PRESENCE AND DISTRIBUTION OF ALS RESISTANT KOCHIA IN THE BIG HORN BASIN OF WYOMING

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ABSTRACT

The purpose of this research was to collect data on the presence and distribution of ALS resistant *Kochia scoparia* in the Big Horn Basin area of Wyoming. The Big Horn Basin is contained with in the following counties Bighorn, Hot Spring, Park, and Washakie. The sites were verified in a three-step process consisting of visual observation of possible sites, GPS data collection and laboratory experimentation for confirmation of resistance. The results are being distributed as appropriate to prevent further expansion of the ALS resistant kochia population.

INTRODUCTION

Weed control is critical to production of food and fiber crops. Crops have to compete with weeds for light, nutrients, space, and water. The loss of effective weed control because of herbicide resistance is well documented. Kochia *(Kochia scoparia)* is a weed of many annual cropping systems including small grains, sugar beets, dry beans and range situations. Resistant biotypes of kochia have been identified for triazines, benzoics, phenoxy, imidazolinones and sulfonylurea (ALS) type herbicides (Tonks, D.J. and Westra, P., 1997). There are currently at least 3 countries and 17 states in the United States that have ALS resistant kochia populations, KS, ND, NM, SD, CO, ID, MT, WA, OK, OR, MN, IL, IN, WI, WY, TX, and UT (Heap, I., 2003). Originally a native of Asia, kochia is an annual, herbaceous dicot in the Chenopodiaceae (goosefoot) family. The height of kochia depends on seasonal growing conditions and can vary from a few inches to over 6 feet with small inconspicuous flowers and small 1/16 inch seeds. The leaves are alternate, simple, hairy, pointed, 1 to 2 inches long, and have no petioles (Whitson, T.D. et al., 1996). Several factors allow kochia to grow well under dry conditions. One characteristic is the deep taproot of kochia that can grow into the soil profile where it can find moisture unavailable to many plants giving it a competitive advantage. Additionally, studies reveal that kochia can germinate under a wide variety of soil salinity and pH ranges that many other crop and weed species cannot tolerate (Knake, E. L., 1998). Three chemical families of active herbicides, imidazolinones (IMI), sulfonylureas (SU) and sulfonamides, inhibit Acetolactate Synthase (ALS). These herbicides are mainly used for weed control in agricultural cropping systems but also have utility in industrial, forestry and right of way applications.

The ALS enzyme catalyzes the first step in the biosynthesis of branched chain amino acids and is inhibited by ALS herbicides. The loss of this step in plants causes cessation of metabolic pathways and death ensues. ALS resistant and ALS susceptible kochia grown alone, in competition with each other, or with wheat had similar biomass and seed production indicating that sulfonylurea resistance resulted in no reduction of biomass and seed production relative to the susceptible biotype (Maxwell, B. D., 1992 and Thompson, C. R. et al., 1994). The objective of this research was to determine the extent of ALS resistant kochia in the Big Horn basin area of Wyoming. The Big Horn Basin is contained with in the following counties: Bighorn, Hot Spring, Park, and Washakie.

MATERIALS AND METHODS

One hundred twenty questionnaires were given out to local agricultural producers in the Big Horn Basin to assess the possible presence of ALS resistant kochia in areas that were under control of the producers. Kochia seeds were collected from 40 different fields (sites) across the Big Horn Basin. The sites were verified in a three-step process consisting of visual observation, Global Positioning Satellite (GPS) location and laboratory experimentation for confirmation. GPS positions were taken adjacent to the plants where the seed was collected. All the seeds were collected from a single plant per field. Seeds were then allowed to dry to ambient air humidity in an outside drying building. Seeds were then separated from the stems and cleaned by hand. Soybean tolerance protocols were used for the testing of herbicide resistance with chlorsulfuron. The seeds were placed in a petrie dish with a single circle of filter paper. For each site 10 replicates with 25 seeds per replicate were treated with a one part per million ALS herbicide and deionized water, with similar but untreated controls. The seeds were allowed to germinate and grow in the petrie dish for 14 days at 20°C. Germinated seeds were then observed for herbicide resistance. Abnormal seedlings, chlorosis, necrosis and excessive anthocyanin are symptoms of sensitivity to chlorsulfuron and the number of resistant seeds counted and tallied.

RESULTS AND DISCUSSION

One hundred twenty questionnaires were sent out to local agricultural producers in the Big Horn Basin with a stamped return envelope. There was a 0.83% response rate to the mailing, only one reply was received. Questionnaires do not seem to be an efficient method in obtaining information for herbicide resistance in the Big Horn Basin.

Preliminary resistance was found at the following levels, 47.1% of the herbicide treated seed and 57.2% of the control seed germinated. Of all the ALS herbicide treated seed only 4.2% of the total germinated seed showed resistance for the 40 sites that were sampled (Table 1).

Twelve out of the 40 sites showed ALS resistance, with a level at 11.8% of the germinated seeds for these 12 sites being resistant to chlorsulfuron herbicide (Table 2). There is roughly a 30% infestation rate of sites sampled, but the actual percentage of resistant site maybe lower as seed selection was

conducted with the intent of finding chlorsulfuron resistant kochia seed. This information infers that there is indeed herbicide resistant kochia occurring in the Big Horn Basin region of Wyoming.

Table 1. ALS Resistance for 40 sites across the Big Horn Basin.

Treatment	Total Seeds	Seeds Germinated	% Seed Germinated	ALS resistant Seed Total
CONTROL	10,000	5720	57.2	0
TREATED	10,000	4710	47.1	420

Table 2. ALS Resistance for the 12 sites with Resistance.

Treatment	Total Seeds	Seeds Germinated	% Seed Germinated	ALS resistant Seed Total	% esistant
TREATED	3,000	1413	47.1	167	11.8

CONCLUSIONS

There are several successful methods of mechanical, cultural, chemical and biological control for kochia. It is important to remember that proper management usually requires multiple types of control methods. For chemical control many herbicides, other than ALS, are labeled for control of kochia. These herbicides can be effective tools for kochia control, especially when applied at the seedling stage. These herbicides have different modes of actions and affect different plant enzymes. Some enzymes are susceptible to the herbicide, others are metabolized and do not adversely affect the plant. Fluroxypyr, dicamba, 2, 4-D ester, bromoxynil, and bromoxynil + MCPA all work well on kochia (Friesen, L. F. et al., 1993 and Tonks, D.J. and Westra, P., 1997). There has been documented resistance to dicamba, a benzoic herbicide, 2, 4-D and MCPA, both phenoxy herbicides, in kochia under field conditions (Tonks, D. J. and Westra, P., 1997). Fluroxypyr (a pyridine herbicide), bromoxynil (a nitrile herbicide) still have excellent levels of control on kochia (Friesen, L. F. et al., 1993). It is common practice to mix herbicides with different modes of action in the plant tissues to not only avoid weed resistance but also achieve better overall weed control. This is sometimes due to synergistic effects that cause greater harm than the sum of individual herbicides alone. By using different herbicides with different modes of actions the plant systems are overloaded and resistance is more difficult to achieve. Also, the probability of evolving resistance to two different herbicides simultaneously is very small.

Additional sites should be collected and tested to further delineate the extent of ALS resistant kochia in the Big Horn Basin. Results will be distributed to Weed and Pest Coordinators as well as interested parties from the Big Horn Basin to promote the integrated control of kochia in crop and rangeland settings. Research into the mechanisms of weed resistance will help with the integrated control of kochia and other weeds in crop and rangeland settings and to prevent the further expansion of herbicide resistance.

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