Trader's Dispatch

Figure 1

To fallow or not to fallow: An innovative and unique experiment at the WTARC

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"To be, or not to be…" Shakespeare wrote in the opening statement of Hamlet, his famous play. Prince Hamlet contemplates death and suicide while waiting for Ophelia, the love of his life. Exactly four centuries later, this year, Montana grain farmers face a different kind of existential question: "to fallow, or not to fallow" the land after lentils, peas, or chickpeas.

In Montana, the question is less philosophical than agro-ecological and economical. Primarily due to low annual quantity and poor distribution of precipitations, dryland crop production risk in Montana is high. With annual average precipitation oscillating between 12-14 inches, most of the soil water storage is depleted after a single crop has been grown. Confronted with this reality, Winter wheat-fallow agricultural systems have been widely adopted to reduce the risk of crop failure. No-till combined with the fallow system ("Chemfallow") allows the conservation of water that had been stored in the soil profile. However, reduced risk goes along with reduced profit potential. The issue is the perception by the producer that leaving land fallowed is required to store soil moisture rather than grow crops. This perception stems from cases of pulse failure across Montana attributed to severe atmospheric (solar radiation, heat, precipitation) and soil (moisture, temperature) climate conditions. However, there are economic

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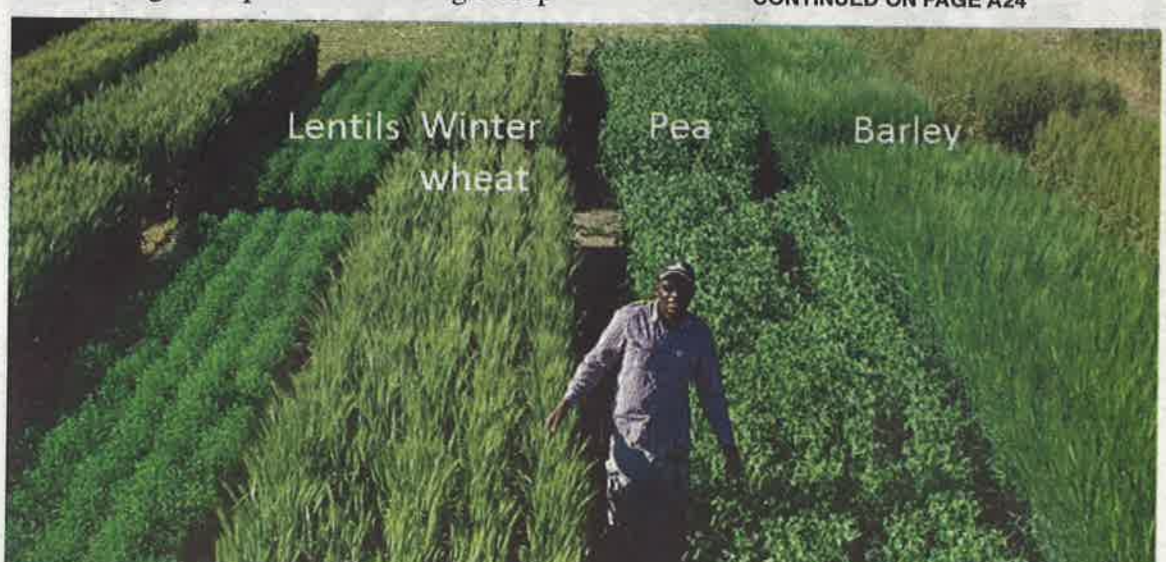

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and environmental costs attached to fallowing: labor, fuel, and herbicide expenses may be aggravated by loss of top soil through wind and water erosion. Although in many instances, crop-fallow is unavoidable (e.g., shallow soils, extremely low annual precipitations), it is not always the case. Geographic regions with substantial annual precipitations and deeper soils that could hold more water may be suited to continuous spring and fall cropping. The intensification of cropping systems based on winter wheat offers the potential for increased profitability while increasing farmers' risk as well. The questions are therefore: when can farmers skip the fallow without substantially increasing the risk of crop failure? What tool, if any, can they use to help them make that decision? Which crops should be included in the rotation?

Pulse crop production is soaring in Montana thanks to economic and environmental drivers. Access to Indian and Chinese markets, development of local processing facilities, and favorable farm bills (2002, 2014). Peas, lentils, and chickpeas (garbanzo beans) are cool-season crops well adapted to the semi-arid climate of Montana. They have beginning of the spring cropping season, but enough rain during the growing season to sustain both spring and winter growing seasons. This might be the scenario in central and eastern Montana in 2016. Precipitations were scarce in April, and producers feared a year of drought. Then May and June received substantial amount of snow and rains. The amount of rain during the growing season is another variable to account for. It is therefore critical to develop a more accurate tool that would help producers in answering the question "to fallow or not to fallow".

It is precisely the goal that Dr Roger Ondoua, MSU's Assistant Professor of Agronomy and Nutrient Management has set last fall: develop an accurate decision-aid tool that accounts for soil moisture, evapotranspiration, and the amount of precipitation during the growing season. To meet this goal, an original and innovative experiment was set up in the fall 2015 at the Western Triangle Agricultural Research Center in Conrad (Figure 1). The trial consisted of five strips of land (T_1, T_2, T_3, T_4, T_5) whose soil profiles had been recharged in August 2015 with five different levels of soil moisture us- a relatively shallower rooting system that prevent them from depleting soil moisture in the subsoil, hence mitigating the competition for soil moisture with the succeeding winter wheat. Furthermore, they can capture nitrogen from the air and return it to the soil, break the cycle of pests and diseases, and last but not the least, pulse crops can mitigate the buildup of grassy weeds (cheat grass, wild oat, goat grass, foxtail, etc…) in cereal production.

Historically, producers have used empirical tools such as soil probe to help them decide whether or not to skip the summer fallow. A hand-held probe is driven into the soil by the operator with the assumption that the deeper it goes into the ground, the wetter the soil is. The tool, although sometimes useful, lacks great accuracy because the depth of penetration of the instrument into the soil doesn't depend uniquely on soil wetness. Other factors such as the operator's strength, and the texture and structure of the soil will influence the depth of penetration of the probe. Moreover, all the moisture in the soil profile at the onset of the growing season will not necessarily be available to the crop. Some of it may be lost through soil evaporation which depends on atmospheric factors such as solar radiation, ambient temperature, relative humidity, and wind. Conversely, there might not be enough moisture at the ing an irrigation gradient method. In each of the five strip, winter wheat (cv Yellowstone) plots were seeded in September 2015; while pea (cv Aragon), lentils (cv CDC Richlea)), and barley (cv Merit 57) plots were planted in four replicates in April 2016 (Figure 2). Preliminary results show that grain yields of lentils, pea, and winter wheat parallel the soil water content in the 0-4 feet soil profile (Figure 3). Pea and lentils grain yields increase with each percentage increment of soil moisture, whereas for barley and winter wheat, results suggest that yield increases with soil moisture in the 0-4 feet soil profile until the threshold of 20% and 22% (respectively) of soil dry weight is reached, which results in the decrease of barley and winter wheat grain yields.

The crop sequences pea-winter wheat, lentil-winter wheat, and barley-winter wheat will be evaluated for total yields and proteins in the summer 2017. The agrometeorological model that will be developed will help establish a tool that farmers would use to predict whether or not the winter wheat that follows a pulse crop or barley sown in the previous spring would be financially successful. To meet this goal, Dr Roger Ondoua has hired a crop modeler, Dr Maral Etesami whose role will be to adapt multivariate and cropping systems analysis to Montana ecosystems.

Figure 3