



Impact of weed management on weed dynamics and yield of rainy (*Kharif*) crops

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ABSTRACT

Two years field study was conducted during 2010 and 2011 at research farm of SKRAU, Bikaner to evaluate the effect of different weed control measures on weed dynamics and yield in *Kharif* crops. Experiment was laid out in factorial randomized block design with three replications comprising different treatment combinations three *Kharif* crops as pearl millet, cluster bean, groundnut and three weed control measures- weedy check, mechanical method (two hand weeding) and chemical methods. The major weed species observed in the experimental plots were *Digera arvensis* L., *Tribulus terrestris* L., *Cenchrus biflorus* L., and *Euphorbia microphylla* L. with respect to their mean density at 30 DAS. The results of experiment showed that among *Kharif* crops, pearl millet recorded maximum density of weeds at 30 DAS whereas groundnut recorded maximum density of *Digera arvensis* and *Euphorbia macrophylla* at 30 DAS and maximum dry weight of all weed species at harvest. Two hand weeding significantly reduced the weed density at 30 DAS and weed dry weight at harvest. Application of atrazine 0.5 kg/ha in pearl millet and pendimethalin at 1.0 kg/ha in cluster bean and groundnut significantly reduced density and dry weight of weeds except that of *Digera arvensis*, which was not significantly controlled by pendimethalin in both cluster bean and groundnut. In pearl millet, cluster bean and groundnut, two hand weeding and chemical method increased the grain and straw yield over weedy check, on pooled mean basis.

Pearl millet, cluster bean and groundnut are traditional rainy season crops cultivated in arid zone of Rajasthan. Wherever irrigation facility is available, these crops are followed by wheat, barley, mustard and cumin in winter season. In North- Western Rajasthan, especially in IGNP (Indira Gandhi Nahar Pariyojana; Indira Gandhi Canal Project) command area, these crops are grown in place of high-water requiring crops like cotton due to limited irrigations. Cropping sequence particularly those that include legumes, often result in improved soil quality and crop yield. Therefore, production technology or management practices should be developed keeping in view all the crops grown in a year.

Weeds compete with crop for moisture, nutrient, light and space and the potential yield losses due to weeds can be as high as about 65% depending on the crop, degree of weed infestation, weed species and management practices (Yaduraju *et al.* 2006). So weed control is essential in crops either by chemical or conventional methods. Chemical weed control is a better supplement to conventional methods and forms

an integral part of the modern crop production. Recently, use of herbicides has become popular over mechanical methods, because of the concomitant increase in crop yield. Pendimethalin and atrazine are commonly used herbicides to control weeds in *Kharif* crops but these herbicides may persist for a longer period under low soil moisture and poor organic matter. There are evidences that pendimethalin and atrazine had residual effects on succeeding crops in Western Rajasthan and Gujarat condition (Patel and Barendia 1999, Yadav and Lal 2001). Atrazine is widely used herbicide for weed control in pearl millet, but it persists in soil for varying lengths of time depending on dose, soil and agro climatic conditions. The objective of this study was to find out the effect of different weed control measures (like hand weeding and chemical control) as compared to weedy check on weed dynamics and yield in different *Kharif* crops.

Two years field study was conducted during 2010 and 2011 at research farm of College of Agriculture, Swami Keshwanand Rajasthan

Agricultural University, Bikaner (28.01°N, 73.22°E, 234.7 m above mean sea level). Bikaner falls under Hot Arid Eco-region. The average annual rainfall of the tract is about 260 mm, which is mostly received during the rainy season. Soils are loamy sand with 0.08% organic carbon, N 133.7 kg/ha, P 16.2 kg/h and K 198.4 kg/ha. Experiment was laid out in factorial randomized block design with three replications comprising two factors *i.e.*, first factor as different *Kharif* crops as pearl millet, cluster bean, groundnut and second factor as three weed control measures- weedy check, mechanical method two hand weeding and chemical methods with gross plot size of 48 m²/plot.

Pearl millet 'HNB-67' 5 kg/ha, cluster bean 'RGC-986' 20 kg/ha and groundnut 'HNG-10' 80 kg/ha were sown in 30 cm row spacing on 5 July 2010 and 8 July 2011 under irrigated condition. Recommended dose of phosphorus and potassium and half dose of nitrogen were applied at the time of sowing through urea, SSP and MOP, respectively in *Kharif* crops. The remaining half dose of nitrogen was top dressed through urea in two equal splits at 25 and 40 DAS in pearl millet only. The herbicides atrazine 0.50/ha sprayed one day after sowing as pre-emergence in pearl millet and pendimethalin 1.0 kg/ha also sprayed one day after sowing as pre-emergence in cluster bean and groundnut. These herbicides were sprayed with the help of knapsack sprayer using 500 liters of water per hectare. In hand weeding treatments, hand weeding was performed at 25 and 45 DAS in all the *Kharif* crops. For the control of bacterial blight in cluster bean, foliar spray of dithane M-45 2 g/litre water was undertaken.

