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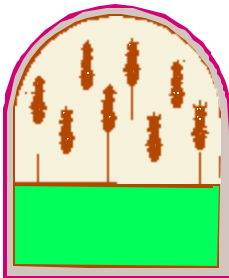
IN THIS ISSUE:

- < **Wheat Stripe Rust**
- < **The Fit for Roundup Ready Alfalfa: Initial Field Results in California**

Sincerely,

Ron Vargas

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Wheat Stripe Rust

Four different rust diseases can affect small grains in California, stripe rust, leaf rust, stem rust and crown rust. Each is caused by a different species of Puccinia, but all four have similar life cycles. According to Lee Jackson, University of California Cooperative Extension Small Grain Specialist, wheat stripe rust got a very early start this season and has become severe and widespread. Lee also points out, "We're having so much more forage wheat being produced throughout the valley. A particular variety that has been adopted by growers is one that's extremely susceptible - it's the variety Dirkwinn, and awnless wheat that dairy producers prefer to feed their cattle. It's normally planted earlier than we plant for grain production, so that gives a very susceptible host to the stripe rust organism and that has allowed these early infections to occur and generate an abundant amount of spores for the whole valley." I have received numerous calls of infested fields in both Madera and Merced counties and although it maybe too late for fungicide treatments, a review is in order. Most of the current wheat varieties, including many durum varieties, are showing varying degrees of susceptibility. The changes in susceptibility of specific varieties this season probably are due to a combination of very favorable conditions for the disease and the presence of new rust races.

Stripe rust of both wheat and barley is caused by Puccinia striiformis. The rust pustules are yellow-orange, develop mainly on leaves and spikes and tend to grow together into thin stripes that run length wise between the veins of the leaves. Disease symptoms are often necrosis and chlorosis, without sporulation which often look like mottled tan colored stripes. Rust infections increase water loss and decrease the amount of photosynthate available for grain filling. As a result, the number and size of kernels are reduced and the grain that is formed may be shriveled. The effects of rust on grain yields are more pronounced if the disease becomes severe before or during flowering, which has been the case this season.

Resistant varieties are the primary means of controlling rust diseases in grain. Because new races may develop that are capable of attacking resistant cultivars, new sources of resistance are constantly being evaluated in the UC small grains breeding program. For example, both RSI-5 and Bonus wheat, initially resistant to stripe rust, now have very little resistance and in the case of RSI-5 very little acreage is planted. Stripe rust tolerant varieties include two red wheats, Stander and Summit, and two white wheats, Blanca Grade and Plata.

Foliar fungicides can be used to control rust diseases, but may not be economical. The UCCE recommendations for forage wheat is to cut the forage as soon as possible instead of letting the disease increase in severity. If wheat is being grown for grain, protection of the flag leaf, with a fungicide, through the soft dough stage should be considered. Two fungicides, Tilt and Quadris are registered for use. Labels need to be checked carefully as Tilt cannot be applied to forage wheat and Quadris has grazing restrictions and can only be applied up to heading with a 45-day pre-harvest interval.

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The Fit for Roundup Ready Alfalfa: Initial Field Results in California

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Complete weed control in alfalfa has been a continual challenge for alfalfa producers. Compared with many other crops, alfalfa competes well with weeds. However, despite alfalfa's competitive ability, weeds remain a problem. The high forage quality demands of the dairy industry in California are such that nearly perfect weed control is important. Similarly, for alfalfa hay to be suitable for sale to the horse industry, it must be almost entirely free of weeds. This has been difficult with conventional herbicides, as typically no single herbicide controls all the weeds present in many alfalfa fields. This is especially true

for weed control in seedling alfalfa where herbicide tank mixes are often required and even when they are used weed escapes are not uncommon.

Potential Benefits

Glyphosate is undoubtedly the most effective non-selective foliar herbicide available. It controls a broader spectrum of weeds, both annuals and perennials, than any other herbicide. Now with the advent of transgenic crops it can be used to control weeds in crops resistant to glyphosate. The impact that herbicide tolerant crops have had on other commodities is remarkable. In 2002, 69 percent of the cotton acreage, 68 percent of the soybean acreage, 55 percent of the canola acreage, and 26 percent of the corn acreage in the United States were planted with varieties genetically altered for herbicide tolerance.

