.43 | \$ 3.08 | \$.88 | \$.81 | ----- | ----- | ----- | ----- | \$ 1.08 | ---- | \$ 4.36 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

* Significant at 5%

** Significant at 1%

Location: John Brocken farm - T29N R20W SE corner of SE $\frac{1}{4}$ of NE $\frac{1}{4}$ Sec 19

Soil Test Results:

| | | |
|-------------------------------|---|-----|
| pH | - | 8.2 |
| Conductivity | - | 2 |
| P ₂ O ₅ | - | 36 |
| O.M. | - | 2.3 |

Table XIX. Swims silty clay loam

| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 | |
|--------------------------------|-----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 | |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 0 | |
| | <u>GRAMS PER PLOT</u> | | | | | | | | | | | | | | | | | | |
| Replication 1 | 296 | 236 | 459 | 415 | 480 | 500 | 355 | 389 | 255 | 231 | 231 | 235 | 231 | 235 | 231 | 231 | 235 | 231 | 231 |
| Replication 2 | 361 | 455 | 261 | 380 | 394 | 358 | 451 | 399 | 404 | 408 | 408 | 251 | 321 | 251 | 321 | 321 | 251 | 321 | 321 |
| Replication 3 | 286 | 306 | 440 | 320 | 376 | 380 | 364 | 275 | 261 | 282 | 282 | 265 | 244 | 265 | 244 | 244 | 265 | 244 | 244 |
| Bushels per acre | 21.7 | 22.9 | 26.6 | 25.6 | 28.7 | 28.5 | 26.9 | 24.4 | 21.1 | 21.1 | 21.2 | 17.3 | 18.3 | 17.3 | 18.3 | 18.3 | 17.3 | 18.3 | 18.3 |
| Gross Return | \$14.32 | \$15.11 | \$17.56 | \$16.90 | \$18.94 | \$18.81 | \$17.75 | \$16.10 | \$13.93 | \$13.99 | \$11.42 | \$12.08 | \$12.08 | \$11.42 | \$12.08 | \$12.08 | \$11.42 | \$12.08 | \$12.08 |
| Fertilizer Cost | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 | 8.00 | 8.00 | 8.00 | 4.00 | 8.00 | 8.00 | 4.00 | 8.00 | 8.00 |
| Gross Return after Fer-tilizer | \$12.07 | \$11.61 | \$10.81 | \$10.65 | \$10.44 | \$8.06 | \$7.50 | \$3.60 | \$.82 | \$ 9.99 | \$ 3.42 | \$12.08 | \$12.08 | \$ 9.99 | \$ 3.42 | \$12.08 | \$ 9.99 | \$ 3.42 | \$12.08 |

Non-significant

Location: Zoback place - T28N R21W N $\frac{1}{4}$ corner SE $\frac{1}{4}$ of SE $\frac{1}{4}$ Sec 23

Soil Test Results:

pH - 7.8
 Conductivity - 24
 P₂O₅ - 104
 O.M. - 4.1%

Table XX. Kalispell loam

| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 80 | 80 | 0 | |
|-------------------------------|---------|---------|---------|---------|---------|---------|-----------------------|---------|---------|---------|---------|---------|----|----|----|---|--|
| Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 80 | 80 | 0 | |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 80 | 80 | 80 | 80 | 80 | 80 | 40 | 80 | 80 | 0 | |
| | | | | | | | <u>GRAMS PER PLOT</u> | | | | | | | | | | |
| Replication 1 | 147 | 168 | 154 | 146 | 140 | 214 | 111 | 171 | 249 | 21 | 45 | 50 | | | | | |
| Replication 2 | 136 | 224 | 199 | 135 | 195 | 176 | 110 | 170 | 86 | 38 | 26 | 34 | | | | | |
| Replication 3 | 114 | 150 | 195 | 94 | 229 | 130 | 127 | 226 | 165 | 25 | 20 | 26 | | | | | |
| Bushels per acre | 9.1* | 12.5* | 12.6* | 8.6* | 13.0** | 12.0** | 8.0* | 13.0** | 11.5** | 1.9 | 2.1 | 2.5 | | | | | |
| Gross Return | \$ 6.01 | \$ 8.25 | \$ 8.32 | \$ 5.68 | \$ 8.58 | \$ 7.92 | \$ 5.68 | \$ 8.58 | \$ 7.59 | \$ 1.25 | \$ 1.39 | \$ 1.65 | | | | | |
| Fertilizer Cost | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 | 8.00 | 8.00 | | | | | |
| Gross Income after Fertilizer | \$ 3.76 | \$ 3.75 | \$ 1.57 | 1 | \$.08 | | | | | | | | | | | | |

1 In all cases left blanks, the fertilizer cost was greater than the gross return

* Significant at 5%

** Significant at 1%

Location: Carl Nommenson farm - T28N R22W SW corner SE1/4 of SE1/4 Sec 3

Soil Test Results:

pH - 7.4
 Conductivity - 20
 P₂O₅ - 74
 O.M. - 3.4%

Table XXI. Tally fine sandy loam

| | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 |
|------------------------------------|-----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | <u>GRAMS PER PLOT</u> | | | | | | | | | | | | | | | | | |
| Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 40 | 80 | 0 |
| Replication 1 | 671 | 879 | 915 | 827 | 767 | 930 | 794 | 790 | 732 | 720 | 700 | 700 | 732 | 720 | 700 | 700 | 700 | 945 |
| Replication 2 | 756 | 720 | 982 | 723 | 975 | 987 | 650 | 700 | 578 | 646 | 611 | 509 | 578 | 646 | 611 | 611 | 611 | 509 |
| Replication 3 | 725 | 746 | 555 | 851 | 912 | 849 | 888 | 939 | 1105 | 552 | 991 | 660 | 1105 | 552 | 991 | 991 | 991 | 660 |
| Bushels per acre | 49.5 | 53.9 | 56.4 | 55.2 | 61.0* | 63.6* | 53.6 | 55.8 | 55.5 | 44.1 | 52.9 | 48.6 | 55.5 | 44.1 | 52.9 | 52.9 | 52.9 | 48.6 |
| Gross Return | \$37.13 | \$40.43 | \$42.30 | \$41.40 | \$45.75 | \$47.70 | \$40.20 | \$41.85 | \$41.63 | \$33.08 | \$39.68 | \$36.45 | \$41.85 | \$41.63 | \$33.08 | \$39.68 | \$39.68 | \$36.45 |
| Fertilizer Cost | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.75 | 12.50 | 14.75 | 4.00 | 8.00 | --- | 14.75 | 4.00 | 8.00 | 8.00 | 8.00 | --- |
| Gross Income after Fer- tilizer | \$34.88 | \$35.93 | \$35.55 | \$35.15 | \$37.25 | \$36.95 | \$29.95 | \$29.35 | \$26.88 | \$29.08 | \$31.68 | \$36.45 | \$29.35 | \$26.88 | \$29.08 | \$31.68 | \$31.68 | \$36.45 |

* Significant at 5%

Location: Hans Tutvedt Farm - T29N R22W SW corner NW $\frac{1}{4}$ of SE $\frac{1}{4}$ Sec 10

Soil Test Results:

- pH - 8.1
- Conductivity - 14
- P₂O₅ - 44
- O.M. - 3.2%

Table XXII. Creston fine sandy loam

| Lbs. Nitrogen applied | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 0 | 0 | 0 | 0 | GRAMS PER PLOT | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----|----|----|---|----------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|-------|-------|-------|-------|-------|-------|--|--|--|--|
| | | | | | | | | | | | | | | | | | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | 15 | 30 | 45 | | | | | | |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 40 | 40 | 40 | 80 | 80 | 80 | 80 | 80 | 80 | 40 | 40 | 80 | 0 | 190 | 206 | 389 | 494 | 445 | 429 | 512 | 365 | 316 | 23.2 | 22.6 | 21.7 | 26.5 | 31.7 | 32.6* | 21.78 | 21.18 | 21.70 | 15.10 | 15.50 | | | | |
| Replication 1 | 279 | 471 | 342 | 444 | 436 | 360 | 286 | 377 | 389 | 206 | 190 | 179 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replication 2 | 360 | 511 | 235 | 454 | 523 | 523 | 471 | 490 | 494 | 445 | 429 | 512 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Replication 3 | 300 | 485 | 519 | 441 | 631 | 589 | 608 | 551 | 496 | 500 | 365 | 316 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bushels per acre | 21.6 | 33.7* | 25.2 | 30.8 | 36.6* | 33.8* | 31.4 | 32.6* | 31.7 | 26.5 | 22.6 | 23.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gross Return | \$14.43 | \$22.51 | \$16.83 | \$20.57 | \$24.45 | \$22.58 | \$20.98 | \$21.78 | \$21.18 | \$17.70 | \$15.10 | \$15.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fertilizer Cost | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 | 8.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gross Return after Fertilizer | \$12.18 | \$18.01 | \$10.08 | \$14.32 | \$15.95 | \$11.82 | \$10.73 | \$9.28 | \$6.43 | \$13.70 | \$7.10 | \$15.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

* Significant at 5%

Location: Charlotte Stevens Farm - T28N R20W SE corner Sec 5

Soil Test Results:

pH - 7.5
 Conductivity - 14
 P₂O₅ - 24
 O.M. - 4.5%

Table XXIII. Walters fine sandy loam

| | GRAMS PER PLOT | | | | | | | | | |
|-------------------------------|----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | 15 | 30 | 45 | 0 | 40 | 15 | 30 | 45 | 40 | 80 |
| Lbs. Nitrogen applied | 15 | 30 | 45 | 0 | 40 | 15 | 30 | 45 | 40 | 80 |
| Lbs. Phosphorous applied | 0 | 0 | 0 | 0 | 40 | 80 | 80 | 80 | 40 | 80 |
| Replication 1 | 785 | 545 | 934 | 796 | 890 | 1071 | 951 | 965 | 961 | 715 |
| Replication 2 | 675 | 730 | 880 | 871 | 1041 | 799 | 634 | 866 | 705 | 604 |
| Replication 3 | 800 | 695 | 675 | 717 | 825 | 712 | 841 | 846 | 905 | 602 |
| Bushels per acre | 50.3 | 45.5 | 57.2 | 54.8 | 63.4* | 59.4 | 55.8 | 61.5* | 59.1 | 44.2 |
| Gross Return | \$37.73 | \$34.13 | \$42.90 | \$41.10 | \$47.55 | \$44.55 | \$41.85 | \$46.13 | \$44.33 | \$33.15 |
| Fertilizer Cost | 2.25 | 4.50 | 6.75 | 6.25 | 8.50 | 10.75 | 10.25 | 12.50 | 14.75 | 4.00 |
| Gross Return after Fertilizer | \$35.48 | \$29.63 | \$36.15 | \$34.85 | \$39.05 | \$33.80 | \$31.60 | \$33.63 | \$29.58 | \$29.15 |
| | | | | | | | | | | \$24.63 |
| | | | | | | | | | | \$37.05 |
| | | | | | | | | | | 8.00 |
| | | | | | | | | | | 49.4 |
| | | | | | | | | | | 43.5 |
| | | | | | | | | | | 770 |
| | | | | | | | | | | 588 |
| | | | | | | | | | | 616 |
| | | | | | | | | | | 145 |

* Significant at 5%

Location: Sam Graham Farm - T30N R21W NW corner NW $\frac{1}{4}$ of SW $\frac{1}{4}$ Sec 25

Soil Test Results:

- pH - 7.9
- Conductivity - 13
- P₂O₅ - 74
- O.M. - 3.4%

Table XXIV . Height and Heading Data. B = boot stage, Hg = early heading, H = headed.