A survey for weed identification was done at 30 DAS of crops with a quadrat of 0.25 m², it was placed at four places in each plot to determine the density and dry weight of different weeds. Weed dry weight was recorded after drying of weed samples at 80 °C in an electric oven for 48 hours and weighed to obtain weed dry weight. The data were subjected to square root transformation $\sqrt{x+0.5}$ to normalize their distribution before analysis. Timely harvesting of all three crops in September and November were done during both the years. Different crop observations as seed, straw and biological yields of each net plot (inclusive of tagged plants) were recorded in kg/plot after cleaning the threshed produce and were converted in to t/ha. The data obtained from the study of two years were analyzed statistically using the F-test, as per the standard procedure described by Panse and Sukhatme (1985).

Weed flora

Weed flora of experimental field consisted of *Digera arvensis* L., *Tribulus terrestris* L., *Cenchrus biflorus* L., *Euphorbia microphylla* L., *Corchorus tridens* L., *Cyperus rotundus* L., *Cynodon dactylon* L., Pers., *Portulaca oleracea* L. However, predominant weeds were *Digera arvensis* L., *Tribulus terrestris* L., *Cenchrus biflorus* L., and *Euphorbia microphylla* L.

Weed density at 30 DAS

Effect of *Kharif* crops: *Digera arvensis* was one of the major weeds of the crops. The maximum population of this weed was obtained in groundnut after that in cluster bean followed by pearl millet. Pearl millet reduced the weed density by 46.40 and 38.07% over groundnut and cluster bean, respectively, in pooled mean. Maximum density of *Tribulus terrestris* was obtained in pearl millet. Groundnut recorded significantly lower weed density compared to pearl millet and cluster bean. On basis of pooled mean groundnut reduced the weed density by 46.21 and 14.91% over pearl millet and cluster bean, respectively. Maximum weed density of *Cenchrus biflorus* was recorded in pearl millet and cluster bean. However, groundnut reduced the weed density to an extent of 68.70 and 54.60% over pearl millet and cluster bean, respectively on the basis of pooled mean. *Euphorbia microphylla*, maximum weed density of this weed was recorded in groundnut and cluster bean. Pearl millet reduced the weed density to an extent of 18.70 and 11.98% over groundnut and cluster bean, respectively. Maximum weed density of total weeds was found in pearl millet and cluster bean during both the years and in pooled mean. However, groundnut reduced the weed density to an extent of 23.33 and 6.69% over pearl millet and cluster bean, respectively at 30 DAS (Table 1).

Effect of weed control measures: Data (Table 1) showed that weed control measures decreased the weed density significantly in both the years and in pooled data over weedy check. Two hand weeding significantly reduced the density of *Digera arvensis* as compared to chemical method. Two hand weeding and chemical method decreased the density of this weed to an extent of 95.93 and 43.41% over weedy check, respectively. Two hand weeding and chemical method significantly decreased the density of *Tribulus terrestris* by 80.36 and 77.56 percent over weedy check, respectively. Two hand weeding and chemical method significantly decreased the density of *Cenchrus biflorus* was to the tune of 95.72 and 78.14% over weedy check, respectively on pooled mean basis. Two hand weeding and chemical method

significantly decreased the density of *Euphorbia microphylla* to an extent of 94.83 and 69.01 percent over weedy check, respectively. Two hand weeding and chemical method significantly decreased the density of total weeds to the tune of 90.03 and 63.17% over weedy check respectively. Pendimethalin absorbed by germinating weeds inhibits cell division in the meristematic tissues resulting in death of most of the weeds within a few days of their emergence. It also plays a role in microtubule disruption and inhibits mitosis because it blocks synthesis of nucleic acids or any other requisites for mitosis (Devine *et al.* 1993). Such inhibiting effect of pendimethalin might have been responsible for reduced weed population and weed dry weight accumulation. These results were in corroboration with the findings of Yadav *et al.* (2011) and Malik *et al.* (2005).

Interactive effect of Kharif crops and weed control measures on weed density of total weeds

The interaction data (Table 3) revealed that atrazine 0.5 kg/ha applied in pearl millet significantly reduced the density of total weeds as compared to pendimethalin 1.0 kg/ha applied in cluster bean and groundnut. The maximum density of total weeds was recorded in pearl millet with weedy check and it was found at par with cluster bean in weedy check but significantly higher than groundnut at 30 DAS.

