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Effect of Crop and Herbicide Rotations on Weed Dynamics with Special Reference to *Asphodelus tenuifolius* in Mustard in Arid Region of Rajasthan

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ABSTRACT

Crop rotation of mustard-wheat-wheat-mustard was most effective in arresting population of *Asphodelus tenuifolius* with similar effect on weed dry weight. As a result, it improved yield attributes and seed yield of mustard by 667 kg ha^{-1} compared with continuous mustard rotation. The herbicidal control (fluchloralin at 1.0 kg ha^{-1} in mustard and 2, 4-D at 0.5 kg ha^{-1} in wheat) in mustard-wheat-wheat-mustard rotation controlled *A. tenuifolius* and total weeds effectively and thus significantly enhanced the seed yield of mustard. On the contrary, use of fluchloralin alone without any herbicide rotation in continuous mustard did not control *A. tenuifolius* effectively and thereby, reduced the seed yield of mustard compared to all other rotations.

INTRODUCTION

Mustard [*Brassica juncea* (L.) Czern & Coss] is the most important winter oilseed crop of arid and semi-arid regions of Rajasthan. Weed infestation particularly of *Asphodelus tenuifolius* is one of the important reasons of low productivity of mustard and is known to reduce its yield to the extent of 56% (Yaduraju *et al.*, 2000). Removal of this weed by mechanical means is costly and time consuming. Dinitroaniline herbicides are widely used to control annual weeds in mustard (Singh *et al.*, 2000). But *A. tenuifolius* is relatively tolerant to these herbicides. Moreover, with continuous use of single group of herbicides, the non-target weeds increase gradually and become predominant over others. No other herbicide selective to mustard has been found to control this problem weed effectively. Application of 2, 4-D in wheat has been found to control *A. tenuifolius* alongwith other weeds effectively (Poonia *et al.*, 2001). So, rotation of crops with herbicides could be a better strategy to control weeds more effectively which is considered to be an efficient system to minimize weed competition (Karlen *et al.*, 1994).

It also facilitates herbicide rotation in the cropping system. With these considerations, the present study involving crop and herbicide rotations was conducted with an objective to control *A. tenuifolius* in mustard effectively.

MATERIALS AND METHODS

The field experiment was conducted during four consecutive winter seasons from 1996 to 2000 on a permanent plot located at Agricultural Research Station, Mandore (Jodhpur) situated in arid western plain zone of Rajasthan. Soil of the experimental plot was loamy sand in texture, alkaline in reaction (pH 8.2) with low organic carbon (0.31%), medium available phosphorus (13.2 kg ha^{-1}) and high available potassium (260 kg ha^{-1}). The experimental field was fallow in rainy season during all the four years. The experiment was conducted in split plot design with three replications. The treatments comprised factorial combinations of four crop rotations (Mustard-wheat-wheat-mustard; mustard-mustard-wheat-mustard; mustard-wheat-mustard-mustard and mustard-mustard-mustard-mustard allocated to main plots and three weed control treatments (weedy check, hand weeding at 25 days after sowing (DAS) and fluchloralin at 1.0 kg ha^{-1} in mustard and 2, 4-D at 0.5 kg ha^{-1} in wheat). Mustard cultivar Bio-902 was sown in second week of October with crop geometry of 30 cm x 15 cm and wheat cultivar Raj-3077 in 3rd week of November at

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a row spacing of 22.5 cm during all the years of study. As a common practice of the region and in order to ensure good germination of the crops and weeds simultaneously, irrigation was given after dry seeding of the crops. Seven irrigations were given to wheat and three to mustard during the crop seasons as per recommendation. The crops, besides above, were raised with recommended package of practices. Mustard was harvested in the first week of March and wheat in first week of April during the crop seasons. The number and kind of weeds in mustard were recorded prior to hand weeding (25 DAS) and the dry weight of individual weeds at harvest from sample rows in each plot using a 50 cm x 50 cm quadrate randomly at 4 points.

RESULTS AND DISCUSSION

Effect on Weeds

The experimental field was heavily infested with *Asphodelus tenuifolius, Rumex dentatus, Chenopodium album, Melilotus indica* and *Cyperus rotundus* were also present. The interaction effect between crop rotations and weed control methods on density and dry weight of *A. tenuifolius* and total weeds was found to be significant over the seasons. Under weedy check, mustard-wheat-wheat-mustard rotation (MWWM) decreased *A. tenuifolius* density over the years, while it increased in all other rotations (Fig. 1). However, maximum increase in the form of density of *A. tenuifolius* was observed in continuous mustard rotation (MMMM). The dry weight of *A. tenuifolius* at maturity over the years also increased in all the crop rotations except in MWWM where marginal change was observed under weedy check over the season (Fig. 4). Maximum increase in *A. tenuifolius* dry weight was obtained in continuous mustard rotation. Similar trend was also observed in total weeds density and dry weight over the years (Figs. 7 and 10).