| | 15-0 | 30-0 | 45-0 | 15-40 | 30-40 | 45-40 | 15-80 | 30-80 | 45-80 | 0-40 | 0-80 | 0-0 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|
| <u>Creston silt loam -- July 5</u> | | | | | | | | | | | | |
| Replication 1 | 10 Hg | 20 Hg | 16 Hg | 30 Hg | 32 Hg | 30 Hg | 24 Hg | 30 Hg | 34 Hg | 20 Hg | 16 B | 14 B |
| Replication 2 | 18 B | 16 B | 12 B | 28 H | 36 H | 36 H | 20 Hg | 22 Hg | 36 H | 22 Hg | 20 B | 12 B |
| Replication 3 | 20 Hg | 20 B | 16 B | 28 Hg | 36 H | 28 Hg | 28 H | 36 Hg | 28 Hg | 18 Hg | 20 H | 18 B |
| Ave. Height | 16 | 18.6 | 14.6 | 28.6 | 34.6 | 31.3 | 24 | 29.3 | 32.6 | 20 | 18.6 | 14.6 |
| <u>Flathead fine sandy loam -- July 5</u> | | | | | | | | | | | | |
| Replication 1 | 24 Hg | 24 Hg | 20 Hg | 26 Hg | 30 H | 28 Hg | 28 Hg | 30 H | 32 H | 12 Hg | 12 B | 12 B |
| Replication 2 | 22 B | 30 Hg | 24 H | 20 H | 28 H | 28 H | 24 Hg | 20 Hg | 24 Hg | 12 B | 12 B | 12 B |
| Replication 3 | 20 B | 24 B | 24 H | 26 H | 20 Hg | 20 Hg | 20 Hg | 30 H | 25 H | 12 B | 12 B | 10 B |
| Ave. Height | 22 | 26 | 22.6 | 24 | 26 | 25.3 | 24 | 26.6 | 27 | 12 | 12 | 11.3 |
| <u>Swims silty clay loam -- July 5</u> | | | | | | | | | | | | |
| Replication 1 | 26 H | 22 B | 36 H | 28 H | 28 Hg | 28 Hg | 26 Hg | 28 Hg | 26 B | 16 B | 18 B | 18 B |
| Replication 2 | 26 Hg | 26 Hg | 26 B | 26 B | 32 Hg | 28 B | 28 Hg | 30 Hg | 30 B | 18 B | 18 B | 14 B |
| Replication 3 | 22 B | 28 Hg | 28 B | 28 Hg | 36 H | 36 H | 28 B | 30 Hg | 32 Hg | 24 B | 20 B | 22 B |
| Ave. Height | 24.6 | 25.3 | 30 | 27.3 | 32 | 30.6 | 27.3 | 29.3 | 29.3 | 19.3 | 18.6 | 18 |

Continued --

Table XXIV. (Continued)

| | 15-0 | 30-0 | 45-0 | 15-40 | 30-40 | 45-40 | 15-80 | 30-80 | 45-80 | 0-40 | 0-80 | 0-0 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| <u>Kalispell loam - July 11</u> | | | | | | | | | | | | |
| Replication 1 | 18 H | 21 H | 26 H | 26 H | 28 H | 29 H | 29 H | 29 H | 29 H | 10 B | 10 B | 10 Hg |
| Replication 2 | 24 Hg | 26 H | 29 H | 26 Hg | 29 H | 29 H | 26 H | 28 H | 28 H | 16 B | 18 B | 15 Hg |
| Replication 3 | 24 Hg | 24 Hg | 30 H | 24 H | 28 H | 28 H | 26 H | 26 H | 28 H | 15 B | 10 B | 10 B |
| Ave. Height | 22 | 23.6 | 28.3 | 25.3 | 28.3 | 28.6 | 27 | 27.6 | 28.3 | 13.6 | 12.6 | 11.6 |
| <u>Walters silty clay loam - July 11 (all headed)</u> | | | | | | | | | | | | |
| Replication 1 | 29 | 24 | 29 | 30 | 32 | 30 | 30 | 31 | 32 | 24 | 24 | 24 |
| Replication 2 | 32 | 27 | 30 | 28 | 33 | 29 | 29 | 32 | 29 | 27 | 27 | 29 |
| Ave. Height | 30.5 | 25.5 | 29.5 | 29 | 32.5 | 29.5 | 29.5 | 31.5 | 30.5 | 25.5 | 25.5 | 26.5 |
| <u>Tally loam - July 11</u> | | | | | | | | | | | | |
| Replication 1 | 18 B | 21 B | 20 B | 28 H | 29 H | 30 H | 30 H | 30 H | 30 H | 29 H | 25 H | 24 Hg |
| Replication 2 | 26 H | 24 Hg | 26 Hg | 28 H | 30 H | 29 H | 25 H | 26 H | 27 H | 24 H | 24 H | 20 Hg |
| Replication 3 | 24 Hg | 26 Hg | 24 Hg | 28 H | 29 H | 28 H | 27 H | 30 H | 29 H | 18 Hg | 24 H | 18 Hg |
| Ave. Height | 22.6 | 23.6 | 23.3 | 28 | 29.3 | 29 | 27.3 | 28.6 | 28.6 | 23.6 | 24.3 | 20.6 |

TITLE: Winter Wheat Fertility in the Camas Prairie Area

PROJECT NUMBER: 5020

PERSONNEL: Don Graham

DURATION: Three years

FUNDS: State

LOCATION: Arthur Argo Farm - $\frac{1}{2}$ mile north of the Camas Prairie School

INTRODUCTION

The Camas Prairie community is predominately a dryland winter wheat area. In the past, very little fertilizer has been used, no fertilizer trials have been conducted, and only very general recommendations have been made for the area.

An appeal had been made by the County Agent and farmers in the area for some fertilizer field trials, which leads to the establishment of this project.

MATERIALS AND METHODS

One trial was set out, using eighteen fertilizer treatments, in September of 1959. Fertilizer was applied with a belt seeder and seeding was done with the same equipment immediately afterwards. Observations in the Spring of 1960 showed that parts of the trial suffered from winter damage. This was particularly severe in parts of replication I, leaving only two replications of each treatment. Rather than to drop the trial completely, the incomplete data will be used to indicate any leads for future field trials in the area.

RESULTS

Table XXV shows the yield of the two replications in grams per plot. Certain rates were duplicated, in one case using Ammonium Nitrate and T.S.P. as the fertilizer material and in the other case, using Sulfate of Ammonia and Super Phosphate as the fertilizer material. The purpose of this was to find the effect of sulfur to the winter wheat.

Table XXV. Winter Wheat Fertilization, Camas Prairie

| | 15 | 15 | 15 | 15 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 100# | 200# | |
|--------|-----|-----|-----|-----|-------|------|-----|------|-------|------|-----|-------|-------|------|-----|-------|-------|-------|-------|------|------|-------|
| N | 0 | 15 | 15 | 15 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | Gyp. | Gyp. | |
| P | 0 | 0 | 30 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 30 | |
| S | | | | | | | | | | | | | | | | | | | | x | x | |
| Rep. 2 | 150 | 105 | 189 | 176 | 164 | 136 | 126 | 218 | 216 | 235 | 229 | 154 | 200 | 240 | 115 | 177 | 177 | 176 | 176 | 81 | 81 | 16 |
| Rep. 3 | 200 | 179 | 205 | 200 | 211 | 276 | 214 | 246 | 181 | 181 | 149 | 261 | 175 | 214 | 131 | 176 | 176 | 176 | 176 | 207 | 207 | 187 |
| Ave. | 175 | 142 | 197 | 188 | 187.5 | 206 | 170 | 232 | 198.5 | 208 | 189 | 207.5 | 187.5 | 227 | 123 | 176.5 | 176.5 | 176.5 | 176.5 | 144 | 144 | 101.5 |
| Bu/A | 8.8 | 7.1 | 9.9 | 9.4 | 9.4 | 10.3 | 8.5 | 11.6 | 9.9 | 10.4 | 9.5 | 10.4 | 9.4 | 11.4 | 6.2 | 8.8 | 8.8 | 8.8 | 7.2 | 7.2 | 7.2 | 5.1 |

Economic Data

Gross Income \$14.52 11.72 16.34 15.51 15.51 17.00 14.03 19.14 16.34 17.16 15.68 17.16 15.51 18.81 10.23 14.52 11.88 8.42
 Fertilizer Cost --- 2.10 4.80 7.50 10.20 4.20 6.90 9.60 12.30 2.70 5.40 8.10 4.20 4.20 4.80 2.10 6.90 ---
 Income after Fertilizer Cost \$14.52 9.62 11.54 8.01 5.31 12.80 7.13 9.54 4.04 4.46 10.28 9.06 11.31 14.01 8.13 7.62 ---

Comparing Sulfur and no Sulfur Treatments - Bushels per acre

| | 0 | 15 | 15 | 30 | 30 | Average |
|-----------|-----|-----|------|------|-----|---------|
| N | 0 | 15 | 15 | 30 | 30 | |
| P | 0 | 0 | 30 | 0 | 30 | |
| No sulfur | 8.8 | 7.1 | 9.9 | 10.3 | 8.5 | 8.95 |
| Sulfur | 8.8 | 6.2 | 11.4 | 9.4 | 8.8 | 8.95 |

Results indicate that no fertilizer treatment was economically feasible and that there was no response to sulfur. Additional trials are planned for the Camas Prairie area with moisture investigations incorporated into the study.

TITLE: Winter Versus Spring Wheat in Northwestern Montana

PROJECT NUMBER: 5020

PERSONNEL: Don Graham

DURATION: One year

FUNDS: State

LOCATION: Charles Frey farm, Mineral County; E-4, Station; 1 mile east of Bill's Crossing, Ravalli County

INTRODUCTION

In an attempt to evaluate yield differences between spring and winter wheat, fertilizer trials using both spring and winter wheat were put out in the fall and spring of 1959-60 at three locations.

RESULTS

In each location, winter wheat yields greatly exceeded yields of spring wheat. Mineral County spring wheat produced no yield while winter wheat averaged 27.4 bushels per acre.

The trials indicated that fertilizer response is more likely using winter wheat than spring wheat. In two of the three trials, economic return was gained by winter wheat fertilization, while essentially no response was shown from spring wheat fertilization.

Table XXVI. Winter Wheat Fertility - Mineral County, Charles Frey Farm. Grams per plot.

| | N | 0 | 15 | 15 | 30 | 30 | 0 |
|---------|-------|-------|-------|-------|-------|-------|----|
| | P | 0 | 0 | 30 | 0 | 30 | 30 |
| Rep. 1 | 652 | 502 | 640 | 354 | 440 | 589 | |
| Rep. 2 | 302 | 605 | 585 | 260 | 484 | 371 | |
| Rep. 3 | 271 | 445 | 840 | 695 | 764 | 646 | |
| Rep. 4 | 730 | 836 | 452 | 698 | 561 | 445 | |
| Average | 488.8 | 597.0 | 629.3 | 501.8 | 562.3 | 512.8 | |
| Bu/acre | 24.4 | 29.9 | 31.5 | 25.1 | 28.1 | 25.6 | |

Economic Data

| | 0 | 15 | 15 | 30 | 30 | 0 |
|-------------------------------|---------|---------|---------|---------|---------|---------|
| N | 0 | 0 | 30 | 0 | 30 | 30 |
| P | 0 | 0 | 30 | 0 | 30 | 30 |
| Gross Return \$1.65/bu | \$40.26 | \$49.34 | \$51.98 | \$41.42 | \$46.37 | \$42.24 |
| Fertilizer Cost * | ----- | 2.10 | 4.80 | 4.20 | 6.90 | 2.70 |
| Gross Return after Fertilizer | \$40.26 | \$47.24 | \$47.18 | \$37.22 | \$39.47 | \$39.54 |
| Gain or Loss | ----- | 6.98 | 6.92 | -3.04 | -.79 | -.72 |

* N @ 14¢ per pound P₂O₅ @ 9¢ per pound

No spring wheat yield was obtained in Mineral County. The lack of moisture was apparently the reason.

