Research reports

First report of the pendimethalin injury to cotton

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Summary

There are various physiological disorders that commonly affect cotton crops including nutrient deficiencies, phytotoxicity from pesticides, and environmental effects. Several herbicides used on cotton are capable of chemical injury when applied contrary to label instructions or under certain environmental conditions. Spray tank contamination can be a problem when farmers apply insecticides to crops with herbicide-contaminated sprayers and cotton is very sensitive to tank contamination. Pendimethalin (33% w/w) is a pre-emergent, preplant-incorporated or early post-emergence, directed dinitroaniline herbicide commonly used in Pakistan. This is the first report of injury on cotton in Pakistan from pendimethalin. This injury was the result of spraying cotton with the insecticide methamedophos (50% w/w) using a pendimethalin-contaminated sprayer. Severe distortion, puckering of leaves, elongation of bracts and lobes of leaves, decrease in lamina expansion, strapping of veins and elongation of leaf petioles were observed as characteristic symptoms of the injury.

Keywords: *Gossypium hirsutum*, herbicide, insecticide, phytotoxicity, pendimethalin, methamedophos.

Introduction

Crop yield and quality depends on effective application of agricultural chemicals. Proper selection, use and maintenance of sprayers can save money, improve the performance of the agrichemicals used and protect the environment (Johnson *et al*. 2005). The phytotoxic effects of small concentrations of herbicides occurring as soil residues, spray drift or spray tank contamination on non-target crop species are well documented (Hemphill and Montgomery 1981, Derksen 1989, Moyer *et al*. 1990, Friesen and Wall 1991, Al-Khatib *et al*. 1993, Eberlein and Guttieri 1994, Wall 1994a, 1994b, 1995). Spray tank contamination can be a problem when farmers apply insecticides to crops with herbicide-contaminated sprayers. Serious crop injury can result from small amounts of herbicides remaining in the sprayer system. Crop injury from sprayer contamination can occur up to several months after using the sprayer if it has not been cleaned properly. Injury from sprayer contamination can affect crop growth and development for several weeks after application and in severe cases can reduce crop yields. With the increased emphasis on custom application of herbicides, post-emergence weed control and use of herbicides that are active at low application rates, proper cleaning and maintenance of sprayers will be increasingly necessary to avoid injury to non-target crop species (Johnson *et al*. 2005).

Observations

Cotton (*Gossypium hirsutum* L.) is a fibre crop intensively cultivated in tropical and subtropical regions of the world. In September 2002 a farmer's cotton field was visited near Faisalabad (Pakistan) as a part of the routine program of farm visits. The farm has a previous history of cotton production. A patch of cotton containing several varieties was observed to have foliar distortion similar to damage resulting from the misapplication of herbicides. This distortion was present only on one side of the field. The same varieties occurring in other areas of the field did not exhibit similar symptoms. The symptoms observed were somewhat similar to the injury caused by phenoxy-type herbicides such as 2,4-D and 2,4-DB (Kirkpatrick and Rothrock 2001). Symptoms included misshapen leaves with severe distortion and puckering, elongation of bracts and lobes of leaves, decrease in lamina expansion, strapping of veins and elongation of leaf petioles (Figures 1, 2). However, during discussions the farmer claimed that he has not used either 2,4-D or 2,4-DB. He believed that he had used only recommended insecticides at recommended rates with this sprayer. During July 2003 another farmer encountered the same problem. His farm was located 70–80 km away from the first farm. Symptoms were restricted to the area where the spraying had started and were absent in the remainder of the field. This farmer realized that he applied pendimethalin while preparing land for a cabbage crop and the next day used the same sprayer for insecticide applications on cotton. The pendimethalin-damaged area of the field was treated identically to the rest of the field for the duration of the growing season. Two to four weeks after the initial symptoms developed the injured plants appeared to have recovered, as new growth during this period was healthy. However, the portion of the plants receiving injury from sprayer contamination did not produce any healthy bolls.

A greenhouse test was conducted during July and August 2003 in an attempt

Figure 1. Severe distortion, puckering of leaves, elongation of bracts and lobes of leaves, decrease in lamina expansion, strapping of veins and elongation of leaf petioles of cotton caused by tank contamination under field conditions.