Efficacy of herbicidal control also varied considerably with crop and herbicide use in crop rotation (Fig. 2). Minimum *A. tenuifolius* density and dry weight were observed in the plots in which wheat was the preceding crop in the rotations (Figs. 2 and 5). This may because of 2, 4-D application that had an effective control of *A. tenuifolius* in wheat. Poonia *et al.* (2001) also reported effective control of *A. tenuifolius* in wheat. MWWM rotation alongwith the application of herbicides (2, 4-D in wheat and fluchloralin in mustard) significantly decreased the *A. tenuifolius* density and dry weight, whereas it increased progressively in plots in which only fluchloralin was applied in continuous mustard rotations over the years. This may be due to tolerance of *A. tenuifolius* to fluchloralin and acquiring dominance due to better control of other weeds under this treatment. Singh *et al.* (2000) also reported similar results. The density and dry weight of *A. tenuifolius* affected marginally in other rotations like mustard-wheat-mustard-mustard (MWMM) and mustard-mustard-wheat-mustard (MMWM) under herbicidal control. Role of crop and herbicide rotation in controlling problematic weeds had also been reported by Dale and Chandler (1979) who found effective control of *Sorghum halepense* in corn grown in rotation with cotton. The total weed density and dry weight were also reduced under all the crop rotations except in continuous mustard for four years where it increased many fold (Figs. 8 and 11). Continuous hand weeding over the preceding three seasons under MWWM rotation reduced the density and dry weight of *A. tenuifolius* compared to continuous mustard rotation (MMMM) (Figs. 3 and 6). Similar trend was also observed in total weeds and dry weight (Figs. 9 and 12).

Rumex, on the other hand, increased over years in number and dry weight under weedy check as well as under herbicidal control over the years under MWWM rotation (data not given) due possibly to its uninterrupted growth under weedy check and its greater affinity to the intervening wheat crop (Malik *et al.*, 1993). Minimum density and dry weight of *Rumex* were recorded in continuous mustard rotation (MMMM).

Effect on Crop

It was evident from Table 1 that seed yield of mustard after preceding wheat in different crop rotations increased by 23, 48.6 and 25.5% over

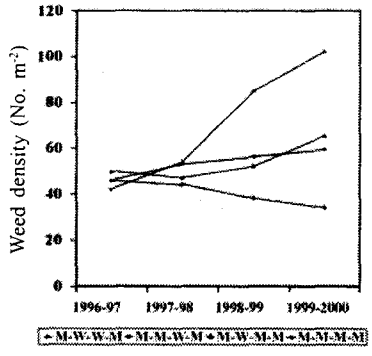

Fig. 1. Density of *Asphodelus* in weedy plots.

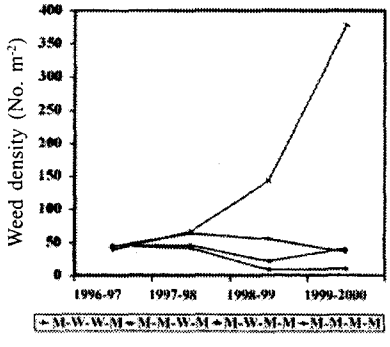

Fig. 2. Density of *Asphodelus* in herbicide treated plots.

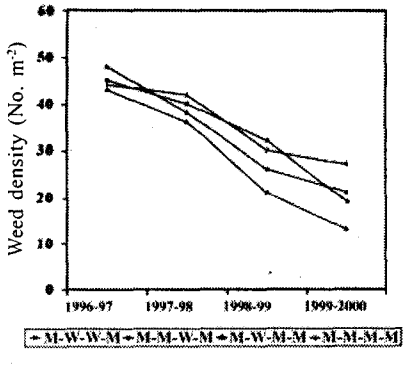

Fig. 3. Weed density of *Asphodelus* in hand weeded plots.