Table XXVII. Winter Wheat Fertilization, Ravalli County on Burnt Forks-Ravalli, gently sloping. Grams per plot.

| | | | | | | |
|---------|-------|-------|-------|-------|-------|-------|
| N | 0 | 15 | 15 | 30 | 30 | 0 |
| P | 0 | 0 | 30 | 0 | 30 | 30 |
| Rep. 1 | 277 | 285 | 270 | 286 | 262 | 302 |
| Rep. 2 | 351 | 284 | 408 | 374 | 406 | 296 |
| Rep. 3 | 299 | 233 | 360 | 285 | 261 | 226 |
| Rep. 4 | 306 | 410 | 345 | 354 | 496 | 386 |
| Average | 308.3 | 303.0 | 345.8 | 324.8 | 356.3 | 302.5 |
| Bu/acre | 15.4 | 15.2 | 17.3 | 16.2 | 17.8 | 15.1 |

Economic Data

| | | | | | | | |
|---|--|---------|---------|---------|---------|---------|---------|
| N | | 0 | 15 | 15 | 30 | 30 | 0 |
| P | | 0 | 0 | 30 | 0 | 30 | 30 |
| Gross Return \$1.65/bu | | \$25.41 | \$25.08 | \$28.55 | \$26.73 | \$29.37 | \$24.92 |
| Fertilizer Cost - N @ 14¢/lb & P @ 9¢/lb | | --- | 2.10 | 4.80 | 4.20 | 6.90 | 2.70 |
| Gross Return after Fertilizer | | \$25.41 | \$22.98 | \$23.75 | \$22.53 | \$22.47 | \$22.22 |
| Gain or Loss | | --- | -2.43 | -1.66 | -2.88 | -2.94 | -3.19 |

Table XXVIII. Spring Wheat Fertilization - Ravalli County on Burnt Forks - Ravalli, gently sloping. Grams per plot.

| | | | | | | |
|---------|-----|-----|-----|-----|-----|-----|
| N | 0 | 15 | 15 | 30 | 30 | 0 |
| P | 0 | 0 | 30 | 0 | 30 | 30 |
| Rep. 1 | 126 | 114 | 135 | 159 | 150 | 130 |
| Rep. 2 | 105 | 161 | 154 | 86 | 105 | 126 |
| Rep. 3 | 150 | 124 | 106 | 139 | 127 | 116 |
| Average | 127 | 133 | 132 | 128 | 127 | 124 |
| Bu/acre | 6.4 | 6.7 | 6.6 | 6.4 | 6.4 | 6.2 |

Economic Data

| | | | | | | | |
|---|--|---------|---------|---------|---------|---------|---------|
| N | | 0 | 15 | 15 | 30 | 30 | 0 |
| P | | 0 | 0 | 30 | 0 | 30 | 30 |
| Gross Return \$1.85/bu | | \$11.84 | \$12.40 | \$12.21 | \$11.84 | \$11.84 | \$11.47 |
| Fertilizer Cost - N @ 14¢/lb & P @ 9¢/lb | | --- | 2.10 | 4.80 | 4.20 | 6.90 | 2.70 |
| Gross Return after Fertilizer | | \$11.84 | \$10.30 | \$7.41 | \$7.64 | \$4.94 | \$8.77 |
| Gain or Loss | | --- | -1.54 | -4.43 | -4.20 | -6.90 | -3.08 |

Obviously the spring wheat yields were severely reduced by a shortage of moisture. One replication was left unharvested due to a lack of any grain production. The winter wheat trial on Burnt Forks-Ravalli soil produced higher yields. However, no yield response was gained by the fertilizer rates applied.

Table XXIX. Winter Wheat Fertilization on Flathead fine sandy loam. Grams per plot.

| | | | | | | | |
|---|-------|---------|---------|---------|---------|---------|---------|
| N | 0 | 15 | 15 | 30 | 30 | 0 | |
| P | 0 | 0 | 30 | 0 | 30 | 30 | |
| Rep. 1 | 604 | 720 | 661 | 649 | 555 | 710 | |
| Rep. 2 | 403 | 805 | 776 | 410 | 681 | --- | |
| Rep. 3 | 572 | 865 | 711 | 871 | 960 | 794 | |
| Rep. 4 | 815 | 844 | 1035 | 987 | 914 | 677 | |
| Average | 598.5 | 808.5 | 795.8 | 729.3 | 777.5 | 727 | |
| Bu/acre | 29.9 | 40.4 | 39.8 | 36.5 | 38.9 | 36.4 | |
| <u>Economic Data</u> | | | | | | | |
| N | | 0 | 15 | 15 | 30 | 30 | 0 |
| P | | 0 | 0 | 30 | 0 | 30 | 30 |
| Gross Return \$1.65/bu | | \$49.34 | \$66.66 | \$65.67 | \$60.23 | \$64.19 | \$60.06 |
| Fertilizer Cost - N @ 14¢/lb & P @ 9¢/lb | | --- | 2.10 | 4.80 | 4.20 | 6.90 | 2.70 |
| Gross Return after Fertilizer | | \$49.34 | \$64.56 | \$60.87 | \$56.03 | \$57.29 | \$57.36 |
| Gain or Loss | | --- | 15.22 | 11.53 | 6.69 | 7.95 | 8.02 |

Table XXX. Spring Wheat Fertilization on Flathead fine sandy loam. Grams per plot.

| | | | | | | | |
|---|-------|---------|---------|---------|---------|---------|---------|
| N | 0 | 15 | 15 | 30 | 30 | 0 | |
| P | 0 | 0 | 30 | 0 | 30 | 30 | |
| Rep. 1 | 349 | 361 | 316 | 374 | 371 | 331 | |
| Rep. 2 | 371 | 316 | 296 | 414 | 306 | 301 | |
| Rep. 3 | 361 | 266 | 330 | 266 | 342 | 273 | |
| Rep. 4 | 306 | 318 | 334 | 495 | 685 | 324 | |
| Average | 346.8 | 315.3 | 319.0 | 387.3 | 426.0 | 307.3 | |
| Bu/acre | 17.3 | 15.8 | 16.0 | 19.4 | 21.3 | 15.4 | |
| <u>Economic Data</u> | | | | | | | |
| N | | 0 | 15 | 15 | 30 | 30 | 0 |
| P | | 0 | 0 | 30 | 0 | 30 | 30 |
| Gross Return \$1.85/bu | | \$29.93 | \$27.33 | \$27.68 | \$33.56 | \$36.85 | \$26.64 |
| Fertilizer Cost - N @ 14¢/lb & P @ 9¢/lb | | --- | 2.10 | 4.80 | 4.20 | 6.90 | 2.70 |
| Gross Return after Fertilizer | | \$29.93 | \$25.23 | \$22.88 | \$29.36 | \$29.95 | \$23.94 |
| Gain or Loss | | --- | -4.70 | -7.05 | -.57 | .02 | -5.99 |

Trials on Flathead fine sandy loam indicate again that winter wheat produced a higher return than spring wheat.

Fertilizers on winter wheat produced good responses to all fertilizers applied. Very little economic gain was realized by fertilization of spring wheat.

The average net return of each check shows that winter wheat grossed \$38.34 per acre while spring wheat grossed \$13.92 average on the three trials.

Table XXXI. Average gross income after fertilizer costs of the fertilizer treatments in each of the three trials.

| | Winter Wheat | Spring Wheat |
|---------|--------------|--------------|
| Check | \$38.34 | \$13.92 |
| 15-0-0 | 44.93 | 11.84 |
| 15-30-0 | 43.93 | 10.10 |
| 30-0-0 | 38.59 | 12.33 |
| 30-30-0 | 39.74 | 11.63 |
| 0-30-0 | 39.71 | 10.90 |
| Average | \$40.87 | \$11.79 |

TITLE: Fertilization on Long Term Dryland Rotation

PROJECT NUMBER: 5020

PERSONNEL: Don Graham

FUNDS: State

DURATION: At least eight years

INTRODUCTION

Information is needed on the most effective methods of fertilizing a rotation. Most present recommendations are based on the fertilizer needs of each individual crop. The object of this study is to determine the effects of various fertilizer practices on a long term rotation.

MATERIALS AND METHODS

The rotation used is of eight years duration, including the following crops: alfalfa, four years and two years of grain alternated with fallow.

The fertilizer treatments are presented for each of the eight fields in the rotation in Table XXXII.

Each plot is 20 x 60 and a check occurs on every fourth strip. Harvest is done by taking three five foot combine strips forty feet long.

The study was initiated in the Spring of 1960 and the first year's results are tabulated in Table XXXIII.

Harvest was performed on hay on R-2, grass on R-3, and spring wheat on R-5.

Table XXXII *

| Year: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---------|-----------------------|---------|---------|---------|-------------|---------|-------------|---------|
| | Seeding Alfalfa | Alfalfa | Alfalfa | Alfalfa | Fal- low | Grain | Fal- low | Grain |
| Rate 1 | 240#P2O5 | | | | | 20#N | | 20#N |
| Rate 2 | 240#P2O5 | | | | | 40#N | | 40#N |
| Rate 3 | 240#P2O5 | | 40#P2O5 | | | 40#P2O5 | | 40#P2O5 |
| Rate 4 | 160#P2O5 | | 40#P2O5 | | | 40#P2O5 | | 40#P2O5 |
| Rate 5 | 160#P2O5 | | 40#P2O5 | | | 40#P2O5 | | 40#P2O5 |
| Rate 6 | 160#P2O5 | | 40#P2O5 | | | 40#P2O5 | | 40#P2O5 |
| Rate 7 | 40#P2O5 | 40#P2O5 | 40#P2O5 | 40#P2O5 | | 40#P2O5 | | 40#P2O5 |
| Rate 8 | 40#P2O5 | 40#P2O5 | 40#P2O5 | 40#P2O5 | | 40#P2O5 | | 40#P2O5 |
| Rate 9 | 40#P2O5 | 40#P2O5 | 40#P2O5 | 40#P2O5 | | 40#P2O5 | | 40#P2O5 |
| Rate 10 | Check - no fertilizer | | | | | 20#N | | 20#N |
| Rate 11 | | | | | | 40#N | | 40#N |
| Rate 12 | | | | | | | | |

Table XXXIII * Alfalfa - R-2 Plot Size: 5 x 6.5 feet

| Fertilizer | Pounds Per Plot | | Plot Size: 5 x 6.5 feet | |
|------------|-----------------|----------|-------------------------|---------|
| | No Fertilizer | 240#P2O5 | 160#P2O5 | 40#P2O5 |
| Rep. 1 | 1.964 | 3.408 | 1.692 | 2.678 |
| Rep. 2 | 1.872 | 2.500 | 3.942 | 1.937 |
| Rep. 3 | 1.664 | 3.488 | 3.104 | 1.065 |
| Average | 1.833 | 3.132 | 2.913 | 1.900 |
| Tons/acre | 1.228 | 2.098 | 1.952 | 1.273 |