Commercial varieties of alfalfa genetically altered for resistance to glyphosate are on the horizon. Monsanto has entered into a cooperative agreement with the alfalfa breeding company Forage Genetics to produce Roundup Ready alfalfa. Roundup Ready alfalfa varieties may be available as soon as 2004.

Conceptually Roundup Ready alfalfa as a weed control system has significant merit for alfalfa producers. Weed control costs could potentially be dramatically reduced while improving the level of weed control. Most alfalfa herbicides injure the crop to some degree. In theory, crop injury could be dramatically reduced or eliminated with Roundup Ready alfalfa. In addition, there are no effective weed control programs for some of the most difficult-to-control perennial weeds (dandelion and quackgrass) common in intermountain alfalfa stands. Control of difficult to control perennial weeds in the California's Central Valley (Bermudagrass, nutsedge, and Johnsongrass) could also be improved with glyphosate. Adequate control of these tough perennials could help extend stand life in some areas.

Unanswered Questions

Even with these potential advantages, questions remain regarding the value of the Roundup Ready System in alfalfa production systems. Glyphosate has no soil residual activity. Many, if not most, of the herbicides used for winter and summer annual weed control have soil residual

activity so that they persist long enough to provide complete weed control. Similarly Pursuit, and now Raptor, each have soil activity which helps control weeds that emerge following the herbicide application. *Could complete season-long weed control be achieved with a foliar herbicide like glyphosate given the prolonged emergence of the weeds that infest alfalfa?* Field trials were needed to compare the Roundup Ready weed management system with standard weed control strategies under the diverse environmental conditions and weed spectrum encountered in California. In addition, the Roundup Ready approach to weed control may require different application timing(s) than other conventional herbicide treatments.

California Field Trials

Uniform weed control trials were conducted in the intermountain area, Sacramento Valley, and San Joaquin Valley of California. Testing the Roundup Ready concept over varied environments allows for a better comparison of the benefits and shortcomings of the system. Roundup Ready alfalfa (fall dormancy appropriate to the production area) was seeded in the fall at each site. An additional spring-seeded trial was conducted at the intermountain site. Different glyphosate rates and application timings were evaluated. The glyphosate rates tested were 1 and 2 pounds active ingredient per acre (0.75 and 1.5 lbs. ae/A). There were three different herbicide application timings based on the alfalfa growth stage: A) unifoliate to first trifoliate, B) 3–4 trifoliate leaves, and C) 6–9 trifoliate leaf stage. The conventional standards tested were imazamox (Raptor) and tank mix of imazethapyr (Pursuit) and bromoxynil (Buctril) or clethodim (Prism). A tank mix of glyphosate and Pursuit was also evaluated. Sequential treatments (when deemed necessary) were evaluated to ascertain the need for multiple treatments to control weeds that emerged after the initial application. The treatments were nearly identical at all sites.

Results

There was very little to no injury to the alfalfa with the Roundup treatments. At some sites there were very slight injury symptoms but they were insignificant and short-lived. Alfalfa at the Kearney Agricultural Center site showed an initial reduction in plant height when treated with Roundup at the 6-9 trifoliate stage compared with other timings, but the injury was no longer evident by the time of first cutting.

The Raptor and the Pursuit plus Buctril tank mix treatments resulted in more injury. However, the injury was generally less than 20 percent at most locations. Alfalfa crop mortality occurred in all Roundup treatments. The Roundup Ready alfalfa planted for the trials was a

blend of experimental varieties and contained a small percentage of plants without Roundup resistance.

Better than 95 percent control of nearly all weeds was achieved with Roundup at all sites. These weeds included prickly lettuce, wild radish, shepherd's purse, volunteer wheat, volunteer oats, common groundsel, annual bluegrass, swinecress, chickweed, purslane, nightshade, and kochia. Roundup was less effective on henbit. While the 2.0 pounds active ingredient per acre rate (1.5 lbs. ae/A) of Roundup resulted in more rapid weed kill, it was generally not needed. A 0.5 pound active ingredient per acre rate was sufficient to control the summer annual weeds in the spring-seeded trial in the intermountain area.