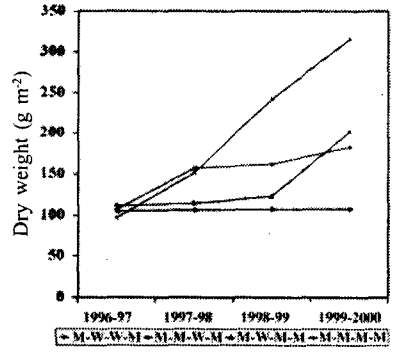

Fig. 4. Dry weight of *Asphodelus* in weedy plots.

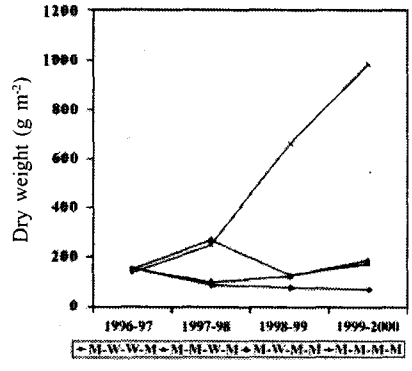

Fig. 5. Dry weight of *Asphodelus* in herbicide treated plots.

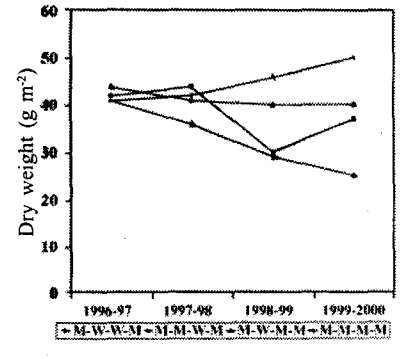

Fig. 6. Dry weight of *Asphodelus* in hand weeded plots.

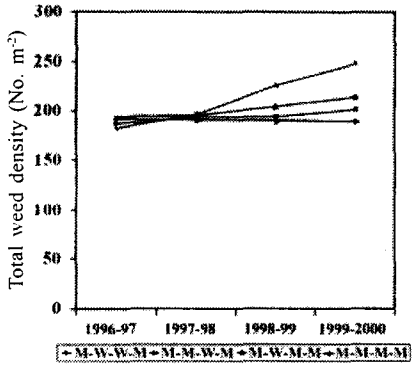

Fig. 7. Total weed density in weedy plot.

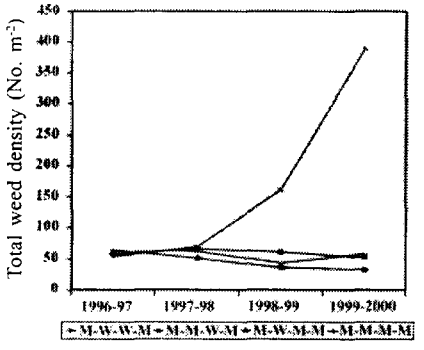

Fig. 8. Total weed density in herbicide treated plots.

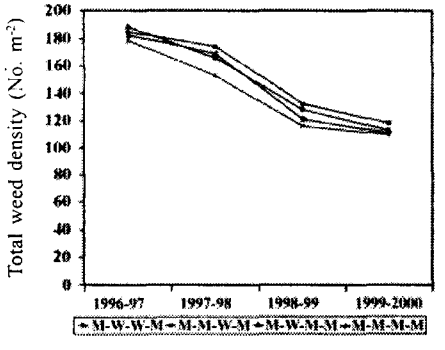

Fig. 9. Total weed density in hand weeded plots.

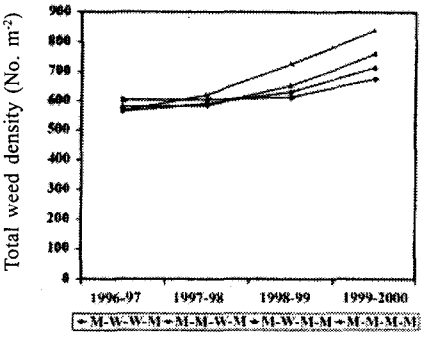

Fig. 10. Total weed dry weight in weedy plots.

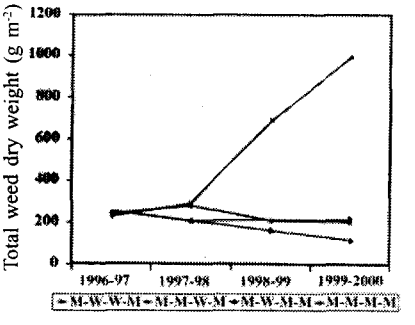

Fig. 11. Total weed dry weight in herbicide treated plots.