Table XXXIV . Grass - R-3

| | 40#N | | 80#N | | 40#N | | 80#N | |
|---------|-----------------------------------|-------|-----------------------------------|-------|-----------------------------------|-------|-----------------------------------|-------|
| | 240#P ₂ O ₅ | 2.603 | 240#P ₂ O ₅ | 2.100 | 160#P ₂ O ₅ | 1.563 | 160#P ₂ O ₅ | 1.625 |
| Check | 1.344 | 2.603 | 2.100 | 1.313 | 1.313 | 1.563 | 1.625 | 1.719 |
| Rep. 1 | .969 | 2.603 | 2.100 | 1.313 | 1.313 | 1.563 | 1.625 | 1.719 |
| Rep. 2 | .719 | 1.313 | 1.950 | .938 | .938 | 2.982 | 1.594 | 3.500 |
| Rep. 3 | 1.25 | 2.350 | 2.407 | .875 | .875 | 1.913 | 2.013 | 1.500 |
| Average | .979 | 2.089 | 2.152 | 1.198 | 1.198 | 2.153 | 1.744 | 2.240 |
| Tons/A | .655 | .915 | 1.441 | .803 | .803 | 1.443 | 1.168 | 1.501 |

| (Con't.) | 40#N | | 80#N | | 40#N | | 80#N | |
|----------|----------------------------------|--|----------------------------------|--|---|--------------------------------------|----------------------|-------|
| | 40#P ₂ O ₅ | 1.950 <th>40#P₂O₅</th> <th>1.500 <th>1.500 <th>1.156 <th>1.156 <th>1.156</th> </th></th></th></th> | 40#P ₂ O ₅ | 1.500 <th>1.500 <th>1.156 <th>1.156 <th>1.156</th> </th></th></th> | 1.500 <th>1.156 <th>1.156 <th>1.156</th> </th></th> | 1.156 <th>1.156 <th>1.156</th> </th> | 1.156 <th>1.156</th> | 1.156 |
| Rep. 1 | 1.563 | 1.950 | .8438 | 1.500 | 1.500 | 2.250 | 2.250 | 2.250 |
| Rep. 2 | 1.913 | 2.979 | 3.440 | 2.399 | 2.399 | 1.656 | 1.656 | 1.656 |
| Rep. 3 | 1.406 | 3.450 | 1.094 | 1.779 | 1.779 | 1.687 | 1.687 | 1.687 |
| Average | 1.627 | 2.793 | 1.793 | 1.779 | 1.779 | 1.687 | 1.687 | 1.687 |
| Tons/A | 1.090 | 1.871 | 1.201 | 1.192 | 1.192 | 1.13 | 1.13 | 1.13 |

Averages:

40#N - 1.311 240#P₂O₅ - 1.044 0 P₂O₅ - 1.161
 80#N - 1.403 160#P₂O₅ - 1.138 0 N - .889
 Checks - 1.040 40#P₂O₅ - 1.552

Table XXXV. Spring Wheat - R-5 Ounces Per Plot

| | Check 1 | Check 2 | Check 3 | 40P ₂ O ₅ (1) | 40P ₂ O ₅ (2) | 20-40 (1) | 20-40 (2) | 40-40 (1) | 40-40 (2) | 20N | 40N |
|---------|---------|---------|---------|--|--|--------------|--------------|--------------|--------------|-------|-------|
| Rep. 1 | 59.50 | ----- | 30.75 | 66.25 | 49.75 | 87.75 | 73.75 | 75.5 | 97.75 | 61.25 | 60.5 |
| Rep. 2 | 68.25 | 59.50 | 32.75 | 50.00 | 62.00 | 93.75 | 84.75 | 86.0 | 101.75 | 57.50 | 54.25 |
| Rep. 3 | 75.00 | 63.00 | 46.00 | 81.25 | 48.00 | 95.00 | 63.00 | 93.0 | 105.50 | 55.00 | 48.50 |
| Average | 67.58 | 61.25 | 36.50 | 65.83 | 53.25 | 92.17 | 73.83 | 84.83 | 101.67 | 57.92 | 54.41 |
| Bu/Acre | 12.16 | 11.02 | 6.57 | 11.85 | 9.58 | 16.59 | 13.29 | 15.26 | 18.30 | 10.43 | 9.79 |

Average Yield per Treatment:

| | |
|-----------------------------------|--------------|
| Check | 9.92 Bu/acre |
| 40# P ₂ O ₅ | 10.72 |
| 20-40 | 14.94 |
| 40-40 | 16.78 |
| 20#N | 10.43 |
| 40#N | 9.79 |

TITLE: Weed Control of Native Grass Pasture by Fertilization

PROJECT NUMBER: 5028

PERSONNEL: Don Graham

DURATION: Five Years

LOCATION: 200 yards east of Columbia Falls High School; Flathead County Airport

INTRODUCTION

The Flathead County Weed Control Board has had difficulty controlling broad-leaf perennial noxious weeds in native pasture and grass wasteland sites. Observations indicated that cattle droppings increase the production of native grasses and offered competition which eliminated the noxious weeds. The objective of this study was to see if commercial fertilizer would have the same effect in eliminating the noxious weeds.

MATERIALS AND METHODS

Eighteen treatments of combinations of Nitrogen and Phosphorous were broadcasted on this surface on April 1, 1960 in three replications. These treatments were 50, 100, 200, and 300.

One-half of each plot was sprayed with eight pounds per acre of 2,4-D.

RESULTS AND DISCUSSION

Observations were made several times during the summer. Outstanding visual response was given by the highest fertilizer rates, however, no yield data was taken.

Visual observations indicate that weed growth was greatly retarded in the plots which received the higher rates of Nitrogen.

Continued observation, particularly of weed count, will be taken at least for four more years.

TITLE: Fertilizers on Forages

PROJECT NUMBER: 5020

PERSONNEL: Don Graham

FUNDS: State

DURATION: Four Years

LOCATION: Station, behind office building, Creston fine sandy loam; Lake County, Baker Farm, T19N R20W N $\frac{1}{4}$ corner Sec 21, Post gravelly silty clay loam; Ravalli County, Strnisha Farm T5N R20W SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec 9, Corvallis silt loam, slightly saline.

INTRODUCTION

Since forage production contributes a significant amount to the agricultural economy of Northwest Montana, trials dealing with fertilizer responses of forages have received considerable emphasis in the Soils research at Northwestern Montana Branch Station.

Currently, three forage trials, one on-station pasture study and two off-station hay trials, are being studied. In all cases, the trials are in a randomized block design with four replications.

The pasture study is in its fourth and last year of investigation and involves four mixtures, each under nine fertilizer treatments.

The off-station trials in Ravalli and Lake Counties, both alfalfa and orchard grass mixtures, are in their second and first harvest year, respectively.

MATERIALS AND METHODS

The pasture study was harvested four times, May 12, June 10, July 14, and August 18 by cutting a randomly located two-foot swath from each plot. Sheep grazed the remainder of the plot which was afterwards uniformly clipped. Irrigation of two inches occurred each time two inches evaporated from the evaporation pan. This occurred five times, June 27, July 11, July 19, July 25, and August 21.

The mixtures involved in this trial are orchard grass-ladino clover, orchard grass-Birdsfoot **trefoil**, bluegrass-ladino clover, and bluegrass-Birdsfoot trefoil. In the mixtures involving Birdsfoot trefoil, the trefoil stand was never well established and after three years, these mixtures are essentially pure grass stands. Due to the relatively poor yield of the bluegrass-Birdsfoot trefoil mixture, it was dropped from the study.

The orchard grass-alfalfa hay mixture in Ravalli County was harvested twice, June 29 and August 18 and the trial in Lake County was har-

vested June 30 and August 12. In each trial, a plot 16 x 4 feet was cut, total green weights were taken and a five pound sample was dried for purposes of computing dry weights. Irrigation procedures were managed and handled by the farm operators, and each trial received two irrigations, one previous to the first harvest and the other shortly after.

RESULTS AND DISCUSSION

The soil at the site of this trial is Creston fine sandy loam and previous to this planting was an orchard-hog pasture combination. Soil tests before establishment of the trial showed a PH of 6.5, a P_2O_5 content of 52 pounds per acre when thirty pounds is considered adequate, and an organic matter content of 4.2% where 4.0% is considered adequate.

The purpose of this trial was to determine the plant species and fertilizer treatment which contributes the highest yield over a long period of time. The tables which follow will show that fertilizers on a high fertility soil, over a three year period, didn't seem to be economically feasible.

The orchard-ladino mixtures produced the highest three-year average yield followed by bluegrass-ladino and orchard-trefoil.

Orchard-Alfalfa Hay Mixture - Ravalli County

A soil test taken before establishment of this trial shows a PH of 7.5, P_2O_5 at 35 pounds per acre where 30 pounds is adequate and an organic matter content of over five per cent where four per cent is considered adequate.

As indicated by the soil test, no economic response was noticed after two years of harvest.

Table XXXVI. Seasonal Yield of Orchard-Ladino Mixture in Ounces Per Plot.

| Treatments | 0-0 | 50-0 * | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|-------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Rep. 1 | 15.5 | 14.2 | 16.8 | 10.2 | 15.3 | 14.0 | 15.5 | 13.7 | 13.8 |
| Rep. 2 | 15.5 | 19.5 | 16.2 | 16.5 | 11.0 | 19.9 | 10.1 | 11.4 | 16.0 |
| Rep. 3 | 9.04 | 8.5 | 17.8 | 11.8 | 12.9 | 14.8 | 16.4 | 14.1 | 17.6 |
| Rep. 4 | 15.3 | 15.8 | 15.5 | 12.4 | 15.2 | 15.0 | 14.2 | 13.4 | 15.2 |
| Average | 13.8 | 14.5 | 16.6 | 12.7 | 13.6 | 15.9 | 14.1 | 13.2 | 15.7 |
| Lbs/Acre | 4706 | 4945 | 5661 | 4331 | 4638 | 5422 | 4808 | 4501 | 5354 |
| Tons/Acre | 2.353 | 2.473 | 2.831 | 2.166 | 2.319 | 2.711 | 2.404 | 2.251 | 2.677 |
| <u>Economic Data</u> | | | | | | | | | |
| Gross Income <u>1</u> | \$47.06 | \$49.45 | \$56.61 | \$43.31 | \$46.37 | \$54.22 | \$48.08 | \$45.01 | \$53.54 |
| Fertilizer Cost <u>2</u> | ----- | 7.00 | 14.00 | 3.60 | 10.60 | 17.60 | 7.20 | 14.20 | 21.20 |
| Gross Income after Fertilizer | \$47.06 | \$42.45 | \$42.61 | \$39.71 | \$35.77 | \$36.62 | \$40.88 | \$30.81 | \$32.34 |

* The first unit represents pounds of actual N per acre and second unit represents actual P₂O₅.

1 \$20.00 per ton.