Weed dry weight at 30 DAS

Effect of Kharif crops: It is evident from data (Table 2) that significantly minimum dry weight of *Digera arvensis* was recorded in pearl millet over cluster bean and groundnut in pooled mean. Pearl millet reduced the weed dry weight by 11.69 and 5.46% over groundnut and cluster bean, respectively at harvest in pooled mean basis. Pearl millet significantly reduced dry weight of *Tribulus terrestris* but it was statistically at par with cluster bean in pooled mean. Pearl millet reduced the weed dry weight to the tune of 10.95 and 5.07% over groundnut and cluster bean respectively, at harvest in pooled mean basis. Minimum dry weight of *Cenchrus biflorus* weed was recorded in pearl millet over groundnut and cluster bean in pooled mean. Pearl millet reduced the weed dry weight by 10.86 and 5.32% over groundnut and cluster bean, respectively. Minimum dry weight of *Euphorbia microphylla* was recorded in pearl millet over groundnut and cluster bean. Pearl millet reduced the weed dry weight by 10.78 and 5.26% over groundnut and cluster bean. Whereas, minimum dry weight of total weeds was recorded in pearl millet but it was non-significantly differed from the dry weight of total weeds reduced by cluster bean. Pearl millet reduced the weed dry weight to the tune of 10.14 and 4.97% over groundnut and cluster bean, respectively at harvest in pooled mean basis.

Table 1. Effect of Kharif crops and weed control measures on weed density (no./m²) 30 DAS

Treatment	<i>Digera arvensis</i>		<i>Tribulus terrestris</i>		<i>Cenchrus biflorus</i>		<i>Euphorbia macrophylla</i>		Total weed	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
<i>Kharif crop</i>										
Pearl millet	1.91(3.1)	1.75(2.5)	2.04(3.7)	2.82(7.4)	2.27(4.6)	2.09(3.9)	1.64(2.2)	1.61(2.1)	4.09(16.3)	4.51(19.8)
Cluster bean	2.33(4.9)	2.17(4.2)	1.95(3.3)	2.01(3.5)	1.94(3.2)	1.77(2.6)	1.74(2.5)	1.67(2.3)	4.01(15.6)	3.81(14.0)
Ground nut	2.53(5.9)	2.28(4.7)	1.85(2.9)	1.85(2.9)	1.41(1.5)	1.30(1.2)	1.80(2.7)	1.76(2.6)	3.91(14.8)	3.65(12.8)
LSD (p=0.05)	0.24	0.22	0.08	0.63	0.45	0.44	0.10	0.10	0.09	0.62
<i>Weed control method</i>										
Weedy check	3.27(10.2)	3.01(8.5)	3.25(10.1)	3.00(8.5)	3.07(8.9)	2.83(7.5)	2.73(7.0)	2.52(5.8)	6.42(40.8)	5.89(34.2)
Two hand weeding	0.97(0.4)	0.90(0.3)	0.93(0.4)	2.12(4.0)	0.97(0.4)	0.87(0.3)	0.80(0.1)	1.02(0.5)	1.59(2.0)	2.52(5.8)
Chemical method	2.52(5.8)	2.30(4.8)	1.66(2.3)	1.55(1.9)	1.57(2.0)	1.46(1.6)	1.65(2.2)	1.51(1.8)	4.00(15.5)	3.56(12.2)
LSD (p=0.05)	0.24	0.22	0.08	0.63	0.45	0.44	0.10	0.10	0.09	0.62

Weed density transformed to $\sqrt{x+0.5}$, Figures in parentheses were original

Table 2. Effect of Kharif crops and weed control measures on weed dry weight (g/m²) at harvest

Treatment	<i>Digera arvensis</i>		<i>Tribulus terrestris</i>		<i>Cenchrus biflorus</i>		<i>Euphorbia macrophylla</i>		Total weed	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
<i>Kharif crop</i>										
Pearl millet	8.16	7.40	3.90	3.59	3.36	3.05	3.21	2.91	22.68	20.87
Cluster bean	8.59	7.87	4.10	3.78	3.53	3.22	3.38	3.08	23.86	21.97
Ground nut	9.12	8.50	4.32	4.08	3.71	3.46	3.55	3.31	25.19	23.28
LSD (p=0.05)	0.57	0.61	0.29	0.32	0.25	0.31	0.24	0.05	1.77	1.85
<i>Weed control method</i>										
Weedy check	17.21	15.77	9.98	9.29	8.59	7.87	8.21	7.53	54.37	50.13
Two hand weeding	0.41	0.38	0.10	0.09	0.09	0.08	0.08	0.08	0.79	0.74
Chemical method	8.25	7.63	2.24	2.06	1.93	1.78	1.84	1.70	16.58	15.26
LSD (p=0.05)	0.57	0.61	0.29	0.32	0.25	0.31	0.24	0.05	1.77	1.85

Table 3. Interactive effect of Kharif crops and weed control measures on weed density (no./m²) of total weeds at 30 DAS

