SUSTAINABLE FARMING Quarterly

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Beeting the odds: Strip-tilling helps control wind erosion

— By Alan Girard for the Alternative Energy Resources Organization in Helena, Mont. —

Sugar beet farmers working on highly erodible land have always been in search of new ways to keep from losing their soil to the wind. They've heard about the success no-till grain farmers have had with stubble during the off-season, but have been unsure how to combine no-till with the corrugation and bedding techniques normally used to grow sugar beets.

Bill Iversen, a beet grower from arid Sidney in extreme northeastern Montana, is cautiously optimistic about "strip-tilling," the term he coined to describe a no-till technique on his land. Strip-tilling has had its share of problems, but has given Iversen valuable new tools for controlling the impact of wind erosion.

The method involves alternating beets with grain, treating grain as a row crop. Beds are formed when the grain is planted so that the grain can be irrigated without the use of border dikes. At harvest, the grain is cut just above the ground, leaving a layer of stubble, the same as in no-till grain farming. One seven-inch-wide band is then tilled on the center of each bed; these bands are 24 inches apart. The beets will then be planted in the tilled strips with a conventional planter. The corrugations remain between the beds to aid in tractor guidance and furrow irrigation.

Bill Iversen checks the root system of his beet crop.

The stubble cuts wind and water erosion and replenishes the crucial organic content of the topsoil as residue slowly decomposes. Moreover, Iversen's method cuts the expense of plowing, mulching and leveling the land just prior to planting the beets in the spring.

Iversen was attracted to no-till because about two thirds of his farm is

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INSIDE THE SFQ

Bug your Russian wheat aphids to death

—— By David Granatstein, coordinator of the Washington State University Center for Sustaining Agriculture and Natural Resources in Wenatchee ——

A number of aphids are permanent residents of the dryland cereal regions of the northwestern states, and several of these periodically cause significant damage to grain crops. Among them are the English grain aphid and the bird cherry-oat aphid.

Weather conditions are a major determinant of damage by these insects. Since distribution and damage is often irregular, few grain growers have a consistent control program for these pests.

Yield losses in wheat from aphids can result from direct feeding, introduction of toxins, and the transmission of plant viruses such as barley yellow dwarf virus. In field settings, two or more of the aphid pest species normally can be found.

Keith Pike, an entomologist at the

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subject to wind erosion. With the help of a small grant from the Alternative Energy Resources Organization (AERO) Farm Improvement Club program, he connected with Montana State University and began developing a no-till approach sensitive to the environmental needs of his beet crop. Dr. Jerald Bergman at the Eastern Agricultural Research Center in Sidney is involved in the experiment, and Iversen has had some support from the Montana Beet Growers Association. Other farmers in the area are watching with interest.

Although Iversen is committed enough to the strip-till theory to try it again this spring, the experiment was costly in terms of time, dollars and yield in 1993. Because the grain is being grown as a row crop, he explained, irrigating requires the frequent movement of siphon tubes around the plot, a task that can easily eat up a lot of time. Iversen also had some unforeseen start-up costs in the time he spent working the straw and stubble — an experience that has prepared him for how to better handle the straw this year.

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Equipment modications will be necessary for strip-tilling to succeed on Bill Iversen's farm in Montana.

The strip-tilled beets yielded 16.5 tons per acre in 1993, compared to 19.3 tons per acre elsewhere in the field, a loss of $120 per acre that Iversen cannot afford again. He chalked up the yield reduction to a fluke rainy spell in late summer that, among other things, caused nitrogen to become "tied up" in the stubble, where it was unavailable to the beets. Despite the loss, he took the risk and planted six acres of strip-tilled beets this spring, after tilling nitrogen into the strips last fall.

In comparing conventionally grown beets with strip-tilling, Iversen found last summer that he was spending approximately $64 more per acre on the strip-tilled beets — for an application of Roundup to replace plowing, and for fall irrigation, straw removal and tilling twice before cultivating the beets.

