Herbicide Resistance Workshop

Weed Science Society of America
Montreal, Canada
February 5, 1990

PREFACE

During the 1990 Weed Science Society of America meeting in Montreal, Quebec, Canada, the Herbicide Resistant Weeds Committee sponsored their second evening workshop on herbicide resistance. The focus of the workshop was management of herbicide resistance. At the beginning of the evening, participants were asked to join one of three smaller working groups depending on their interests. The three groups focused on different types of resistance, specifically, diclofop-methyl, sulfonylurea, or triazine resistance. Each group had a leader who was selected to lead discussion on herbicide resistance problems, issues, research areas, and management strategies. After the working groups met, participants convened as one group to hear reports from the three leaders and for a general discussion. The following proceedings have been edited from tapes and notes taken during that workshop.

For more background on herbicide resistance and further information on the first evening workshop, held during the 1989 WSSA meeting in Dallas, Texas, see Weed Technology Volume 4(1), pages 139–220.

Jodie S. Holt, Chairperson
Herbicide Resistant Weeds Committee

Summary of Group Discussion on ALS (Acetolactatesynthase)/Sulfonylurea Resistance

Discussion leader was Dr. Donn Thill, University of Idaho.

1. How extensive is resistance to this herbicide/class?

In 1987, weed species in seven locations in Idaho, North Dakota, Kansas, and Colorado were documented as showing resistance to ALS-inhibiting herbicides. Weeds showing resistance were prickly lettuce and kochia. By 1988, a total of 68 locations showed resistance. Weeds showing resistance were prickly lettuce and kochia. By 1988, a total of 68 locations showed resistance. Weeds showing resistance now include Russian thistle and chickweed. No new species were reported as resistant during 1989. Through 1989, ALS resistance has been documented at 111 locations. These sites are in 10 U. S. states and two Canadian provinces. Of the total 111 locations, ALS resistance has been documented at 89 agricultural sites and 22 IVM (Integrated Vegetation Management) sites.

2. What are the biggest problems it poses?

Some isolated resistance is due to windblown plants. CRP (Crop Reduction Program) land could be a problem in the future. Currently, continuous wheat rotation and vegetation management sites are most likely to face ALS resistance problems. Weeds most susceptible to ALS herbicides are also most likely to show first signs of resistance. Potential for resistance problems exist in corn/soybean rotations because ALS-inhibiting herbicides are being marketed for use in both crops. Potential problems also exist in wheat/legume rotations for the same reason. Potential for problems is high in monoculture corn where ALS inhibitors are used for shattercane control.

3. What are the most important issues to address? Listed by the discussion group's rank of importance.

1) *Prevention* by rotating herbicides in existing cropping systems and changing cultural practices to include more mechanical tillage. 2) *Management* of existing conditions by attempting to predict in which species resistance is most likely to occur. Don't market products in areas where potential situations have been identified. Use more tankmix combinations. Quicker action is needed to identify problem sites. At problem sites, use spot control with selective herbicides to prevent the spread of resistance. Caution against the use of other herbicides with similar modes of action, which may prolong or increase the problem. 3) *Understanding mechanism of action.* More sharing of information among manufacturers is necessary to better understand the ALS mechanism of action. A group has been formed to do just that. 4) *Other* points mentioned, but

Weed Technology. 1991. Volume 5:244–246

not discussed in detail, included: Farm Bill policies, grower compliance, education, and cancellation of classes of affected herbicides.

4. What are the most important research areas to address? Listed by the discussion group's rank of importance.

1) *Ecology* and environmental factors involved. This includes a better understanding of weed seed life in soil. Understanding causes versus responses. 2) *Gene flow* and genetics in weed populations. 3) *General effectiveness of management systems*. Included are effectiveness of alternatives and the need for chemicals with new/different modes of action. How this will or can be done was discussed. It will take money. Even when only cultivation is used, different weeds tend to become a problem.

5. How can resistant weeds be controlled?

Foremost is the need to evaluate how resistance problems are currently being managed. Other items discussed included the need to recognize problem sites and act quickly and to explore ideas entomologists have gained from dealing with insecticide-resistant insects.

Summary of Group Discussion on Diclofop-Methyl Resistance

Discussion leader was Dr. Arnold Appleby, Oregon State University.