Kharif (rainy) crops	Weed control method								
	2010			2011			Pooled		
	Weedy check	Two hand weeding	Chemical method	Weedy check	Two hand weeding	Chemical method	Weedy check	Two hand weeding	Chemical method
Pearl millet	6.85(46.46)	1.65(2.24)	3.77(13.74)	6.29(39.02)	3.81(14.04)	3.43(11.26)	6.57(42.66)	2.73(6.97)	3.60(12.47)
Cluster bean	6.40(40.43)	1.53(1.85)	4.10(16.29)	5.87(33.91)	1.90(3.10)	3.67(12.96)	6.13(37.10)	1.71(2.44)	3.88(14.58)
Groundnut	6.02(35.37)	1.59(2.02)	4.12(16.40)	5.52(30.00)	1.85(2.93)	3.58(12.34)	5.77(32.82)	1.72(2.46)	3.85(14.33)
LSD (p=0.05)	0.16			1.07			0.52		

Weed density transformed to $\sqrt{x+0.5}$, Figures in parenthesis are original, Chemical method: (atrazine (0.50 kg/ha in pearl millet) and pendimethalin (1.0 kg/ha in cluster bean and groundnut))

Table 4. Effect of weed control measures on grain yield (t/ha) and straw yield (t/ha) of kharif crops

Kharif (rainy) crops	Weed control method					
	Grain yield (pooled)			Straw yield (pooled)		
	Weedy check	Two hand weeding	Chemical method	Weedy check	Two hand weeding	Chemical method
Pearl millet	1.34	1.92	1.81	2.30	3.21	3.08
Cluster bean	0.89	1.38	1.22	2.55	3.76	3.44
Ground nut	1.76	2.75	2.58	4.20	6.45	6.08

Effect of weed control measures: Data (Table 2) showed that weed control measures decreased the dry weight of weeds significantly over weedy check. Two hand weeding and chemical method significantly reduced the weed dry weight of *Digera arvensis* by 97.63 and 51.84% over weedy check, respectively on the basis of pooled mean at harvest. Two hand weeding and chemical method significantly reduced the dry weight of *Tribulus terrestris* by 98.96 and 77.69% over weedy check. Two hand weeding and chemical method significantly reduced the weed dry weight of *Cenchrus biflorus* which was 98.90 and 77.52% over weedy check. Two hand weeding and chemical method significantly reduced the weed dry weight to an extent of 98.98 and 77.50% over weedy check, respectively, in pooled mean at harvest. Two hand weeding and chemical method significantly reduced the weed dry weight total weeds by 98.54 and 69.53% over weedy check. Highest weed dry weight of production was recorded at harvest under weedy check. The increase in dry weight production of weeds under weedy check may be attributed to uninterrupted weed growth throughout the crop season. Two hand weeding gave almost season long control of weeds obviously due to weed free environment for a sufficiently long time. The results were in close conformity with those of Ram *et al.* (2005), Sharma and Gautam (2010) and Singh (2011). Pendimethalin exerts its herbicidal effect by inhibiting both root and shoot growth and development through disruption of ATP formation (Wang *et al.* 1974) and inhibition of cell division in the meristematic tissue (Rao 1983).

Effect of weed control measures on grain yield of Kharif crops: It is evident from data (Table 4) that in pearl millet, two hand weeding and chemical method increased the grain yield to the tune of 43.28 and 35.07% over weedy check, respectively. In cluster bean, two hand weeding and chemical method increased grain yield of 55.05 and 37.07% over weedy check, respectively. Whereas, in groundnut, increment in grain yield due to hand weeding and chemical method was 56.25 and 46.59% over weedy check, respectively. Sharma and Jain (2003) observed that all the weed control measures significantly increased the seed and stover yield of pearl millet compared with weedy check. Datta *et al.* (2001) also reported similar findings.

Effect of weed control measures on straw yield of kharif crops: Data (Table 4) revealed that among different control measures, two hand weeding and chemical method significantly increased the straw yield in pearl millet by 39.66 and 32.65% over weedy check, respectively. In cluster bean, increment in straw yield due to hand weeding and chemical method was 47.37 and 34.89% over weedy check, respectively. It was observed that in groundnut, two hand weeding and chemical method increased the grain yield to the tune of 53.81 and 44.72% over weedy check, respectively.

Conclusion

Based on the two years of study it was recommended that application of atrazine 0.5 kg/ha in pearl millet and pendimethalin at 1.0 kg/ha in cluster bean and groundnut significantly reduced density and

dry weight of weeds except that of *Digera arvensis* which was not significantly controlled by pendimethalin in both cluster bean and groundnut. In pearl millet, cluster bean and groundnut, two hand weeding and chemical method increased the grain and straw yield over weedy check.

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