2 N @ 14¢ per pound and P₂O₅ at 9¢ per pound.

Table XXXVII. Yield Per Cutting of Orchard-Ladino Mixture in Ounces Per Plot.

| First Cutting - May 12 | | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|---|------|------|-------|------|-------|--------|------|-------|--------|
| Treatments | | 0-0 | | | | | | | |
| Rep. 1 | 4.0 | 4.5 | 5.5 | 3.0 | 6.0 | 4.0 | 6.0 | 4.5 | 4.5 |
| Rep. 2 | 4.5 | 5.0 | 5.5 | 5.5 | 4.0 | 6.5 | 2.0 | 2.5 | 3.0 |
| Rep. 3 | 3.5 | 3.0 | 5.0 | 5.5 | 5.0 | 6.5 | 6.5 | 5.0 | 3.0 |
| Rep. 4 | 5.0 | 4.5 | 5.0 | 4.5 | 5.0 | 4.5 | 4.0 | 5.0 | 6.5 |
| Average | 4.25 | 4.25 | 5.25 | 4.63 | 5.0 | 5.38 | 4.63 | 4.25 | 4.25 |
| Second Cutting - June 10 | | | | | | | | | |
| Rep. 1 | 8.0 | 6.0 | 5.5 | 3.5 | 5.5 | 5.0 | 5.0 | 5.5 | 3.0 |
| Rep. 2 | 5.5 | 5.5 | 5.0 | 6.5 | 4.0 | 5.5 | 5.0 | 4.0 | 6.0 |
| Rep. 3 | 3.0 | 3.5 | 6.0 | 3.5 | 4.0 | 5.0 | 3.0 | 4.5 | 5.5 |
| Rep. 4 | 5.5 | 5.5 | 5.5 | 4.5 | 4.5 | 4.5 | 5.0 | 6.0 | 4.0 |
| Average | 5.50 | 5.13 | 5.50 | 4.5 | 4.5 | 5.00 | 4.50 | 5.00 | 4.6 |
| Third Cutting - July 14 | | | | | | | | | |
| Rep. 1 | 3.0 | 3.0 | 5.0 | 3.0 | 3.0 | 4.0 | 4.0 | 3.0 | 5.5 |
| Rep. 2 | 4.5 | 8.0 | 5.0 | 3.5 | 2.0 | 7.0 | 2.5 | 4.0 | 6.0 |
| Rep. 3 | 1.5 | 1.5 | 6.0 | 2.0 | 3.0 | 2.5 | 6.0 | 4.0 | 8.5 |
| Rep. 4 | 4.0 | 5.0 | 4.0 | 2.5 | 5.0 | 5.0 | 4.5 | 2.0 | 4.0 |
| Average | 3.25 | 4.38 | 5.0 | 2.75 | 3.25 | 4.63 | 4.25 | 3.25 | 6.00 |
| Fourth Cutting - August 18 - Grams Per Plot | | | | | | | | | |
| Rep. 1 | 13.0 | 18.0 | 22.5 | 20.0 | 21.0 | 27.0 | 13.5 | 18.0 | 21.5 |
| Rep. 2 | 28.0 | 26.5 | 18.5 | 26.5 | 27.0 | 25.0 | 17.0 | 23.0 | 26.0 |
| Rep. 3 | 28.0 | 13.5 | 22.0 | 22.0 | 23.0 | 21.0 | 24.5 | 16.0 | 16.5 |
| Rep. 4 | 21.5 | 21.5 | 27.5 | 23.0 | 18.5 | 27.5 | 20.0 | 11.0 | 19.0 |
| Average | 22.6 | 19.9 | 22.6 | 22.9 | 22.4 | 25.1 | 18.8 | 17.0 | 20.8 |

Table XXXVIII. Summary of Cuttings by Rank of Orchard-Ladino Mixture.

| Treatments | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|-------------|------|------|-------|------|-------|--------|------|-------|--------|
| 1st Cutting | 5 | 5 | 2 | 4 | 3 | 1 | 4 | 5 | 5 |
| 2nd Cutting | 1 | 2 | 1 | 5 | 5 | 3 | 5 | 3 | 4 |
| 3rd Cutting | 6 | 4 | 2 | 7 | 6 | 3 | 5 | 6 | 1 |
| 4th Cutting | 3 | 6 | 3 | 2 | 4 | 1 | 7 | 8 | 5 |
| Ave. Rank | 3.75 | 4.25 | 2.0 | 4.5 | 4.5 | 2.0 | 5.25 | 5.5 | 3.8 |

Table XXXIX. Summary of Three Years Investigation in Tons Per Acre.

| Treatments | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|---------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1958 | 3.47 | 4.27 | 3.97 | 4.05 | 4.00 | 4.14 | 3.96 | 3.64 | 3.92 |
| 1959 | 3.37 | 3.59 | 3.63 | 2.88 | 3.58 | 3.49 | 3.45 | 2.89 | 3.26 |
| 1960 | 2.35 | 2.47 | 2.83 | 2.17 | 2.32 | 2.71 | 2.40 | 2.25 | 2.68 |
| Total Yield | 9.19 | 10.33 | 10.43 | 9.10 | 9.90 | 10.34 | 9.80 | 8.78 | 9.88 |
| Gross In- come | \$183.80 | \$206.60 | \$208.60 | \$182.00 | \$198.00 | \$206.80 | \$196.00 | \$175.60 | \$197.60 |
| Fert. Cost | ----- | 21.00 | 42.00 | 10.80 | 31.80 | 52.80 | 21.60 | 42.60 | 63.60 |
| Gross In- come after Fertilizer | \$183.80 | \$185.56 | \$166.60 | \$171.20 | \$166.20 | \$154.00 | \$174.40 | \$133.00 | \$134.00 |

Table XL. Seasonal Yields of Orchard grass-Birdsfoot Trefoil Mixture in Ounces Per Plot.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|-------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Rep. 1 | 9.4 | 14.5 | 15.7 | 12.3 | 11.4 | 16.4 | 15.1 | 17.0 | 18.9 |
| Rep. 2 | 13.3 | 11.8 | 13.8 | 9.4 | 10.0 | 18.2 | 9.9 | 14.3 | 12.9 |
| Rep. 3 | 14.3 | 11.7 | 14.4 | 10.3 | 10.9 | 18.5 | 13.8 | 10.7 | 16.3 |
| Rep. 4 | 12.4 | 13.7 | 14.8 | 10.7 | 14.1 | 16.7 | 11.7 | 10.9 | 16.2 |
| Average | 12.4 | 12.9 | 14.7 | 10.7 | 11.6 | 17.5 | 12.6 | 13.2 | 16.1 |
| Lbs/acre | 4228 | 4399 | 5013 | 3649 | 3956 | 5968 | 4297 | 4501 | 5490 |
| Tons/acre | 2.114 | 2.199 | 2.507 | 2.825 | 1.978 | 2.984 | 2.149 | 2.250 | 2.745 |
| <u>Economic Data</u> | | | | | | | | | |
| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
| Gross Income | \$42.28 | \$43.99 | \$50.13 | \$36.49 | \$39.56 | \$59.68 | \$42.97 | \$45.01 | \$54.90 |
| Fertilizer Cost | ----- | 7.00 | 14.00 | 3.60 | 10.60 | 17.60 | 7.20 | 14.20 | 21.20 |
| Gross Income after Fertilizer | \$42.28 | \$36.99 | \$36.13 | \$32.89 | \$28.96 | \$42.08 | \$35.77 | \$30.80 | \$23.70 |

Table XLI. Yield Per Cutting of Orchard-Birdsfoot Trefoil Mixture in Ounces Per Plot.

| First Cutting - May 12 | | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|---|------|------|-------|------|-------|--------|------|-------|--------|
| Treatment | 0-0 | | | | | | | | |
| Rep. 1 | 2.0 | 4.0 | 6.0 | 4.0 | 2.5 | 5.0 | 5.0 | 6.0 | 7.0 |
| Rep. 2 | 4.5 | 3.0 | 5.5 | 1.5 | 4.5 | 7.0 | 3.5 | 5.5 | 3.5 |
| Rep. 3 | 5.0 | 3.5 | 5.5 | 2.0 | 3.5 | 8.0 | 5.5 | 4.0 | 5.5 |
| Rep. 4 | 4.0 | 4.0 | 6.0 | 4.0 | 4.5 | 7.0 | 5.0 | 3.5 | 5.0 |
| Average | 3.88 | 3.63 | 5.75 | 2.88 | 3.75 | 6.75 | 4.75 | 4.75 | 5.25 |
| Second Cutting - June 10 | | | | | | | | | |
| Rep. 1 | 3.5 | 5.5 | 5.5 | 3.0 | 4.0 | 4.5 | 3.5 | 6.0 | 6.0 |
| Rep. 2 | 4.0 | 5.0 | 3.5 | 4.0 | 3.5 | 5.5 | 3.0 | 5.0 | 5.5 |
| Rep. 3 | 4.5 | 3.5 | 4.5 | 3.5 | 2.5 | 4.5 | 4.0 | 3.5 | 4.5 |
| Rep. 4 | 3.5 | 5.0 | 5.0 | 3.5 | 5.0 | 5.0 | 3.0 | 3.0 | 4.5 |
| Average | 3.88 | 4.75 | 4.63 | 3.5 | 3.75 | 4.88 | 3.38 | 4.38 | 5.13 |
| Third Cutting - July 14 | | | | | | | | | |
| Rep. 1 | 3.0 | 4.0 | 3.5 | 4.5 | 4.0 | 6.0 | 5.5 | 4.0 | 5.0 |
| Rep. 2 | 4.0 | 3.0 | 4.0 | 3.5 | 1.5 | 5.0 | 2.5 | 3.0 | 3.5 |
| Rep. 3 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 3.5 | 2.5 | 5.5 |
| Rep. 4 | 4.0 | 4.0 | 3.0 | 2.5 | 4.0 | 4.0 | 3.0 | 4.0 | 6.0 |
| Average | 3.75 | 3.75 | 3.63 | 3.63 | 3.38 | 5.00 | 3.63 | 3.38 | 5.00 |
| Fourth Cutting - August 18 in Grams Per Plot | | | | | | | | | |
| Rep. 1 | 24.0 | 26.5 | 17.5 | 21.5 | 24.0 | 24.5 | 29.5 | 26.0 | 25.0 |
| Rep. 2 | 20.5 | 21.5 | 21.5 | 10.0 | 13.5 | 17.5 | 24.0 | 21.0 | 11.0 |
| Rep. 3 | 21.5 | 20.0 | 12.0 | 21.5 | 24.5 | 26.0 | 22.5 | 18.0 | 22.5 |
| Rep. 4 | 24.0 | 18.5 | 21.5 | 18.0 | 16.5 | 18.0 | 20.0 | 10.5 | 18.0 |
| Average | 22.5 | 21.6 | 18.1 | 17.8 | 19.6 | 21.5 | 24.0 | 18.9 | 19.1 |

Table XLIII. Summary of Cuttings by Ranks of Orchard-Birdsfoot Trefoil Mixture.

| Treatments | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|-------------|------|------|-------|------|-------|--------|------|-------|--------|
| 1st Cutting | 5 | 7 | 2 | 8 | 6 | 1 | 4 | 4 | 3 |
| 2nd Cutting | 6 | 3 | 4 | 8 | 7 | 2 | 9 | 5 | 1 |
| 3rd Cutting | 2 | 2 | 3 | 3 | 4 | 1 | 3 | 4 | 1 |
| 4th Cutting | 2 | 3 | 8 | 9 | 5 | 4 | 1 | 7 | 6 |
| Ave. Rank | 3.75 | 3.75 | 4.25 | 7.0 | 5.5 | 2 | 4.25 | 5.0 | 2.75 |

Table XLIII. Summary of Three Years Investigation in Tons Per Acre.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1958 | 2.70 | 2.93 | 3.66 | 2.70 | 3.38 | 3.62 | 3.10 | 3.17 | 3.78 |
| 1959 | 2.89 | 2.59 | 3.11 | 2.43 | 3.62 | 3.06 | 3.28 | 3.18 | 3.21 |
| 1960 | 2.11 | 2.20 | 2.51 | 2.83 | 1.98 | 2.98 | 2.15 | 2.25 | 2.75 |
| Total Yield | 7.70 | 7.72 | 9.28 | 7.96 | 8.98 | 9.66 | 8.53 | 8.60 | 9.74 |
| Gross Income | \$154.00 | \$154.40 | \$185.60 | \$159.20 | \$179.60 | \$193.20 | \$170.60 | \$172.00 | \$194.80 |
| Fert. Cost | ----- | 21.00 | 42.00 | 10.80 | 31.80 | 52.80 | 21.60 | 42.60 | 63.60 |
| Gross Income after Fert. | \$154.00 | \$133.40 | \$143.60 | \$148.40 | \$147.80 | \$140.40 | \$149.00 | \$129.40 | \$131.20 |

