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Short Note

Comparative efficiency and economics of weed control methods in controlling weeds in rainfed maize (*Zea mays*)

Purushottam Kumar* and Manoj Gupta
CSK Himachal Pradesh Krishi Vishvavidyalaya
Hill Agricultural Research and Extension Centre, Dhaulakuan- 173 001.

Maize is the major crop of rainy season in Himachal Pradesh. It suffers heavy yield losses due to infestation of weeds owing to congenial environmental condition for their luxurious growth as maize has wider row planting and slow growth at early stage. Yield losses due to weeds varied 28-93 % depending upon the type of weed flora and their intensity, stage, nature and duration of weed competitions (Sharma and Thakur, 1998). Atrazine is widely used for the control of weeds in maize. However, it is less effective for the control of some weeds like sedges. Uncontrolled growth of weed flora present in the field may offer severe competition to the crop. Therefore, to get effective control of weeds, various cost effective weed control methods need to be evaluated. Since the information on best approach for the control of weeds in maize under rainfed conditions is meagre, the present investigation was, therefore, undertaken. The field experiment was conducted under rainfed condition during *Kharif* 1999, 2000 and 2001 at the research farm of Hill Agricultural Research and Extension Centre, Dhaulakuan. The soil of experimental field was sandy loam in texture, medium in available N (278 kg/ha), high in Available P_2O_5 (31 kg/ha) and low in available K_2O (184 kg/ha) with pH 6.7. Nine treatments comprising T_1= deep summer ploughing, T_2= stale seed bed and application of Glyphosate @ 1 kg a.i./ha before 10 days of maize sowing, T_3= directed application of Glyphosate @ 1 kg a.i./ha in standing maize crop (45-60 days), T_4= Atrazine @ 1 kg a.i./ha as pre emergence, T_5= T_1 + T_4, T_6= T_2 + T_4, T_7= two hand weedings (15 & 30 DAS) and T_8= unweeded control were evaluated in randomized block design with three replication. Maize variety Naveen was sown on 17, 15 and 13 June, 1999, 2000 and 2001, respectively in a planting geometry of 60cm x 20cm using 20 kg seed per ha. One-thirds of N (30 kg N/ha), full P (45 kg P_2O_5/ha) and K (30 kg K_2O/ha) were applied at the time of sowing as basal and remaining 2/3 of N (60 kg N/ha) was top dressed in two equal splits, one at knee-high and another at pre-tasselling stages. Atrazine dissolved in 750 liters water/ ha was sprayed on the next day of sowing. Directed spray of Glypohsate was done in inter-row space of maize using plastic hood of 50 cm width, fitted at the nozzle of sprayer. In hand weeding plots, two weedings 15 and 30 days after sowing were done. Weed dry matter was determined using quadrate of 50cm x 50cm size placed randomly in each plots and weed fallen in the quadrate were removed and hot air oven dried. Weed control efficiency was also calculated. Crop was raised using all the recommended package of practices. The total rainfall received during the crop season of 1999, 2000 and 2001 was 1771.5, 1177.4 and 1361.6 mm, respectively.

Weed Flora

The experimental field was infested with sedges, grasses and non- grasses weeds. Among sedges *Cyperus rotundus* was the predominant weed. *Sorghum helepense*, *Digitaria sanguinalis*, *Echinochloa* spp., *Cynodon dactylon* and *Eleusine indica* were the major weeds among grasses. Among non-grasses *Ageratum conyzoides*, *Commelina benghalensis*, *Oxalis latifolia* and *Amaranthus viridis* were the dominant weeds. Sedges, grassy and non-grassy constituted 45.2 to 50.1, 40.0 to 42.5 and 8.5 to 14.8 per cent, respectively to total weed dry weight.

Effect on weeds

Weed control methods significantly reduced the dry weight of weeds compared to weedy check (Table 1). Similar results were reported by Thakur

* *Horticulture Research and Extension Centre, Srinagar, Garhwal (U.A.)*

Table 1. Effect of various treatments on weeds and maize crop (mean of 3 years-1999 to 2001)

