Impact of herbicide overuse on insect pests and their natural enemies in no-till farming

By Anamika Sharma, Gadi V.P. Reddy, Western Triangle Agricultural Research Center, Montana State University, Conrad, MT; and Prashant Jha, Southern Agricultural Research Center, Montana State University, Huntley, MT

No-till farming is common in dryland production systems in the Golden Triangle area of Montana and is greatly recognized for improved soil moisture conservation, crop productivity, and improved soil health. However, this system often requires greater use of herbicides to control weeds. Most common weeds in this area include: perennial sowthistle, western salsify, shepherd's purse, field pennycress, common lambsquarters, kochia, Russian thistle, bindweed, wild buckwheat, wild oat, downy brome, and Persian darnel. Glyphosate (Roundup), dicamba (Banvel/Clarity), fluroxypyr (Starane), 2,4-D, sulfonylurea (SU, and pinoxaden (Axial) are the most commonly used herbicides for weed control in this region. In Montana, herbicide resistance to one or more of the herbicide groups have been confirmed in kochia, wild oat, Persian darnel, Russian thistle, and downy brome populations in the predominantly no-till, agronomic production fields. Glyphosate and dicamba multiple-resistant kochia is an increasing concern for growers in this region.

Herbicides are the most commonly applied pesticides in agro-ecosystems, and their overuse may pose significant adverse impacts on beneficial insects and environment. Nevertheless, the use of herbicides has increased many folds in last two decades. Other than killing unwanted plants (weeds), herbicides pose unintended consequences of injuring non-target plants. Herbicide drift as spray-particle drift or vapor drift and herbicide-contaminated soil are major causes of injury to non-target plants. Farmers are also concerned about the herbicide carryover. This may happen due to soil-residual activity of some herbicides used for weed control in agronomic crops. Injury due to residual herbicides can also be responsible for drastic crop yield losses, such as in canola crop due to 2,4-D, or in pulse crops due to carryover of certain Group 2 sulfonylurea herbicides applied in wheat. Stunting, malformation and chlorosis are some of the symptoms in crop plants that may be associated with herbicide carryover. Another source of crop injuries could be the presence of herbicide residues in manure, compost, or hay. Contaminated manure produced by animals fed on the herbicide-treated hay can be a potential concern for gardeners and organic producers.