Table XLIV. Seasonal Yield of Bluegrass-Ladino Mixture in Ounces Per Plot.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Rep. 1 | 8.4 | 14.6 | 14.2 | 11.3 | 13.4 | 13.6 | 11.9 | 13.4 | 11.8 |
| Rep. 2 | 10.1 | 10.7 | 12.8 | 15.4 | 11.7 | 13.7 | 6.6 | 16.4 | 13.7 |
| Rep. 3 | 11.1 | 13.4 | 11.6 | 10.9 | 14.8 | 10.5 | 13.1 | 10.5 | 14.7 |
| Rep. 4 | 11.3 | 13.5 | 12.6 | 11.7 | 11.2 | 14.9 | 12.9 | 11.5 | 14.3 |
| Average | 10.2 | 13.1 | 12.8 | 12.3 | 12.8 | 13.2 | 11.1 | 13.0 | 13.6 |
| Ibs/Acre | 3478 | 4467 | 4365 | 4194 | 4365 | 4501 | 3785 | 4433 | 4638 |
| Tons/Acre | 1.739 | 2.234 | 2.183 | 2.097 | 2.183 | 2.251 | 1.898 | 2.217 | 2.319 |
| <u>Economic Data</u> | | | | | | | | | |
| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
| Gross Income | \$34.78 | \$44.67 | \$43.65 | \$41.94 | \$43.65 | \$45.01 | \$37.85 | \$44.33 | \$46.38 |
| Fert. Cost | ----- | 7.00 | 14.00 | 3.60 | 10.60 | 17.60 | 7.20 | 14.20 | 21.20 |
| Gross Income After Fert. | \$34.78 | \$37.67 | \$29.65 | \$38.34 | \$33.05 | \$27.41 | \$30.65 | \$30.13 | \$25.18 |

Table XLV. Yield Per Cutting of Bluegrass-Ladino Mixture in Ounces Per Plot.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|---|------|------|-------|------|-------|--------|------|-------|--------|
| <u>First Cutting - May 12</u> | | | | | | | | | |
| Rep. 1 | 2.5 | 2.0 | 2.5 | 1.0 | 2.0 | 1.5 | 1.0 | 2.5 | 1.0 |
| Rep. 2 | 3.0 | 1.5 | 3.0 | 3.5 | 2.5 | 2.5 | 0.3 | 2.5 | 3.0 |
| Rep. 3 | 2.5 | 2.5 | 1.0 | 3.0 | 5.0 | 2.5 | 2.5 | 3.5 | 3.0 |
| Rep. 4 | 1.0 | 1.0 | 1.5 | 3.0 | 0.5 | 4.0 | 2.0 | 2.5 | 4.0 |
| Average | 2.25 | 1.75 | 2.0 | 2.63 | 2.5 | 2.62 | 1.45 | 2.75 | 2.75 |
| <u>Second Cutting - June 10</u> | | | | | | | | | |
| Rep. 1 | 3.0 | 7.0 | 5.5 | 6.0 | 7.0 | 6.5 | 5.0 | 6.0 | 6.0 |
| Rep. 2 | 4.0 | 4.5 | 4.0 | 7.0 | 6.0 | 6.0 | 4.5 | 7.0 | 6.0 |
| Rep. 3 | 4.0 | 7.0 | 6.0 | 4.5 | 5.5 | 4.5 | 4.5 | 4.5 | 7.0 |
| Rep. 4 | 4.5 | 5.5 | 6.0 | 5.0 | 5.0 | 5.0 | 6.0 | 5.5 | 5.0 |
| Average | 3.88 | 6.00 | 5.38 | 5.63 | 5.88 | 5.50 | 5.00 | 5.75 | 6.00 |
| <u>Third Cutting - July 14</u> | | | | | | | | | |
| Rep. 1 | 2.5 | 5.0 | 5.5 | 3.5 | 3.5 | 5.0 | 5.0 | 4.0 | 4.0 |
| Rep. 2 | 2.5 | 4.0 | 5.0 | 4.0 | 2.5 | 4.5 | 1.0 | 6.0 | 4.0 |
| Rep. 3 | 3.5 | 3.0 | 4.0 | 3.0 | 3.5 | 3.0 | 5.0 | 2.0 | 4.0 |
| Rep. 4 | 5.0 | 6.0 | 4.5 | 3.0 | 5.0 | 5.0 | 4.0 | 2.5 | 4.5 |
| Average | 3.38 | 4.50 | 4.75 | 3.38 | 3.63 | 4.38 | 3.75 | 3.63 | 4.13 |
| <u>Fourth Cutting - August 18 in Grams Per Plot</u> | | | | | | | | | |
| Rep. 1 | 9.5 | 16.5 | 20.0 | 21.5 | 23.5 | 16.5 | 24.5 | 25.5 | 21.5 |
| Rep. 2 | 17.0 | 19.0 | 20.5 | 25.0 | 17.5 | 18.5 | 22.5 | 23.5 | 18.5 |
| Rep. 3 | 30.5 | 23.5 | 15.5 | 10.5 | 22.5 | 13.5 | 30.0 | 14.0 | 17.5 |
| Rep. 4 | 20.5 | 28.0 | 16.5 | 18.0 | 20.0 | 24.0 | 24.0 | 27.0 | 21.0 |
| Average | 19.4 | 21.8 | 18.1 | 18.8 | 20.9 | 18.1 | 25.3 | 22.5 | 19.6 |

Table XLVI. Summary of Cuttings by Rank of Bluegrass-Ladino Mixture.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|-------------|-----|------|-------|------|-------|--------|------|-------|--------|
| 1st Cutting | 5 | 7 | 6 | 2 | 4 | 3 | 8 | 1 | 1 |
| 2nd Cutting | 8 | 1 | 6 | 4 | 2 | 5 | 7 | 3 | 1 |
| 3rd Cutting | 7 | 2 | 1 | 7 | 6 | 3 | 5 | 6 | 4 |
| 4th Cutting | 6 | 3 | 8 | 7 | 4 | 8 | 1 | 2 | 5 |
| Ave. Rank | 6.5 | 3.25 | 5.25 | 5.0 | 4.0 | 4.75 | 5.25 | 3.00 | 2.75 |

Table XLVII. Summary of Three Years Investigation.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1958 | 3.28 | 3.90 | 4.07 | 3.18 | 3.99 | 3.89 | 3.73 | 3.23 | 3.37 |
| 1959 | 3.37 | 3.39 | 3.40 | 3.17 | 3.65 | 3.71 | 3.62 | 3.66 | 3.43 |
| 1960 | 1.74 | 2.23 | 2.18 | 2.10 | 2.18 | 2.25 | 1.90 | 2.22 | 2.32 |
| Total Yield | 8.39 | 9.52 | 9.65 | 8.45 | 9.82 | 9.85 | 9.25 | 9.11 | 9.12 |
| Gross Return | \$167.80 | \$190.40 | \$193.00 | \$169.00 | \$196.40 | \$197.00 | \$185.00 | \$182.20 | \$182.40 |
| Fert. Cost | ----- | 21.00 | 42.00 | 10.80 | 31.80 | 52.80 | 21.60 | 42.60 | 63.60 |
| Gross Income After Fert. | \$167.80 | \$169.40 | \$151.00 | \$158.20 | \$164.60 | \$144.20 | \$163.40 | \$139.60 | \$118.80 |

Table XLVIII. Yields of Each Mixture by Fertility Levels Over Three Year Period.

| Treatment | 0-0 | 50-0 | 100-0 | 0-40 | 50-40 | 100-40 | 0-80 | 50-80 | 100-80 | Ave. |
|-----------------------|------|-------|-------|------|-------|--------|------|-------|--------|------|
| Orchard- Ladino | 9.19 | 10.33 | 10.43 | 9.10 | 9.90 | 10.34 | 9.80 | 8.78 | 9.88 | 9.75 |
| Orchard- Birdsfoot | 7.70 | 7.72 | 9.28 | 7.96 | 8.98 | 9.66 | 8.53 | 8.60 | 9.74 | 8.69 |
| Bluegrass- Ladino | 8.39 | 9.52 | 9.65 | 8.45 | 9.82 | 9.85 | 9.25 | 9.11 | 9.12 | 9.24 |
| Average | 8.43 | 9.19 | 9.78 | 8.50 | 9.57 | 9.95 | 9.19 | 8.83 | 9.58 | 9.23 |

Table XLIX. Sixteen Fertilizer Treatments on Alfalfa-Orchard Grass Hay - Ravalli County.

| | OUNCES PER PLOT | | | | | | | | | | |
|--------------------------|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | 0-0 | 0-80 | 33-0 | 33-80 | 33-160 | 33-240 | 0-160 | 66-0 | 66-80 | 66-160 | 66-240 |
| Rep. 1 | 13.50 | 10.93 | 12.01 | 9.41 | 10.70 | 10.88 | 12.35 | 12.75 | 10.94 | 12.71 | 12.04 |
| Rep. 2 | 11.03 | 10.66 | 10.23 | 10.63 | 12.97 | 11.86 | 9.96 | 11.94 | 9.58 | 9.69 | 13.39 |
| Rep. 3 | 10.97 | 10.71 | 10.21 | 8.73 | 12.56 | 8.29 | 9.20 | 11.76 | 11.64 | 9.42 | 13.43 |
| Rep. 4 | 9.04 | 8.22 | 11.65 | 8.55 | 9.46 | 7.46 | 9.74 | 8.32 | 10.26 | 9.91 | 10.12 |
| T/Acre | 11.14 | 10.13 | 11.03 | 9.33 | 11.42 | 9.62 | 10.30 | 11.19 | 10.60 | 10.40 | 12.25 |
| Gross Income | 4.04 | 3.68 | 4.00 | 3.39 | 4.15 | 3.49 | 3.74 | 4.06 | 3.85 | 3.78 | 4.45 |
| Fert. Cost | \$80.80 | \$73.60 | \$80.00 | \$67.80 | \$83.00 | \$69.80 | \$74.80 | \$81.20 | \$77.00 | \$75.60 | \$89.00 |
| Gross Income After Fert. | ----- | ----- | 4.62 | 4.62 | 4.62 | 4.62 | ----- | 9.24 | 9.24 | 9.24 | 9.24 |
| | \$80.80 | \$73.60 | \$75.38 | \$63.18 | \$78.38 | \$65.18 | \$74.80 | \$71.96 | \$67.76 | \$66.36 | \$79.76 |

(Con't.)