1. How extensive is resistance to this herbicide/class?

The majority of resistance to diclofop has been documented in annual ryegrass in Australia. Approximately 300 farmers across 5000 km have experienced resistance problems with *Lolium rigidum*; more recently, six farmers across 5000 km have reported resistance problems with *Avena*. Many of the *Lolium* biotypes have shown cross-resistance to several other herbicides used in small grains in Australia. The first reported resistance in the U. S. has been noted in *Lolium multiflorum* on a small, localized scale in Oregon. Resistance in *Avena fatua* in Oregon has now been documented.

2. What are the biggest problems it poses?

Diclofop resistance is already a farm-scale problem in Australia and poses a strong threat to small grain production in the U. S. and Canada.

3. What are the most important issues to address?
4. What are the most important research areas to address?

The group chose to address these questions together, and developed the following list of issues/questions: 1) Industry's status and stance on the diclofop resistance issue must be determined. Because the issue is relatively new, industry needs to understand the complete situation and review alternatives for control. 2) Further evaluation is needed to determine if resistant biotypes are less fit or pose less of a threat than susceptible biotypes. 3) Additional work is needed to determine differences in metabolism between resistant and susceptible biotypes. Initial research is inconclusive and raises additional questions. 4) Work is also needed to determine differences in isozymes. 5) Herbicide strategies must be developed to address the situation, particularly strategies that attack resistance at multiple action sites. 6) A model is now being developed to help determine the rate at which diclofop resistance is developing–how fast it's spreading, how it's spreading, etc.

5. How can resistant weeds be controlled (general strategies, specific methods)?

Four options were discussed by the group: 1) Don't let future resistance develop. Reduce selection pressure through herbicide rotation. 2) Practice crop rotation where possible. 3) Consider introducing sensitive biotypes to resistant biotypes to try to "dilute" the resistance. This option, the group agreed, would be extremely difficult to sell to farmers. 4) "If you can't beat it, join it!" Make a cultivar out of the resistant wild oats for the turf market.

Summary of Group Discussion on Triazine Resistance

Discussion leader was Dr. Ron Ritter, University of Maryland.

1. How extensive is resistance to this herbicide/class?

Participants indicated that triazine-resistant weeds (TRWs) have been identified in Mid-Atlantic states, Virginia, New York, Connecticut, New England, and Ontario, in the North Central region and the High Plains, New Mexico, Arizona (primarily in right-of-ways), and California. The group concluded that TRWs infest the entire continental U. S. except in the Delta and Southeast. With the group in agreement that the

problems are widespread, the question was asked whether triazine herbicides are still needed. The group concluded that because atrazine in particular still offers many benefits for weed control, triazine herbicides are definitely still needed.

2. What are the most important issues to address?

Dr. Ritter mentioned the presence of cross-resistance by TRWs to other herbicides with similar modes of action. The group then discussed the potential for resistance to herbicides with different modes of action. A point raised in the discussion was that in metabolic triazine resistance that does not occur at the PSII binding site, TRWs could also be resistant to sulfonylurea herbicides and other ALS inhibitors. The group indicated that this could be possible, however there was disagreement with that conclusion. The potential impact of triazine-resistant crops was discussed. Although it was felt by some that resistant crops would not lead to the major use of one herbicide across many different crops, the group in general felt that the development of herbicide-resistant crops might foster the initiation and spread of other resistant weed biotypes.

3. What are the most important research areas to address?

A question was raised that led to significant discussion on the actual cause of triazine resistance. The group concluded that other contributing factors are present besides just use of a triazine every year on continuous corn in a minimum tillage situation. These contributing factors might include: a) effect of ecological changes in weed population dynamics; b) selection from small mammals eating weed seeds; c) the spreading of seeds by wind, combines, etc.; d) timing of planting and weed control practices; and 3) crop rotation. The need to study how triazine resistance spreads, from the use of herbicides to how cultural practices may favor resistant weeds, should be pursued. Also important is research on how the conditions favorable to selection for resistance can be avoided, plus studies that examine ways to lessen any natural advantage to TRWs.

Dr. Don Penner of Michigan State University discussed his development of a field identification test kit (using the "floating disc" technique). In work with six test kits by extension workers in Michigan last summer, weeds were tested for resistance in the field and retested in the greenhouse and there was only one discrepancy. Dr. Penner indicated that 40 kits will be in use this season. He said that it is conceivable that cross-resistance to other photoinhibiting herbicides may be identified by this test. The group concluded that research on the identification of TRWs is also very important.

4. How can resistant weeds be controlled?

The group concluded that education is needed at the grass roots level. Such education should include information about crop and herbicide rotation practices best suited to preventing the problem from developing any further.