Dinitroaniline Resistance in Barnyardgrass (Echinochloa crusgalli (L.) Beav.)

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When a weed species that has been susceptible to a herbicide develops populations that can now tolerate the herbicide, that species is said to have developed resistance to the herbicide. Over 30 weed species have been reported to have developed resistance to one or more of at least 11 chemical families of herbicides. Resistance to the triazine and acetolactate synthase inhibiting herbicides have been the most numerous.

The dinitroaniline herbicides have been used for over three decades in the growing of many crops. In the San Joaquin Valley of California, trifluralin is the dinitroaniline that has been used most extensively, primarily in the growing of cotton. Worldwide, resistance to the dinitroanilines has been reported only on four species of weeds: Palmer amaranth, goosegrass, green foxtail and johnsongrass.

Observations of poor control of barnyardgrass by trifluralin in cotton fields located in Tulare County of California was the first indication that this species might be developing resistance. Later discussions with others revealed a similar concern from a site in Kings County, California.

Barnyardgrass seed from plants suspected of being dinitroaniline resistant were collected from cotton fields in Tulare and Kings County where the control of barnyardgrass with trifluralin had recently not been satisfactory. Seeds of barnyardgrass were collected from plants growing nearby in areas where dinitroaniline herbicides had not been used and were presumably susceptible to dinitroanilines.

Of the four herbicides selected for this study, two were dinitroanilines – trifluralin and pendimethalin. The mode of action of this chemical family of herbicides is to interfere with cell division in root tips of germinating seedling by interfering with intermediate steps of mitotic cell division. Any potential differences in the details of the mode of action between these two herbicides have not been investigated/reported. The other two herbicides are also used soil incorporated preemergence to weeds. The mode of action of these two herbicides is distinctly different from the dinitroanilines (atrazine interferes with photosynthesis and napropamide stops mitotic cell division before it starts. Based on the crop rotation used on the field sites involved, it is unlikely that napropamide or atrazine had been used in the fields where the resistant barnyard grass occurred.

The response of the seeds from each of the four sites was evaluated when exposed to varying rates of four preplant incorporated herbicides. Trifluralin, pendimethalin, atrazine or napropamide was applied to the soil at 0, ½, 1, 2 and 4 times a frequently used recommended rate. The recommended (1x) rates used (kg active ingredient per ha) were trifluralin 0.56,

pendimethalin 0.56, atrazine 2.22, and napropamide 1.68. All plants were grown in a greenhouse for 30 days. The percent reduction in total shoot dry weight per pot caused by the recommended (1x) rate of these four herbicides to barnyardgrass seedlings collected from four sites is shown below.

	Tulare County		Kings County	
Herbicide	**Susceptible**	**Resistant**	**Susceptible**	**Resistant**
trifluralin	57	10	59	29
pendimethalin	99	73	99	82
napropamide	98	98	98	98
atrazine	97	97	97	97

This summary table clearly shows that a biotype exists in both counties that is resistant to trifluralin and that the resistant biotype from Tulare County is more resistant than the resistant biotype from Kings County. At an equivalent rate of use, pendimethalin produced greater reduction in barnyardgrass seedling growth than trifluralin for all biotypes. The resistant biotype from both counties had less reduction in growth than the susceptible biotype with pendimethalin as compared to trifluralin.

For napropamide and atrazine, all biotypes were able to grow very little compared to the untreated control. Thus there is no indication of a cross-resistance being present between these two herbicides and the dinitroanilines trifluralin and pendimethalin.

To prevent a buildup of barnyardgrass that is resistant to trifluralin, cotton growers could use a selective postemergence grass herbicide before the barnyardgrass produces seed. They should also rotate to another crop where a soil applied herbicide with a different mode of action could be used to control the dinitroaniline resistant barnyardgrass.