Iversen reported that the stubble performed exceedingly well at holding his soil, which may make the additional start-up costs worth it the long run. He also expects to see a significant decrease in expenses if all the straw can be left on the field and the tiller modified to accomplish in one pass that which has taken two. These two steps have been taken for the 1994 crop.

After he finishes working out the bugs in the sugar beet system, Iversen will consider using the strip-till approach on dry beans, which he currently raises conventionally in rotation. He says it takes at least two years before one can expect a new system to work efficiently. Then he expects the strip-tilling technique will equal the conventional system, improving his soil quality and giving him a competitive edge in years to come. ❐

Hot water a promising 'herbicide'

The *Journal of Soil and Water Conservation* reports that the use of boiling hot water to scald weeds shows promise in a variety of applications, including weed control in fruit groves, potato and cotton fields, and waterways.

Hot water generated by an Aqua Heat electronically-controlled boiler is distributed through a boom fastened to the side of a tractor. For more information, contact Aqua Heat Technologies Inc., at (612) 781-3867. ❐

Computers can't farm, but they can help manage

—— By David Granatstein, coordinator of the Washington State University Center for Sustaining Agriculture and Natural Resources in Wenatchee ——

Computers can't replace the experience of seasoned growers, but they are becoming more widely used as decision-support tools for refining farm management.

One example is the use of computer decision models to process a large amount of real time information regarding crop conditions and prices. Such models are becoming more common in pest management. USDA/ARS and Washington State University researchers at Pullman are developing a computer model, PALWEED: WHEAT, to assist wheat growers in eastern Washington in their weed control decisions. The model is currently being tested in farmers' fields.

The model is based on field research data collected over six years from the Integrated Pest Management cropping systems project near Pullman. This project, managed by USDA/ARS weed scientist Frank Young, focused on managing weeds so farmers can move into a conservation tillage system. The plot size was large enough to accommodate full-size farm machinery to make the results more realistic and representative.

The study included both conservation and conventional tillage systems, continuous wheat and wheat-barley-pea rotations, and three intensities of weed management — minimum, moderate and maximum. The weed control intensities were roughly equivalent to 90, 70 and 50 percent of the recommended label rates of applied herbicides. Weed control actions were adjusted each year to reflect the weed species, weed densities, and environmental conditions.

The researchers extensively monitored the plots, identified weed species and determined weed populations in the spring prior to post-emergence herbicide treatments and again before harvest. Soil organic matter, soil moisture and crop yield were measured. Douglas Young, a WSU agricultural economist, and Tae-Jin Kwon, a research assistant, used the data to construct a bioeconomic model that links biological responses with optimal economic weed control choices.

Weed survival functions first were calculated to determine weed density after herbicide use. Then a yield response function was developed to relate wheat yield to surviving weed density and other factors. Finally, the estimated results were used to determine the profit maximizing rates for three herbicide classes.

A unique aspect of this prototype model is its use of a competitive index for multiple weed species. Also, the model can adjust recommendations based on preceding crop, tillage intensity and other management factors. At the same time, the researchers tried to keep the model simple enough so growers or consultants could practically collect the needed data to make it work.

Preliminary experiments with the model indicate that spring weed seedling counts are good indicators of midsummer weed survival and competition with the wheat crop. Preplant nonselective herbicides, even at higher rates (within label), were economically justified in the conservation tillage plots. The model did not recommend postemergence broadleaf herbicides for the conservation tillage system, but it did recommend greater use of postemergence grass herbicides. No postemergence herbicides were recommended under conventional tillage. With the additional tillage, predicted yields were not substantially reduced (without herbicide use), while predicted profits increased.

The model currently is being tested with data from a number of actual field trials. It is likely the model will require further refinement and calibration based on another one or two years of field testing before it can be released. If the model proves successful under field conditions, growers who want to use it will need to collect information on weed seedling populations and soil conditions. They also must provide information regarding tillage, preceding crop and prices. Ultimately, the cost to implement the model (mostly time) must be outweighed by any benefits of using it. If a consultant collects the data, costs will be higher.