The importance of the timing of Roundup application varied depending on weed species, location, and time of the year. At the intermountain site an application made at the unifoliate to first trifoliate timing resulted in subsequent invasion of prickly lettuce and henbit, but shepherd's purse was completely controlled, as there was no subsequent emergence of this weed after the initial application. A second application (3/28/02) was needed to control all the weeds that could infest first cutting. Similarly, a second application of Roundup was needed at one of the San Joaquin Valley sites (West Side Research and Extension Center) when the first Roundup application occurred when the alfalfa was at the cotyledon to unifoliate stage.

All of the Roundup timings resulted in excellent weed control in other trials. This was the case in the spring trial in the intermountain area and the trial on the east side of the San Joaquin Valley (Kearney Research and Extension Center). The situation was similar in the San Joaquin County trial, where all Roundup timings performed well. However, a second flush of annual bluegrass and canarygrass germinated in all treatments by early December. None of the herbicide treatments controlled this second flush of weeds.

Raptor and the Pursuit combinations controlled most

weeds, but not as complete control as with Roundup. Weeds not adequately controlled with Pursuit alone were purslane, prickly lettuce, henbit, kochia and the grasses. Raptor was more effective than Pursuit for the control of the grasses and was generally slightly more effective on some of the broadleaf weeds.

The Roundup Ready system of weed management shows significant promise for use in seedling alfalfa. It resulted in the best overall weed control of the treatments evaluated and there was considerable flexibility in treatment timing. One of the major causes for weed control failures with conventional herbicides is late application—the weeds become too large for complete control. It appears that this will not

be nearly as critical with glyphosate as it is with standard herbicides. Extremely early applications, at the unifoliate to first trifoliate growth stage are ill advised because at some sites and under some conditions subsequent weed invasion can occur because open areas in the young stand facilitate weed encroachment. Crop injury from glyphosate appears to be less than with most conventional herbicides.

Concerns and Other Issues

While this new technology has many advantages, Roundup Ready alfalfa will not be a panacea. Even though glyphosate is an extremely effective broad spectrum herbicide, there are still weeds such as malva and filaree that it does not adequately control. Continued use of glyphosate can over time result in a weed shift. While glyphosate is not as prone to weed resistance as are other herbicides, it still is feasible. Glyphosate-resistant ryegrass has already been found in the Sacramento Valley. Uninterrupted use of Roundup in a perennial crop like alfalfa, especially if followed by other Roundup Ready

crops, increases the likelihood of resistance. The key is to avoid continual reliance on a single herbicide for weed control—integrate several weed management strategies including cultural and

chemical weed control and alternate herbicides with different modes of action.

There are other issues related to Roundup Ready alfalfa that warrant consideration. Glyphosate obviously will not control Roundup Ready alfalfa. Hence, volunteer alfalfa may become more of a dilemma in rotation crops such as tomatoes, peppers, beans, etc., as glyphosate is often used to kill alfalfa prior to plowing or disking out an alfalfa stand in some areas. Similarly, volunteer alfalfa will be especially problematic when it appears in other Roundup Ready crops such as cotton and corn. Feral alfalfa growing along roadsides and non-crop areas may cross with Roundup Ready alfalfa. This is a concern, as many government agencies rely on glyphosate for control. Public acceptance of genetically-altered crops is an issue with alfalfa as it is with any transgenic crop. Adoption of Roundup Ready alfalfa by California producers will depend largely on the amount of the technology fee and the performance (both yield and quality) of Roundup Ready alfalfa varieties compared with conventional alfalfa varieties.

Conclusion

These results clearly demonstrate that there is a fit for Roundup Ready alfalfa in California alfalfa production systems. The commercial availability of Roundup Ready alfalfa awaits regulatory approval and may depend on agreements with alfalfa importing countries such as Japan. The introduction of Roundup Ready alfalfa varieties into California would be a significant advancement and would likely become a landmark in alfalfa weed control practices.