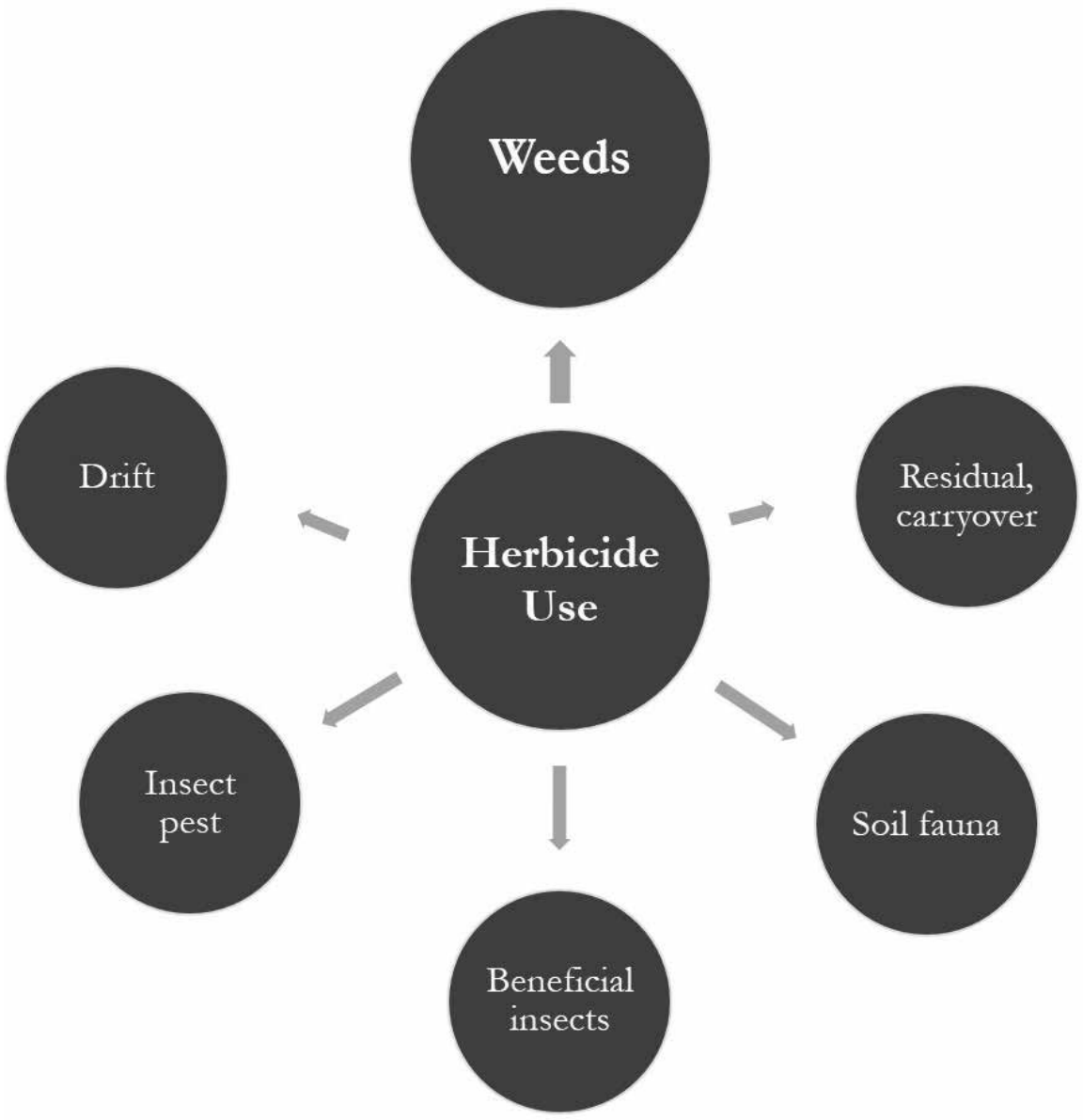
Common understanding exists among farmers regarding the above-mentioned concerns, but impact of herbicides on pest and beneficial insects is a less demonstrated, and hence, is a less communicated subject. Association of herbicides with insects is complex and reported to influence various guilds of insects in a diverse manner. Herbicides can be directly toxic to insects or can affect them indirectly by destroying food supplies and can have both indirect and direct effects on pest and beneficial insect populations in agricultural communities. The insects before attacking the crop plants can stay on weeds (alternate host) and removal of these weeds either can eradicate insect pests or can expose the crop pest for greater levels of damage. Direct exposure to certain toxic herbicides can be harmful for beneficial insects and can decrease their population in the field. On the other hand, it can also influence the parasitoids feeding on the nectar from flowers of certain weeds. In some instances, the pest can shift their host plants from the weed to the crop and that can be harmful for the crop, causing an outbreak of the insect pest. Such as, an abrupt increase in the population of Lygus bugs due to eradication of host weed plants (e.g., removal of Russian thistle and alfalfa close to the fields of peas and lentils). On the other hand, the level of harm posed by herbicides to predatory insects can vary by insect species and their life stages (eggs, larvae, or adults). Several carabids and various species of ladybird beetles are reported to be negatively affected by certain herbicides. Insect parasitoids, another group of beneficiary insects, can also be affected by certain herbicides and the major impact of herbicide application is often on adult insect emergence. Further, bees, another group of beneficiary insects, plays an important role as pollinators. Herbicides and other pesticides, such as insecticides, fungicides and acaricides used in farms were detected in honey and wax collected from the foraging bees in a study done in Nebraska by Johnson et al. (2010). These pesticides and herbicides can also influence the soil micro-fauna including soil insects, other arthropods and both predatory and phytophagous nematodes. Moreover, other than above-mentioned direct and indirect impacts of herbicides on insects, added factors also need to be taken under consideration while understanding the specific association of herbicide–weed–insect. If used properly and perceptively, herbicides can be used to aid the beneficial insects which act as biological control agents to control weeds. Further, some common entomopathogenic fungi (Metarhizium and Beauveria sp.) used against several major insect pests are found to be compatible with commonly used herbicides.