However, in an era of ever-changing policy and prices, a model such as PALWEED can provide a quick look at a number of weed control options, and help a grower zero in on those that look most promising. ❐

Grass clippings, leaf mulch invite return of earthworms to bad soil

Agricultural Research Service (ARS) scientists have found grass and leaf-mulched plots had twice as many earthworms as plots where the previous season's corn stalks were left on the soil. And water infiltrated two to four times faster on the earthworm-laden, residue-covered plots than on those without residue. Since earthworms turn organic matter into nitrogen for plants to use, the amount of nitrogen they make available to plants depends on the quality of organic matter. ❐

APHIDS, FROM PAGE 1

Washington State University research center in Prosser, Wash., recently demonstrated the potential impact of aphids on grain yield. In plots of dryland winter wheat, there was a natural infestation of four different aphids. One set of plots received a systemic seed and foliar insecticide treatment that prevented aphid damage. Another set of plots had no control. Yields increased from 108 bushels per acre on the untreated plots, subject to aphid damage, to 218 bushels per acre on the treated plots. Aphid-transmitted virus played a role in reducing yields.

The arrival of a new aphid pest in the region in the late 1980s has increased interest in control strategies. Named the Russian wheat aphid, *Diuraphis noxia* entered North America through Mexico in 1980 and proved to be well-adapted to the conditions in the western U.S.

It was first detected in the U.S. in 1986 and made its way to Washington State by 1987. By late 1988, populations of the Russian wheat aphid had reached high enough levels in eastern Washington to cause significant yield loss in cereal crops. This incredibly fast movement of a new pest across the important cereal-growing regions elicited a rapid response from state and federal agriculture agencies. The national Russian Wheat Aphid Integrated Pest Management Program was started in 1989 to develop a coordinated response that would lead to long-term solutions.

Entomologists are focusing on three primary approaches to aphid control: development of biological control, development of crop varieties with increased resistance to aphids, and re-evaluation of cropping systems relative to their impact on the pest. Usually, two or more control tactics are used. For example, chem-fallow is used in late summer to eliminate volunteer wheat that hosts aphids, and fall planting is delayed for one or two weeks, depending on seasonal aphid flight patterns. In addition, more dense plant spacing makes the crop less attractive to the aphid, economic threshold information helps avoid unnecessary insecticide use, and targeted use of systemic insecticides such as seed treatment kills the aphids without impacting beneficial organisms.

A major effort is under way to identify, multiply and release natural enemies of the RWA in eastern Washington, under the leadership of Lynell Tanigoshi, WSU entomologist, and Keith Pike. They realized that many of the pest aphids originated in central Asia, where existing natural enemies, climate or other factors keep them in check and prevent chronic damage to crops. So they have been conducting an ambitious collaborative project to find new potential biological control agents on the RWA "home turf" and to release them in eastern Washington. The project has led them on collecting expeditions to Jordan, Turkey, Syria and Morocco. They have cooperated with scientists in those countries as well as with those in other states and in the USDA.

The two researchers focused on areas with agronomic zones similar to those in the dryland cereal regions of the Pacific Northwest (annual precipitation 10 to 16 inches, winter rainfall pattern). In these areas, they and several collaborative teams collected 11 species of natural enemies and numerous ecotypes adapted to local conditions. With the help of their cooperators, several of these natural enemies have been propagated, run through quarantine procedures, further multiplied, and released in the field.

The most promising species are small parasitic wasps, including *Aphelinus albipodus*, *Aphelinus asychis*, and *Aphidius colemani*. Since 1988, Tanigoshi and Pike have released nearly three million natural enemies at more than 200 sites in eastern Washington. This may sound like a lot of bugs, but Tanigoshi reminds us that with nearly three million acres of cropland, that amounts to only one beneficial insect released per acre.

A key factor in the success of their program is to confirm establishment by the introduced beneficial insects. They have done this with the *Aphelinus* species, and are increasing their work on monitoring.