Continued --

| | OUNCES PER PLOT | | | | | |
|--------------------------|-----------------|---------|---------|---------|---------|--|
| | 0-240 | 99-0 | 99-80 | 99-160 | 99-240 | |
| Rep. 1 | 11.56 | 11.55 | 12.25 | 12.08 | 11.48 | |
| Rep. 2 | 13.09 | 10.53 | 9.93 | 13.98 | 12.59 | |
| Rep. 3 | 12.75 | 10.50 | 10.60 | 10.91 | 10.46 | |
| Rep. 4 | 9.25 | 9.59 | 11.88 | 11.95 | 7.14 | |
| T/Acre | 11.66 | 10.54 | 11.17 | 12.25 | 10.42 | |
| Gross Income | 4.23 | 3.82 | 4.05 | 4.45 | 3.78 | |
| Fert. Cost | \$84.80 | \$76.40 | \$81.00 | \$89.00 | \$75.60 | |
| Gross Income After Fert. | ----- | 13.86 | 13.86 | 13.86 | 13.86 | |
| | \$84.80 | \$62.54 | \$67.14 | \$75.14 | \$61.74 | |

Table L. Sixteen Fertilizer Treatments on Alfalfa-Orchard Grass Hay - Ravalli County.

| Treatment | Rep. 1 | Rep. 2 | Rep. 3 | Rep. 4 | Ave. | Rank |
|------------------------|--------|--------|--------|--------|------|------|
| <u>OUNCES PER PLOT</u> | | | | | | |
| <u>First Cutting</u> | | | | | | |
| 0-0 | 8.79 | 6.64 | 6.48 | 5.39 | 6.83 | 4 |
| 0-80 | 5.17 | 5.80 | 5.91 | 3.74 | 5.16 | 15 |
| 33-0 | 7.13 | 6.29 | 5.70 | 6.65 | 6.44 | 9 |
| 33-80 | 5.26 | 6.13 | 4.99 | 4.51 | 5.22 | 14 |
| 33-160 | 5.58 | 8.18 | 7.88 | 5.31 | 6.74 | 6 |
| 33-240 | 6.61 | 6.73 | 4.69 | 3.56 | 5.40 | 13 |
| 0-160 | 6.86 | 5.08 | 5.05 | 5.43 | 5.61 | 12 |
| 66-0 | 7.31 | 7.31 | 6.67 | 4.86 | 6.54 | 7 |
| 66-80 | 7.04 | 4.99 | 7.54 | 5.75 | 6.33 | 11 |
| 66-160 | 8.38 | 5.74 | 5.26 | 6.20 | 6.40 | 10 |
| 66-240 | 6.56 | 7.50 | 7.70 | 5.47 | 6.81 | 5 |
| 0-240 | 6.61 | 7.46 | 7.22 | 4.64 | 6.48 | 8 |
| 99-0 | 6.17 | 6.40 | 6.01 | 4.96 | 5.89 | 2 |
| 99-80 | 8.55 | 5.71 | 6.09 | 7.02 | 6.84 | 3 |
| 99-160 | 8.00 | 8.47 | 5.99 | 6.80 | 7.31 | 1 |
| 99-240 | 7.67 | 7.44 | 6.08 | 4.40 | 6.40 | 10 |
| <u>Second Cutting</u> | | | | | | |
| 0-0 | 4.71 | 4.39 | 4.49 | 3.65 | 4.31 | 10 |
| 0-80 | 5.76 | 4.86 | 4.88 | 4.48 | 5.00 | 3 |
| 33-0 | 4.88 | 3.94 | 4.51 | 5.00 | 4.58 | 8 |
| 33-80 | 4.15 | 4.50 | 3.74 | 4.04 | 4.11 | 12 |
| 33-160 | 5.12 | 4.79 | 4.68 | 4.15 | 4.69 | 6 |
| 33-240 | 4.27 | 5.13 | 3.68 | 3.90 | 4.25 | 12 |
| 0-160 | 5.49 | 4.88 | 4.15 | 4.31 | 4.71 | 5 |
| 66-0 | 5.44 | 4.63 | 5.09 | 3.46 | 4.66 | 7 |
| 66-80 | 3.90 | 4.59 | 4.10 | 4.51 | 4.28 | 11 |
| 66-160 | 4.33 | 3.95 | 4.16 | 3.71 | 4.04 | 13 |
| 66-240 | 5.48 | 5.89 | 5.73 | 4.65 | 5.44 | 1 |
| 0-240 | 4.95 | 5.63 | 5.53 | 4.61 | 5.18 | 2 |
| 99-0 | 5.38 | 4.13 | 4.49 | 4.63 | 4.66 | 7 |
| 99-80 | 3.70 | 4.22 | 4.51 | 4.86 | 4.32 | 9 |
| 99-160 | 4.08 | 5.51 | 4.92 | 5.15 | 4.92 | 4 |
| 99-240 | 3.81 | 5.15 | 4.38 | 2.74 | 4.02 | 14 |

Table LI. Two-Year Summary of Sixteen Fertilizer Treatments on Alfalfa-Orchard Grass Hay - Ravalli County.

| | 1959 | Rank | 1960 | Rank | Total | Gross Return | Cost of Fert. | |
|--------|------|------|------|------|-------|--------------|---------------|----------|
| 0-0 | 4.3 | 10 | 4.0 | 4 | 8.3 | \$166.00 | --- | \$166.00 |
| 0-80 | 4.7 | 7 | 3.7 | 5 | 8.4 | 168.00 | \$ 7.20 | 160.80 |
| 33-0 | 4.71 | 6 | 4.0 | 4 | 8.71 | 174.20 | 9.24 | 164.96 |
| 33-80 | 4.97 | 4 | 3.4 | 7 | 8.37 | 167.40 | 16.44 | 150.96 |
| 33-160 | 4.86 | 6 | 4.2 | 2 | 9.06 | 181.20 | 23.64 | 157.56 |
| 33-240 | 4.86 | 6 | 3.5 | 6 | 8.36 | 167.20 | 30.84 | 136.36 |
| 0-160 | 4.2 | 11 | 3.7 | 5 | 7.90 | 158.00 | 14.40 | 143.60 |
| 66-0 | 5.04 | 3 | 4.1 | 3 | 9.14 | 182.80 | 18.48 | 164.32 |
| 66-80 | 5.04 | 3 | 3.9 | 5 | 8.94 | 178.80 | 25.68 | 153.12 |
| 66-160 | 5.08 | 2 | 3.8 | 4 | 8.88 | 177.60 | 32.88 | 144.72 |
| 66-240 | 4.9 | 5 | 4.5 | 1 | 9.40 | 188.00 | 40.80 | 147.20 |
| 0-240 | 4.39 | 9 | 4.2 | 2 | 8.59 | 171.80 | 21.60 | 150.20 |
| 99-0 | 4.68 | 8 | 3.8 | 4 | 8.48 | 169.60 | 27.72 | 141.88 |
| 99-80 | 4.9 | 5 | 4.1 | 3 | 9.00 | 180.00 | 34.92 | 145.08 |
| 99-160 | 5.08 | 2 | 4.5 | 1 | 9.58 | 191.60 | 42.12 | 149.48 |
| 99-240 | 5.3 | 1 | 3.8 | 4 | 9.10 | 182.00 | 49.32 | 132.68 |

Soil Test:

pH - 7.5

P₂O₅ - 35# per acre where 30# P₂O₅ is adequate.

O.M. - 5% where 3% is considered adequate.

TITLE: Response of Alfalfa to Gypsum in Northwestern Montana

PROJECT NUMBER: 5020

PERSONNEL: Don Graham

FUNDS: State

DURATION: Three Years

INTRODUCTION

Limited investigations by the Northwest Branch Station has indicated that only in very scattered areas of Western Montana does alfalfa respond to applications of gypsum. However, when responses have been noted, they are highly economical.

The objective of this study is to adequately define areas where gypsum responses occur in order to establish accurate recommendations. A study of soil samples from each trial will aid in refining a sulfur soil test, which is being devised at Montana State College.

MATERIALS AND METHODS

In each of about fifty locations on established alfalfa fields, 300 pounds of gypsum was broadcasted in 8 x 100 ft. strips. In twelve of these locations, a strip of 600 pounds of super phosphate was also applied.

These trials are not intended to give detailed information, but only to define areas where more detailed experiments will be carried out.

A breakdown of the trials into counties and communities will follow the Results and Discussion.

RESULTS AND DISCUSSION

Probably due to an extremely dry year, very little response was observed the first year.

No location appeared to respond at the time of the first cutting about June 15 and only four locations showed a response by August 10. These were locations Flathead 5, 14, 18, and Lake 8.

Location Flathead 5 showed a very good response to both the gypsum and the phosphorous strips, while location Flathead 14 showed only a response to phosphorous.

Location Flathead 18 showed a good response in height and leafiness to gypsum and location Lake 8 more than doubled yields by the use of gypsum. Yield data will be collected from three locations within and three locations adjacent to each strip to determine the response to gypsum. Soils samples will also be taken and utilized in the establishment of a sulfur soil test.

Breakdown of Counties and Communities:
Flathead County

| <u>No.</u> | <u>Community</u> | <u>Legal Description</u> | <u>Soil Type, if known</u> |
|------------|------------------|--|--|
| 1 | Swan River | T27N R19W NE corner Sec 19 | Haskill fine sand |
| 2 | Swan River | T27N R19W SW corner SE $\frac{1}{4}$ Sec 18 | Haskill fine sand |
| 3 | Swan River | T27N R19W NW corner Sec 22 | Radnor silt loam |
| 4 | Swan River | T27N R20W SW corner Sec 13 | Blanchard loamy fine sand |
| 5 | Creston | T27N R20W SE corner NW $\frac{1}{4}$ Sec 3 | Swims silty clay loam |
| 6 | Creston | T28N R20W NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec 10 | Flathead fine sandy loam |
| 7 | Egan | T28N R21W SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec 14 | Swims silt loam |
| 8 | Lower Valley | T27N R20W SW corner Sec 16 | Somers silty clay loam |
| 9 | Lower Valley | T27N R20W W $\frac{1}{4}$ corner Sec 9 | Somers silty clay loam |
| 10 | Lower Valley | T27N R21W center Sec 12 | Tuffit-Somers silty clay loam |
| 11 | Kalispell | T28N R21W NW corner Sec 21 | Kalispell-Demers silt loam |
| 12 | Deer Park | T29W R20W NW $\frac{1}{4}$ Sec 9 | Flathead very fine sandy loam |
| 13 | Bad Rock | T30N R20W SW $\frac{1}{4}$ Sec 20 | Blanchard loamy fine sand |
| 14 | LaSalle | T30N R21W SW corner Sec 25 | Swims silt loam |
| 15 | Half Moon | T30N R21W SE corner Sec 10 | Half Moon very fine sandy loam |
| 16 | Whitefish | T30N R21W NW corner Sec 16 | Half Moon-Haskill complex |
| 17 | Whitefish | T30N R22W SE corner Sec 1 | Half Moon silt loam |
| 18 | Whitefish | T30N R22W E $\frac{1}{4}$ corner Sec 13 | Whitefish gravelly silt loam |
| 19 | Stillwater | T30N R22W SW $\frac{1}{4}$ Sec 34 | Depew silty clay loam |
| 20 | Stillwater | T29N R22W N $\frac{1}{4}$ corner Sec 9 | Yeoman gravelly loam moderate deep over sand |
| 21 | Stillwater | T29N R22W NE corner Sec 10 | Depew silty clay loam |
| 22 | Stillwater | T29N R22W NW corner Sec 35 | Kalispell loam |
| 23 | Stillwater | T29N R22W SW corner Sec 22 | Kalispell loam |
| 24 | Kalispell | T29N R21W NW corner Sec 30 | Kalispell loam |