In the Golden Triangle area of Montana, spring wheat and winter wheat are the major cereal crops grown under no-till dryland production. Wheat stem sawfly, wireworms and wheat midge are the major pests of wheat in this region and are known to cause economically-significant crop yield losses. The control of both these insect pests has been challenging. Insecticides and natural enemies both are less effective to control both these pests. Two parasitoids (Bracon cephi and Brocon lissogaster) are known to attack wheat stem sawfly populations in wheat and some carabids and entomopathogenic fungi can work as potential microbial insecticide for wireworms. Having known several aspects of association of these insect pests, their natural enemies and host plants, very little is known about the association of these biotic elements in herbicide-dominated, no-till farming systems. One greenhouse study done in 1967 by Gall and Dogger, revealed that 2, 4-D has an effect on larvae of the wheat stem sawfly, while adults were unaffected and eggs appeared to be slightly affected. However, these results are confined to indoor studies and there has not been any field study to validate those findings. Similarly, association of herbicides with other insects in our no-till cropping system is also unknown, such as other minor pests of wheat, e.g., wheat head armyworm, wheat midge, and pests of other important crops in this area including pea weevil and pea leaf weevil on peas and flea beetle and cabbage seedpod weevil on canola. We also do not know the impact of commonly used herbicides on natural enemies of these main insect pests of crops grown in the Golden Triangle area of Montana.

CONTINUED ON PAGE B4

Impact of herbicide overuse on insect pests and their natural enemies in no-till farming

CONTINUED FROM PAGE B2



Overuse of herbicides: Yes or No?

With what little we know about this association, some approaches can be analyzed and then applied in our area. In no-till cropping systems, trap crops or cover crops can be used to harbor ants and termites; hence, warding the direct damage done by these insects to the main crop. Nevertheless, this complex relationship needs better understanding to arrive to ecologically-friendly approaches, such as using mustard species as a trap crop surrounding wheat fields, where cutworm population is higher. The trap crop can be grown to lure pests away from the cash crop until the larvae mature and feed on the trap crop. Then, they can be treated with an insecticide in a localized area rather than treating the entire field. Sometimes, weeds also harbor the predatory insects as their alternative host plant e.g., ladybird beetles and shield bugs. By avoiding overuse of herbicides in the fallow periods in no-till fields, these predatory and beneficial soil insect fauna can be improved. Alternatively, soil covering with cover crops during the fallow periods or between cash crops can aid in suppressing weeds and insect pests through allelopathic mechanisms; hence, reducing the overuse of herbicides or insecticides and enhancing biodiversity and productivity of no-till farming systems of this region.

Essentially, chances of overusing the herbicides are obvious and enticing when it comes to getting good yield and seeking an economical way to control weeds, but herbicide use should be well thought, in terms of its effect on several ecological components, such as beneficial insects. Observation and scouting to analyze the residual effect of herbicides on insect survival can help us to understand this association. At present, several aspects of this association are vague and undetermined, but wise and judicious use of herbicides is critical. The lack of information exists on the potential influence of herbicides more commonly used in no-till farming systems on insect pests and their natural enemies, which is unsettling. Assessing direct impacts and host-plant-mediated indirect impacts of commonly used herbicides on the soil fauna will be inevitable in near future. Nevertheless, judicious use of herbicides will help us to reduce their adverse impacts on environment and ecological components.

Absolutely Incredible Kids Day

Date When Celebrated: in March, date varies

Sure, your kid is pretty good. But, my kid is absolutely incredible! As a matter of fact, all of my kids are absolutely incredible. As a parent, I am going to take full advantage of being the author of this page to exercise my bragging rights, and to let you know that my kids are absolutely incredible. (Wow! That felt pretty good.)

If the paragraph above doesn't give you a good impression of the meaning and purpose of this day, then you probably don't have kids...yet. When those offspring do arrive, you will most certainly use this special day to profess how incredible your kids are. Amazingly, tomorrow they go back to being brats.

Did you Know? "Kids" are baby goats. Does that mean this day is really about incredible goats!? .....Nah!

Celebrate today by letting your kids know how good they are, and how much you love them.

Origin of "Absolutely Incredible Kids Day":

Campfire USA created this day as a day in 1997, to show kids they are loved and cared for. Among other things, they suggest you write a letter to your kid today.

It used to be held on the third Thursday in March. Now, it seems to vary.