

Green manures for disease control

by Donna Fleury

Continued study targets verticillium wilt.

Interest in the use of green manures to control plant disease is growing, particularly for controlling soilborne potato diseases. Growers have been looking to the successes from other areas, including the Pacific Northwest, and are interested in how to successfully implement this practice to control soilborne potato diseases on their farms.

Dr. Mario Tenuta, Canada Research Chair in Applied Soil Ecology at the University of Manitoba, with Drs. Fouad Daayf and Abdel El Hadrami and graduate student Oscar Molina, have initiated a project to look at the potential of green manures in Manitoba and beneficial impact on controlling early dying of potato and improved soil health. "Our team has a lot of experience with other types of organic soil amendments and have expanded our research to include green manures, both in the field and in the laboratory," says Tenuta. "Together, this research is tackling the question of finding alternatives to pesticides in soil to control plant diseases."

One of the main soilborne diseases causing yield losses and economic impacts for Manitoba potato farmers is verticillium wilt, part of the complex of early dying disease. "Verticillium wilt is our target, and is a very difficult disease to control because it is very long lived in the soil and has multiple

alternate hosts," explains Tenuta. "In Manitoba, we have very high levels of verticillium wilt in many fields, and some fields continue to succumb to early dying."

As part of their research program, the researchers want to determine the importance of verticillium wilt in terms of yield reduction in potatoes in Manitoba.

The research project started in 2006 with field trials established at three locations, one at Canada-Manitoba Crop Diversification Centre (CMCDC) at Carberry and two other sites in farmers' fields using various organic amendments and green manure treatments. "The CMCDC site is a super site that includes 12 different treatments," says Tenuta. The trials followed a three-year rotation, with a common cereal crop seeded in the first year. The second year included the application of organic amendments or seeding green manure crops, followed by a potato crop in 2008. Two treatments included perennial crops seeded in the first year (alfalfa, sorghum sudan), continued in the second year, and then plowed down and seeded to potatoes in year three.

Tenuta explains the green manure and soil organic amendment treatments were designed to address different approaches to soilborne disease control. Some treatments were designed to be toxic to the pathogens, which were expected to kill the verticillium wilt pathogen directly. Other treatments were designed to protect the plants against the verticillium wilt pathogen. For example, sorghum sudan has been shown elsewhere to fool the verticillium wilt into germinating, but does not allow it to infect the plant. The researchers were also interested in the impact of the various treatments on soil properties and soil health, such as organic matter, nutrient availability, soil structure, moisture holding capacity and biological activity.

The green manure crop treatments included: oriental mustard, white mustard, Canada milkvetch, fall rye, oat-pea mixture, spring wheat and a wheat-animal compost mixture. One other treatment included a wheat crop with a fall Vapam fumigant application. "Vapam is not commonly used in western Canada, but is regularly used on high value crops elsewhere," explains Tenuta. "Growers were interested in finding out if Vapam was an option here and we wanted to know the consequence of dramatically lowering verticillium levels and its use on disease in coming years.

"We added mustard seed meal as a new treatment in 2008 to a plot that had been seeded to cereals in the first two years," says Tenuta. Mustard meal is a result of an oil crushing process, and the remaining meal product can be used for food processing. "In this case we applied the mustard meal early in the spring followed by incorporation about two weeks before the potatoes were seeded."



Dr. Mario Tenuta speaking on green manures and amendments at the CMCDC annual field tour.

PHOTO COURTESY: ERIKA WOLSKI, UNIVERSITY OF MANITOBA.



Yellow mustard growing at Canada-Manitoba Crop Diversification Centre (CMCDC) just prior to plow-down as a green manure.

PHOTO COURTESY: OSCAR MOLINA, UNIVERSITY OF MANITOBA.

The compost treatment also received another application in 2008, prior to seeding potatoes.

The green manure crops were seeded in late spring or early summer, and then plowed down later in the year. Mustard crops are allowed to grow to their peak flowering stage, and then either chopped, flailed or rolled before being plowed under. Soil moisture should also be adequate; otherwise the green manure will not work as well. The discing operation is important for incorporating the green manure to a depth of five to 10 centimetres (two to four inches), and providing a second extra chopping of the plant material.

The perennial crops can be harvested and then plowed down in late September. "The Canada milkvetch should be treated the same way," says Tenuta. "Canada milkvetch is very experimental and something unique to the University of Manitoba. We did find it more difficult to get established, and the slow establishment meant more potential weed problems, but by the end of July it was doing well." The researchers are also experimenting with other potential uses of Canada milkvetch, such as an extract that may provide an alternative to seed treatment.

Preliminary results show promise

The potato crop was harvested in late September 2008, but the final grades and yield information are not available to date. "Our preliminary results indicate

we are definitely getting responses from some of the treatments, although they are varied," explains Tenuta. "In some cases, verticillium wilt pathogens are being killed directly, in others the pathogen levels are lowered, but this doesn't necessarily relate to an increase in yield or quality."

The question remains whether or not the overall yield is impacted by the various treatments. "We will be analyzing the results during the fall and winter, as well as continuing the lab work to refine our experiments and to determine what is happening in the field," explains Tenuta. "Some of the treatments that seem to be the most interesting are the mustard green manure and seed meal treatments that definitely knock down the verticillium wilt populations in the soil. The mustards don't eradicate verticillium wilt, but they lower the populations."

Mustard meal also lowers the verticillium wilt populations and more effectively than the mustard green manure treatments. Some of the other green manure treatments, such as alfalfa and Canada milkvetch, did not lower the verticillium wilt pathogen, but the plants were healthier and yields were higher. The compost treatment also showed similar results, with preliminary examination indicating the greatest increase in yield. "Once we have completed our analysis, we expect to have better answers for growers," says Tenuta. "We believe there is the potential for the use of green manures and soil organic amendments in any crop rotation. With higher value crops, there is potentially more leeway to cover added labour or other costs by using green manures and soil organic amendments."

The key for growers before deciding to use green manures or soil organic amendments is to know the diseases and soil conditions to carefully identify what the problem is. "Likely the disease and soil conditions will design the objectives of a green manure or organic amendment application and help determine which of the various approaches and different mechanisms will work the best for that situation." ■

Hit yield potential of irrigated crops

by Helen McMenamin

It also takes high, well-managed inputs, crop management skills and attention to detail.

Hitting the full yield potential of irrigated crops means getting a lot of things right.

Ross McKenzie, research agronomist with Alberta Agriculture, along with soil and water scientist, Shelley Woods, have been running a major research project on 11 crops at four sites in Alberta for the last three years. He will collect more data in 2009, the final year of the study. He is looking at seeding dates and rates, nitrogen use efficiency and crop water use efficiency.

Once the project is complete, McKenzie will have a huge amount of data even though not all crops or comparisons are grown at every site. When analyzed, he will have much more confidence in cropping recommendations than is possible at present. "We're developing nitrogen response curves that will allow us to update our recommendations from research done in the 1980s," he says. "Those response curves are outdated, for soft wheat, for example, top yields then were 110 bushels. Now we get 160 bushels, sometimes 200."

Fundamentals always apply

Already, McKenzie has come to some strong conclusions. Variety selection, he says, is the first and most important decision of the cropping year. He advises choosing the variety with a very high yield potential, but making sure it has good disease resistance and lodging resistance. "In the high-moisture environment of an irrigated crop, good