Surrounding habitat, such as range grass, appears to be an important factor in survival of the pest and the natural enemy. Thus, the extensive plantings of grass on CRP lands may be an asset to this biological control effort. Through some initial monitoring, the researchers have measured parasitism of the Russian wheat aphid as high as 80 to 100 percent in spring populations. This clearly prevented the pest from reaching economically significant levels. However, the extent of the parasitism is not yet known. Some of the natural enemies attack other aphid pests as well.

According to Tanigoshi, an expanded monitoring program will be conducted this summer to measure more thoroughly the impact of native and exotic natural enemies of the Russian wheat aphid in field situations.

Researchers will use exclusion cages that can keep the natural enemies from attacking aphids on infested plants. Aphid levels and damage will be compared to that of plants without the cages. Fields far from where exotic natural enemies have been released will be monitored to evaluate native natural enemies, and fields in release areas will be monitored to evaluate the combined effect of native and introduced natural enemies.

The researchers have focused on

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natural enemies that can attack the Russian wheat aphid inside the rolled leaf where it is protected from other possible control techniques. Most likely, a complex of natural enemies will need to become established to provide adequate and stable control of the aphids.

To "customize" the natural enemy mixes to the specific conditions of a local area, Tanigoshi and Pike are using DNA fingerprinting of their imported bugs. This allows examination and comparison of the genetic material from insects collected in different environments. Thus, genetic variation within species can be determined and linked to specific environments. This should allow for the introduction of natural enemies with the greatest chance for permanent establishment.

The type of program under way by Tanigoshi and Pike is probably not a solution for an aphid outbreak this year. It may take several years for the beneficial populations to establish, if they establish at all, and begin to synchronize with native natural enemies and populations of aphids that they parasitize and feed upon. This type of classical biological control can, however, result in a permanently established system that keeps the pest in check for the indefinite future. Such is the case with the vedalia beetle introduced in southern California over a century ago to control cottony-cushion scale, an introduced pest.

Tanigoshi and others at WSU have bolstered their ability to look for biological solutions to insect problems such as the Russian wheat aphid by establishing a biocontrol insectary and a soon-to-be-certified (USDA-APHIS) regional quarantine facility on the WSU campus at Pullman. These facilities enable them to bring in promising exotic natural enemies, learn how to rear them, and produce large numbers for field release. The facility is dedicated to addressing regional problems. Their initial efforts with the Russian wheat aphid have come a long way and put promising new natural enemies in the field. The next step is to determine whether the newest immigrants can keep up with the adaptable aphid and protect cereal crops from damage.

CALENDAR

JUNE

9-12: Cuisine, Agriculture and Social Change, a conference, Westward Look Resort, Tucson, Ariz. Sponsors are the Agriculture, Food and Human Values Society and the Association for the Study of Food and Security. Contact: Ann Tinsley, Department of Nutritional Sciences, University of Arizona, Tucson, AZ 85721.

JULY

29-31: Alternative Energy Resources Organization 1994 annual meeting and 20th anniversary celebration. AERO publishes the *Sustainable Farming Quarterly*, Blacktail Ranch between Great Falls and Helena, Mont. Contact: AERO at (406) 443-7272.

AUGUST

7-10: Agroforestry and Sustainable Systems, Fort Collins, Colo. Contact: Kim Isaacson, Center for Semiarid Agroforestry, Rocky Mountain Forest and Range Experiment Station, UNL East Campus, Lincoln, NE 68583-0822; (402) 437-5178.

18-20: WRCC-67 Sustainable Agriculture meeting, Cheyenne, Wyo. This annual meeting brings together researchers from the various land grant universities and others in the western states to discuss ongoing sustainable agriculture activities and provide direction for the USDA SARE program. Contact: David Granatstein, chair, at (509) 663-8181 ext. 222.