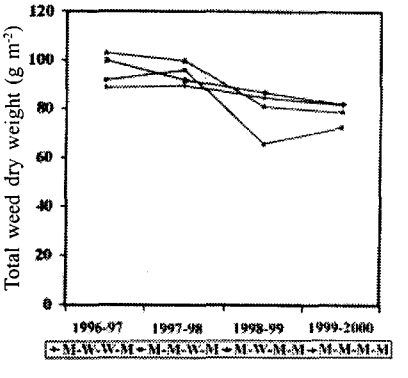

Fig. 12. Total weed dry weight in hand weeded plots.

Table 1. Interaction effect of crop and herbicide rotations and weed control methods on seed yield (kg ha^{-1}) of mustard

Crop rotation (R)	Weed control methods											
	Weedy check				Hand weeding				Herbicidal control			
	1996-97	1997-98	1998-99	1999-2000	1996-97	1997-98	1998-99	1999-2000	1996-97	1997-98	1998-99	1999-2000
M-W-W-M	2879	4622	4018	2018	3280	5239	5259	3018	3197	4872	5352	2890
M-M-W-M	2871	1744	4667	2167	3174	2167	5296	2593	2916	2324	5241	2761
M-W-M-M	2810	4243	2111	1945	3007	5294	2902	2445	2924	5128	2840	2630
M-M-M-M	2697	1739	1715	1722	2916	1739	1952	1944	3273	2083	2262	2259

LSD (P=0.05) : (R x C) 1996-97=NS; 1999-2000=207

M–Mustard, W–Wheat, R–Crop rotation, C–Weed control methods.

Herbicidal control : Fluchloralin in mustard and 2, 4-D in wheat under different rotations.

continuous mustard (MMMM) rotation under weedy check, herbicidal control and hand weeding, respectively, during third year of rotation (1998-99). As a consequence of interaction effect of weed control treatments with different crop rotations on the control of different weed species, a significant interaction effect of these weed control methods with different crop rotations was also noted on seed yield of mustard during fourth year of study (1999-2000). Maximum and significantly higher seed yield (3018 kg ha^{-1}) of mustard was obtained in the plots having mustard-wheat-wheat-mustard (MWWM) rotation alongwith the application of fluchloralin in mustard and 2, 4-D in wheat compared to all other treatments (Table 1). This may be due to better control of *A. tenuifolius* and total weeds under crop (MWWM) and herbicidal rotations (Figs. 2, 5, 8 and 11). Minimum and significantly lower seed yield of mustard was obtained in continuous mustard rotation with the use of single herbicide (fluchloralin) compared with all other crop rotations. This may be due to poor control of *A. tenuifolius* in continuous mustard rotation alongwith fluchloralin application (Figs. 2, 5, 8 and 11).

Thus, it could be concluded from a four-year study of weed control in different crop rotations involving mustard and wheat in different proportions that weeds by and large and *A. tenuifolius* in particular in mustard could best be controlled with use of herbicide rotations, namely, fluchloralin at 1.0 kg ha^{-1} in mustard and 2, 4-D at 0.5 kg ha^{-1} in wheat by adopting mustard-wheat-wheat-mustard (MWWM) rotation.

REFERENCES

Dale, J. E. and J. M. Chandler, 1979. Herbicide-crop rotation for grass (*Sorghum halepens*) control. *Weed Sci.* **27** : 479-485.

Karlen, D. L., G. E. Varvel, D. G. Bullock and R. M. Cruse, 1994. Crop rotation for the 21 century. *Adv. in Agron.* **53** : 1-45.

Malik, R. K. and S. Singh, 1993. Evolving strategies for herbicide use in wheat : Resistance and integrated weed management. In : Proc. International Symposium on Integrated Weed Management for Sustainable Agriculture held at CCSHAU, Hisar from Nov. 18-20, **1** : 225-238.

Poonia, B. L., N. K. Jain and S. K. Singh, 2001. Weed management in wheat (*Triticum aestivum*) with special reference to *Asphodelus tenuifolius*. *Indian J. Weed Sci.* **33** : 100-103.

Singh, S. K., N. K. Jain and B. L. Poonia, 2000. Integrated weed management in Indian mustard (*Brassica juncea*). *Indian J. agric. Sci.* **70** : 850-852.

Yaduraju, N. T., J. S. Mishra and S. Kushwaha, 2000. Evaluation of herbicides for the control of *Asphodelus tenuifolius* in mustard (*Brassica juncea*). *Indian J. Weed Sci.* **32** : 186-189.