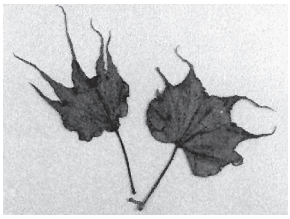

Figure 2. Severe distortion, puckering of leaves, elongation of petioles and lobes of leaves, decrease in lamina expansion and strapping of veins of cotton caused by tank contamination under field conditions.

Figure 3. Chlorosis, necrosis, cupping of leaves of cotton caused by tank contamination under glass house conditions.

Figure 4. Severe distortion, puckering of leaves, elongation of lobes of leaves, decrease in lamina expansion and strapping of veins of cotton caused by tank contamination under glass house conditions.

Figure 5. Distortion of leaf and strapping of veins of cotton caused by tank contamination under glass house conditions.

to recreate the symptoms observed in the field. Five plants of the upland cotton cultivar 'Cedix' were sprayed with the insecticide methamedophos using a pendimethalin-contaminated sprayer, five plants with insecticide methamedophos, five plants with pendimethalin while five plants were kept as control as no treatment was applied to them. The average day temperature in the greenhouse was 45°C during the course of study. Plants sprayed with methamedophos using the pendimethalin-contaminated tank showed chlorosis followed by necrosis of old leaves and cupping of the upper leaves within 3 to 5 days after spraying (Figure 3). New growth of these plants showed severe distortion, puckering of leaves, elongation of bracts and lobes of leaves, decrease in lamina expansion, strapping of veins and elongation of leaf petioles after 7–10 days (Figures 4, 5). These plants were maintained (kept alive) utilizing normal irrigation and fertilizer requirements. Plants showing only necrosis and chlorosis recovered soon after while plants showing severe symptoms recovered after 3–5 weeks. The plants treated only with pendimethalin exhibited only burning of the sprayed areas and new growth was free from injury while plants sprayed with insecticide methamedophos and control plants were free from any injury.

These results indicate that the severe distortion observed was the result of the tank contamination. This injury seems to be temporary but yield losses of 20–30% or more have been observed. Therefore it is advisable to use separate sprayers for herbicides and insecticides or wash all spraying apparatus thoroughly following the appropriate cleanup procedures after use.

References

Al-Khatib, K., Mink, G.I., Reisenauer, G., Parker, R., Westberg, H. and Lamb, B. (1993). Development of a biologically-based system for detection and tracking of airborne herbicides. *Weed Technology* 7, 404-10.

Derksen, D.A. (1989). Dicamba, chlorsulfuron, and clopyralid as sprayer contaminants on sunflower (*Helianthus annuus*), mustard (*Brassica juncea*), and lentil (*Lens culinaris*), respectively. *Weed Science* 37, 616-21.

Eberlein, C.V. and Guttieri, M.J. (1994). Potato (*Solanum tuberosum*) response to simulated drift of imidazolinone herbicides. *Weed Science* 42, 70-5.

Friesen, G.H. and Wall, D.A. (1991). Residual effects of CGA-131036 and chlorsulfuron on spring-sown rotational crops. *Weed Science* 39, 280-3.

Hemphill, D.D. and Montgomery, M.L. (1981). Response of vegetable crops to sublethal applications of 2,4-D. *Weed Science* 29, 632-5.

Johnson, B., Casady, B., Peterson, D. and Kuhlman, D. (2005). Cleaning field sprayers to avoid crop injury In: Weed Control: MU Guide. http://muextension.missouri.edu/explorepdf/agguides/crops/g04852.pdf.

Kirkpatrick, T.L. and Rothrock, C.K. (2001). 'Compendium of cotton diseases', 2nd edition, p. 100. (The American Phytopathological Society, Minnesota USA).

Moyer, J.R., Esau, R. and Kozub, G.C. (1990). Chlorsulfuron persistence and response in nine rotational crops in alkaline soils of southern Alberta. *Weed Technology* 4, 543-8.

Wall, D.A. (1994a). Response of potato (*Solanum tuberosum*) to simulated drift of dicamba, clopyralid and tribenuron. *Weed Science* 42, 110-4.

Wall D.A. (1994b). Response of five-broadleaf crops to simulated thifensulfuron: tribenuron (2:1) spray drift. *Weed Technology* 8, 785-3.

Wall, D.A. (1995). Response of four annual broadleaf crops to simulated imazamethabenz spray drift. *Canadian Journal of Plant Science* 75, 751-7.

Note

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