18-21: Symposium on Sustainability of Range Livestock Production in the West, Billings, Mont. Designed for ranchers, agricultural leaders, technical specialists, educators and policy makers, this symposium will focus on economic, social, biological and management strategies. Environmental assessments, wildlife issues, riparian management and public policy concerns relative to sustainability of range livestock operations will be addressed. Sponsors are Montana State University and the Western SARE Program. Contact: Jack Riesselman, 525 Leon Johnson Hall, Montana State University, Bozeman, MT 59717; phone (406) 994-5149 or fax (406)

Further reading:

1. Pike, K.S. et al. 1991. *Russian wheat aphid: biology, damage and management*. Cooperative Extension publication PNW371, Washington, Oregon, Idaho, 28 pp. Order from the WSU Extension Bulletin Office, Pullman, WA 99164-5912, or call (509) 335-2857.

2. Tanigoshi, L.K. et al. 1994. *Search for, and release of, parasitoids to control biologically Russian wheat aphid in Washington State. Agriculture*, Ecosystems, Environment. In press.

3. Pike, K.S. et al. 1993. *Compatibility of imiaclorprid with fungicides as a seed treatment control of Russian wheat aphid and effect on germination, growth, and yield of wheat and barley*. J. Economic Entomology Vol. 86:586-592. Available in agriculture libraries. ❐

RESOURCES

Editor's note: The Alternative Energy Resources Organization, which publishes the Sustainable Farming Quarterly, receives notification of new releases of books and video tapes pertinent to sustainable agriculture. We share the following titles with our readers, but the SFQ does not necessarily endorse them.

1993 Pacific Northwest On-Farm Test Results. The results from field scale on-farm tests in the dryland regions of the Pacific Northwest are summarized in a straightforward format that includes the tests' objectives, treatments, data, comments and conclusions. Topics include tillage and seeding, rotations, fertilizers and amendments, crop varieties and pesticides. Copies are free. Request Technical Report 94-1 from the Department of Crop and Soil Sciences, Washington State University, Pullman, WA 99164-6420.

Specialty Farming Guides. The University of Idaho has produced this series of short publications to assist in the planning, establishment and operation of specialty farms. Topics include types of enterprises to begin, site selection, budgets, and business and marketing strategies. For a list of publications and ordering instructions, write to Dan Barney, Specialty Farming Guide, University of Idaho, Sandpoint R&E Center, 2105 N. Boyer, Sandpoint, ID 83864, or call (208) 263-2323.

The Human Consequences of the Chemical Problem. 1993. Cindy Duehring and Cynthia Wilson, the Chemical Injury Information Network, White Sulphur Springs, Mont. The authors discuss chemically-induced health problems and provide an exhaustive bibliography and appendices that describe specific chemicals and the problems they cause or are suspected to cause. Copies are available for $5.95 from TT Publishing, P.O. Box T, White Sulphur Springs, MT 59645.

Mycorrhizae in Sustainable Agriculture. 1992. G.J. Bethlenfalvay and R.G. Linderman (eds.) The book is based on a 1991 symposium at the Agronomy meetings. Its five chapters cover the role of mycorrhizae (a beneficial fungus that inhabits many crop roots) in crop production, soil conservation, microbial interactions, and cultural and environmental stresses. The book provides an excellent introduction to mycorrhizae and their relation to sustainable agriculture, American Society of Agronomy, Madison, Wis. 124 pp. $18.

The 1994 National Directory of Organic Wholesalers includes more than 800 cross-referenced organic commodities bought and sold, updated state and federal organic laws, and hundreds of new growers, wholesalers, processors, manufacturers, brokers, farm suppliers, certification agencies and resource groups nationwide. Order for $38.95 per copy, postage paid, from Community Alliance with Family Farmers, P.O. Box 464, Davis, CA 95617; (800) 852-3832.

Biological Control of Weeds in Montana is a new 17-minute videotape released by the Montana State University Agricultural Experiment Station. Researchers describe their progress and the future of biological control of spotted knapweed, leafy spurge and other noxious weeds. The information is pertinent outside Montana as well. Copies may be viewed at Montana extension offices or purchased for $25 (prepayment required) from MSU Publications Office, 115 Culbertson Hall, MSU, Bozeman, MT 59717. ❐

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