Continued -----

Breakdown of Counties and Communities - Continued

Lake County

| <u>No.</u> | <u>Community</u> | <u>Legal Description</u> | <u>Soil Type, if known</u> |
|------------|------------------|---|-------------------------------|
| 1 | Arlee | T16N R19W W $\frac{1}{4}$ corner Sec 12 | Hyrum gravelly loam |
| 2 | Arlee | T17N R20W SE $\frac{1}{4}$ Sec 21 | Trenton very fine sandy loam |
| 3 | St. Ignatius | T18N R20W NE $\frac{1}{4}$ Sec 28 | Lonepine very fine sandy loam |
| 4 | St. Ignatius | T19N R20W W $\frac{1}{4}$ corner Sec 29 | Post gravelly silty clay loam |
| 5 | Moiese | T19N R20W SW $\frac{1}{4}$ Sec 30 | Post clay loam |
| 6 | Charlo | T20N R21W S $\frac{1}{4}$ corner Sec 36 | Lonepine very fine sandy loam |
| 7 | Ronan | T21N R20W SE $\frac{1}{4}$ Sec 25 | Flathead fine sandy loam |
| 8 | Pablo | T21N R19W W $\frac{1}{4}$ corner Sec 17 | McDonald gravelly loam |
| 9 | Pablo | T22N R19W NW $\frac{1}{4}$ Sec 28 | Hyrum gravelly loam |
| 10 | Pablo | T22N R19W NW $\frac{1}{4}$ Sec 31 | Hyrum gravelly loam |
| 11 | Valley View | T22N R20W NE $\frac{1}{4}$ Sec 30 | Millville loam |
| 12 | Valley View | T22N R21W S $\frac{1}{4}$ corner Sec 24 | Millville loam |
| 13 | Valley View | T22N R21W SE $\frac{1}{4}$ Sec 22 | Flathead fine sandy loam |
| 14 | Round Butte | T21N R21W SE $\frac{1}{4}$ Sec 25 | Lonepine silt loam |
| 15 | Round Butte | T21N R20W SW $\frac{1}{4}$ Sec 19 | Lonepine silt loam |

Ravalli County

| | | | |
|---|------------|-----------------------------------|---------------------------------|
| 1 | Grantsdale | T15N R20W SE $\frac{1}{4}$ Sec 5 | Grantsdale loam |
| 2 | Victor | T 7N R21W Sec 36 | Slocum loam slightly saline |
| 3 | Corvallis | T 7N R20W SW $\frac{1}{4}$ Sec 27 | Burnt Forks loam |
| 4 | Corvallis | T 7N R20W SW $\frac{1}{4}$ Sec 23 | Burnt Forks loam gently sloping |
| 5 | Corvallis | T 6N R20W SE $\frac{1}{4}$ Sec 5 | Hamilton silt loam |
| 6 | Corvallis | Vern Jenkins farm | |
| 7 | Corvallis | Moore farm | |
| 8 | Corvallis | Talbot farm | |
| 9 | Corvallis | Dave Huls farm | |

TITLE: Nitrogen Fertilization of Irrigated Corn

PROJECT NUMBER: 5020

LEADER: Don Graham

DURATION: Two Years

LOCATION: Y

INTRODUCTION

The purpose of this study was to determine the optimum rates of Nitrogen and Phosphorous fertilizers for irrigated corn and to compare yield and fertilizer responses of an early and a medium maturity corn variety.

MATERIALS AND METHODS

Sixteen fertilizer rates in three replications was broadcasted on Creston silt loam and worked in before planting two trials, one using Early Silobred corn and the other one using Northrup King Hybrid **KT-MS** corn.

Average yields for all plots in each trial show that the early variety out-produced the later one in total dry matter. However, the early variety produced 10.08 tons of silage while the late variety produced 11.08 tons average for all plots.

No significant yield response was obtained in the early corn trial, while several rates showed significant responses using a later variety of corn.

Table LII. Percent Dry Matter at Harvest of a Late and Early Maturing Corn Variety Under Sixteen Fertilizer Treatments.

| Treatment N P | Early Corn | | | Percent Dry Matter Average | Late Corn | | | Ave. |
|------------------|------------|-------|---------|----------------------------------|-----------|---------|-------|------|
| | I | II | III | | I | II | III | |
| | 0 | 22.43 | 18.49 | | 15.09 | 18.67 | 12.92 | |
| 50 | 15.55 | 14.92 | 16.22 | 15.56 | 8.59 | 13.45 | 11.75 | |
| 100 | 12.88 | 22.52 | 16.16 | 17.19 | 14.04 | 13.28 | 13.24 | |
| 150 | 15.58 | 14.77 | 13.19 | 14.51 | 11.87 | 12.44 | 11.87 | |
| 200 | 16.34 | 13.70 | 14.21 | 14.75 | 13.81 | 10.74 | 11.57 | |
| 0 | 18.33 | 15.77 | 14.28 | 16.13 | 14.54 | 14.10 | 14.24 | |
| 50 | 12.13 | 12.89 | 14.93 | 13.32 | 21.10 | 18.33 | 17.25 | |
| 100 | 15.13 | 14.27 | 14.74 | 14.71 | 12.86 | 11.94 | 12.71 | |
| 150 | 16.67 | 12.96 | ----- | 14.82 | 14.31 | 15.96 | 14.31 | |
| 200 | 16.74 | 18.07 | 14.11 | 16.30 | 13.36 | 12.71 | 14.71 | |
| 0 | 15.63 | 16.84 | 13.88 | 15.45 | 13.50 | 11.73 | 13.07 | |
| 50 | 14.50 | 14.35 | 18.62 | 15.82 | 12.87 | 12.16 | 12.93 | |
| 100 | 13.24 | 12.43 | 15.06 | 13.58 | 12.80 | 14.97 | 13.56 | |
| 150 | 14.51 | 12.92 | 9.84 | 12.42 | 13.24 | 13.64 | 13.32 | |
| 200 | 14.09 | 15.19 | 12.91 | 14.06 | 13.08 | 14.25 | 13.89 | |
| 100 | 13.44 | 20.29 | 13.74 | 15.82 | 12.33 | 13.36 | 13.72 | |
| | | | Average | 15.19 | | Average | 13.44 | |

*. 60 pounds K₂O also applied.

Table LIII. Corn Fertility -- Late Variety

| Pounds/Acre of Treatment | Plot Yield in Pounds | | | | Total Lbs. | Tons /Acre | Rank | \$5.90/T Silage Gross Return | Fert. Cost | Gross Return After Fert. | Gain or Loss |
|--------------------------|----------------------|-------|-------|---------|------------|------------|----------|------------------------------|------------|--------------------------|--------------|
| | I | II | III | III | | | | | | | |
| 0 | 19.96 | 20.56 | 11.25 | 51.77 | 3.52 | 16 | \$ 62.30 | \$ --- | \$62.30 | \$ --- | |
| 50 | 14.95 | 24.16 | 17.89 | 57.00 | 3.88 | 14 | 68.68 | 7.00 | 61.68 | -.62 | |
| 100 | 25.83 | 22.19 | 19.26 | 67.28 | 4.58 | 7 | 81.07 | 14.00 | 67.07 | + 4.77 | |
| 150 | 23.27 | 20.89 | 14.93 | 59.09 | 4.02 | 11 | 71.15 | 21.00 | 50.15 | -12.15 | |
| 200 | 23.20 | 16.56 | 17.51 | 57.27 | 3.90 | 13 | 69.03 | 28.00 | 41.03 | -21.27 | |
| 0 | 26.90 | 21.82 | 20.45 | 69.17 | 4.71 | 6 | 83.37 | 4.50 | 78.87 | +16.57 | |
| 50 | 37.35 | 22.18 | 32.26 | 91.79 | 6.25* | 1 | 110.63 | 11.50 | 99.13 | +36.83 | |
| 100 | 23.53 | 22.93 | 19.10 | 65.56 | 4.46 | 9 | 78.94 | 18.50 | 60.44 | - 1.86 | |
| 150 | 22.18 | 22.91 | 28.25 | 73.34 | 4.99* | 2 | 88.32 | 25.50 | 62.82 | .52 | |
| 200 | 24.85 | 24.91 | 23.26 | 73.02 | 4.97* | 4 | 87.97 | 32.50 | 55.47 | - 6.83 | |
| 0 | 20.93 | 17.49 | 17.13 | 55.55 | 3.78 | 15 | 66.91 | 9.00 | 57.91 | - 4.39 | |
| 50 | 23.17 | 23.38 | 12.65 | 59.20 | 4.03 | 10 | 71.33 | 16.00 | 55.33 | - 6.97 | |
| 100 | 22.66 | 22.35 | 25.60 | 70.61 | 4.81* | 5 | 85.14 | 23.00 | 62.14 | -.16 | |
| 150 | 23.83 | 23.69 | 18.96 | 66.48 | 4.52 | 8 | 80.00 | 30.00 | 50.00 | 12.30 | |
| 200 | 23.68 | 26.65 | 22.80 | 73.13 | 4.98* | 3 | 88.15 | 37.00 | 51.15 | 11.15 | |
| 100 | 20.22 | 22.43 | 15.77 | 58.42 | 3.98 | 12 | 70.45 | | | | |
| | | | | Average | 4.46 | | | | | | |

* Significant at 5%

** 60 pounds K₂O also applied

Table LIV. Corn Fertility Trial - Early Variety

| Pounds/Acre of Treatment | Dry Weight Plot Yields in Pounds | | | Total Pounds/Acre | Tons/Acre | Rank | Gross Return | Fert. Cost | Gross Return After Fert. | Gain or Loss | |
|--------------------------|----------------------------------|-------------------------------|-------|-------------------|-----------|------|--------------|------------|--------------------------|--------------|----|
| | N | P ₂ O ₅ | I | | | | | | | | II |
| 0 | 0 | 22.09 | 23.29 | 23.24 | 68.62 | 4.67 | \$82.66 | \$ --- | \$82.66 | \$ --- | |
| 50 | 0 | 18.43 | 22.09 | 20.11 | 60.63 | 4.13 | 73.10 | 7.00 | 66.10 | -16.56 | |
| 100 | 0 | 18.35 | 34.57 | 22.30 | 75.40 | 5.13 | 90.80 | 14.00 | 76.80 | - 5.86 | |
| 150 | 0 | 24.07 | 23.26 | 20.58 | 67.91 | 4.62 | 81.77 | 21.00 | 60.77 | -21.89 | |
| 200 | 0 | 20.75 | 20.21 | 20.25 | 61.21 | 4.17 | 73.81 | 28.00 | 45.81 | -36.85 | |
| 0 | 50 | 19.25 | 23.81 | 20.28 | 63.34 | 4.31 | 76.29 | 4.50 | 71.79 | -10.87 | |
| 50 | 50 | 16.98 | 20.69 | 23.59 | 61.26 | 4.17 | 73.81 | 11.50 | 62.31 | -20.35 | |
| 100 | 50 | 20.80 | 20.98 | 24.98 | 66.76 | 4.55 | 80.54 | 18.50 | 62.04 | -20.62 | |
| 150 | 50 | 23.75 | 19.96 | 23.26 | 66.97 | 4.56 | 81.71 | 25.50 | 56.21 | -26.45 | |
| 200 | 50 | 27.12 | 26.83 | 22.36 | 76.31 | 5.19 | 91.86 | 32.50 | 59.36 | -23.30 | |
| 0 | 100 | 24.46 | 26.02 | 21.10 | 71.58 | 4.87 | 86.20 | 9.00 | 77.20 | - 5.46 | |
| 50 | 100 | 20.74 | 21.45 | 31.10 | 73.29 | 4.99 | 88.32 | 16.00 | 72.32 | -10.34 | |
| 100 | 100 | 18.41 | 20.39 | 24.47 | 63.27 | 4.31 | 76.29 | 23.00 | 53.29 | -29.37 | |
| 150 | 100 | 22.05 | 19.96 | 15.05 | 57.06 | 3.88 | 68.68 | 30.00 | 38.68 | -43.98 | |
| 200 | 100 | 21.77 | 18.46 | 21.50 | 61.73 | 4.20 | 74.34 | 37.00 | 37.34 | -45.32 | |
| 100 | 50* | 21.10 | 29.42 | 21.23 | 71.75 | 4.87 | 86.20 | | | | |
| Average | | | | | | 4.54 | | | | | |

* 60 pounds K₂O also applied

No significant responses