Treatments	Weed dry matter (g/m^2)		Weed control efficiency (%)		Plant height (cm)	Cob length (cm)
	30 DAS	At harvest	30 DAS	At harvest		
T_1	38.2	260.6	73.5	61.6	170.4	12.1
T_2	32.2	198.6	77.6	70.8	180.5	12.3
T_3	81.6	93.5	43.3	86.2	150.6	10.1
T_4	34.2	196.7	53.9	71.1	185.1	12.3
T_5	21.7	171.4	84.9	74.8	190.2	12.2
T_6	10.1	116.7	92.9	82.8	201.3	14.8
T_7	11.4	120.8	92.1	82.2	210.3	14.9
T_8	144.0	679.9	-	-	130.3	9.1
CD (P=0.05)	8.8	29.3	-	-	13.8	0.9

and Sharma (1996). Stale seed bed and application of Glyphosate @ 1 kg a.i./ha before 10 days of maize sowing with Atrazine @ 1 kg a.i./ha as pre-emergence (T_6) and two hand weedings (T_7) being statistically at par significantly reduced the dry weight of weeds compared to other weed control methods followed by deep summer ploughing with Atrazine @ 1 kg a.i./ha (T_5) at 30 DAS. Deep summer ploughing (T_1), stale seed bed and application of Glyphosate @ 1 kg a.i./ ha before 10 days of maize sowing (T_2) and Atrazine @ 1 kg a.i./ha alone (T_4) statistically equal in reducing the dry weight of weeds but were significantly better than directed application of Glyphosate @ 1 kg a.i. / ha in standing maize crop at 45-60 days (T_3) and weedy check at 30 DAS. At the time of harvesting, T_3 resulted in significantly better reduction of dry weight of weeds followed by T_6 and T_7. Deep summer ploughing (T_1) resulted in lowest reduction of dry weight of weeds compared to other weed control treatments but it was significantly better than weedy check. Highest weed control efficiency (92.9%) was recorded with T_6 followed by T_7 (92.1%) at 30 DAS. However, at the time of harvesting, T_3 recorded the highest weed control efficiency (86.2%) followed by T_6 (82.8%) and T_7 (82.2%).

Effect on crop

Weed control methods significantly influenced the plant height, cob length and grain and stover yield compared to weedy check (Table 1&2). Saini and Angiras (1998) and Sharma and Thakur (1998) reported the similar results. Significantly highest plant height was recorded with two hand weedings (T_7) however, it was statistically at par with T_6 followed by T_5. Directed application of Glyphosate @ 1 kg a.i. /ha in standing maize crop (45-60 days) resulted in lowest plant height among the weed control methods but it was significantly better than weedy check. T_6 and T_7 being statistically at par with each other recorded significantly higher cob length compared to other weed control treatments. Lowest cob length was recoded in weedy check. T6 and T_7 being at par resulted in significantly higher grain and stover yields compared to other weed control treatments and gave 35.7 and 36.4 mean grain yield (q/ha) and 60.1 and 62.0 mean stover yield (q/ha), respectively followed by T_4. Lowest grain and stover yields were recorded in T_3, however, it gave better yield than weedy check. Higher yields in T_6 and T_7 may be due to the better weed control at initial growth stage of maize.

Economics

All the weed control treatments influenced the incremental gross and net returns per ha over unweeded control (Table 2). Highest mean incremental gross returns of Rs 12,525 were obtained with T_7 followed by T_6 (Rs 12,080) over control. Lowest incremental gross returns were recorded with deep summer ploughing (Rs 6415). However, after

Table 2. Effect of various treatments on yield and economics of maize crop (mean of 1999 to 2001)

Treatment	Grain yield (q/ha)	Stover yield (q/ha)	Economics (Rs/ha)		
			Treatment cost	Incremental gross returns over control	Incremental net returns over control
T_1	26.4	39.8	525	6415	5890
T_2	29.6	44.9	1165	8270	7105
T_3	21.4	32.7	1165	8560	7395
T_4	30.1	48.5	487	8700	8213
T_5	29.8	47.5	1012	8500	7488
T_6	35.7	60.1	1652	12080	10428
T_7	36.4	62.0	2550	12525	9975
T_8	15.4	21.5	-	-	-
CD (P=0.05)	2.4	3.9	-	-	-

taking the cost treatment into account and calculating incremental net returns over control, T_6 emerged as the most profitable treatment (Rs 10,428) followed by T_7 (Rs 9,975). It may be due to the better yield and less cost of the former treatment.

The results of the three year study clearly showed that stale seed bed and application of Glyphosate @ 1 kg a.i./ha before 10 days of maize sowing with Atrazine @ 1 kg a.i./ha as pre-emergence application was the cost effective method for the control of weeds in rainfed rainy maize.

VIR SOFTECH

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