Integrated Weed Management Studies in Rabi Maize

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Abstract

A field experiment was conducted during Rabi season of 2015-2016 at Agricultural College and Research Institute, Killikulam to study the effect of weed management on weeds and yield of maize. Weed management has positive influence on growth, yield attributes and yield of maize. Alachlor @ 1.5 kg a.i./ ha + HW at 30 DAS proved equally effective in increasing most of the growth parameters, yield attributes, yield and economic advantage. The effect due to different weed management practices on grain yield of maize was found statistically significant. Maximum highest grain yield were recorded under alachlor @ 1.5 kg a.i./ ha + HW at 30 DAS (7115 kg ha^{-1}) and was statistically at par with grain yield obtained by two hand weedings at 15 and 30 DAS (6855 kg ha^{-1}) and mechanical weeding with power weeder twice on 15 and 30 DAS (6714 kg ha^{-1}). Yield advantages due to different weed management over weedy check were mainly attributed due to enhanced yield attributing parameters as a result of low weed population, biomass along with higher weed control efficiency. The highest net returns and highest benefit:cost ratio were obtained under alachlor @ 1.5 kg a.i./ ha + HW at 30 DAS followed by two hand weedings at 15 and 30 DAS.

Keywords

Economics, Integrated Weed management, Maize, yield

I. INTRODUCTION

Maize grown in rabi season suffers heavily due to severe weed infestation owing to suitable temperature, high humidity and adequate moisture which are favourable for weed growth. Wider row spacing of the crop provide enough opportunity for the weeds to emerge and offer severe competition. Maize is most sensitive to weed competition during its early growth period. The growth of maize plants in the first 3-4 weeks is rather slow and during this period weeds establish rapidly and take competitive advantage. The maximum weed competition in maize occurs during the period of 2 to 6 weeks after sowing, suggesting the importance of maintaining weed free environment during the early stage which is the critical period of weed competition. Hence, suitable weed control strategies in maize can be the sequential use of pre-emergence and post-emergence herbicides or a pre-emergence herbicide application followed by two hand weedings or intercultural operation with power weeder so that the crop is protected well against the weeds during the critical period of crop weed competition. Atrazine, alachlor and pendimethalin are widely used for control of weeds in maize. But their continuous use for long time may lead development of herbicide resistance in weeds (Pandey et al., 2000). Hence, development of a suitable weed management strategy to alleviate weed pressure on the available resources is known to prop up the crop productivity considerably.

II. MATERIALS AND METHODS

The field experiment was conducted during Rabi season of 2015-2016 at Department of farm management, Agricultural College farm, Agricultural College and Research Institute, Killikulam. The experimental field is geographically located in the southern part of Tamil Nadu at 8°46' North latitude and 77° 42' East longitude at an altitude of 40 meters above mean sea level.The experimental site was sandy clay loam, 0.34% organic carbon, neutral in reaction (pH 7.28), low in available N (198 kg ha-1), low in available P (10.1 kg ha^{-1}) and medium in available K (139 kg ha^{-1}). The experiment was laid out in a randomized block design with three replications. The gross plot size was 5 x 3.6 m and net plot size was 4.5 x 3.1 m. A set of nine twelve treatments comprising T_1 - Alachlor @ 1.5 kg a.i ha^{-1}, T_2 - Alachlor @ 1.5 kg a.i ha^{-1} + one hand weeding on 30 DAS , T_3 - Alachlor @ 1.5 kg a.i ha^{-1} + one mechanical weeding with power weeder on 30 DAS, T_4 - Atrazine @ 0.25 kg a.i ha^{-1}, T_5 - Atrazine @ 0.25 kg a.i ha^{-1} + one hand weeding on 30 DAS, T_6 - Atrazine @ 0.25 kg a.i ha^{-1} + one mechanical weeding with power weeder on 30 DAS ; T_7 - Pendimethalin @ 0.75 kg a.i ha^{-1}, T_8 - Pendimethalin @ 0.75 kg a.i ha^{-1} + one hand weeding on 30 DAS, T_9 - Pendimethalin @ 0.75 kg a.i ha^{-1} + one mechanical weeding with power weeder on 30 DAS, T_{10} - Hand weeding twice on 15 and 30 DAS, T_{11}-Mechanical weeding with power weeder twice on 15 and 30 DAS, T_{12} - Unweeded control. Maize hybrid COH (M) 6 sown with a spacing of 60 x 25 cm.Crop was fertilized with 250:75:75 Kg NPK ha^{-1} through urea, single super phosphate and muriate of potash respectively. Thinning was done at 15 DAS to maintain plant to plant distance of 25 cm. Thinning

was done at 10 DAS to maintain plant to plant distance of 25 cm. All the herbicides dissolved in water (500 L ha-1) were sprayed as pre-emergence on the next day of sowing. Cost of cultivation and gross returns were calculated on the basis of prevailing market prices of different inputs and produces, respectively.

III. RESULTS AND DISCUSSION

A) Weed growth, Density and weed control efficiency

Dominant weed species observed in the experimental field were Cyperus rotundus among sedges, Cynodon dactylon among grasses and Digera arvensis, Trianthema portulacastrum, Cleome viscosa and Phyllanthus niruri among broad-leaved weeds. Among all the three weed groups, the most predominant weed species observed was Cyperus rotundus.

Weed density was significantly affected due to different weed management practices. There was reduction in total weed density in application of alachlor @ 1.5 kg a.i ha^{-1} with one hand weeding on 30 DAS (T_2). Pre-emergence application of alachlor @ 1.5 kg a.i. ha^{-1} was effective in controlling the broad leaved weeds. The present findings are in conformity with the findings of Reddy et al. (2000). The next best treatment was hand weeding twice on 15 and 30 DAS which recorded significantly lower weed density of 5.27 m^{-2} on 20 DAS (Table 1). This might be due to fact that the first hand weeding eliminated all the early emerged weeds while the second hand weeding removed the later germinated weeds keeping the weed density below the critical level of competition. The current results are in conformity with the findings of Nagalakshmi et al. (2006) and Sandhya rani and Karuna sagar (2013).

Weed-control efficiency (WCE) of different treatments varied from 63.55-90.33%. Among all the treatments, alachlor @ 1.5 kg a.i ha^{-1} with one hand weeding on 30 DAS (T_2) was the most effective in controlling the weeds (WCE 90.33%), followed by hand weeding twice on 15 and 30 DAS(T_{10})(WCE 84.08%) (Table 1). This could be attributed to the weed free condition achieved during the critical period of crop growth with two hand weeding. Weed control efficiency recorded with pre-emergence application of atrazine with one hand weeding was high at all the stages of crop growth. This could be due to the fact that the initial weed population was effectively controlled by persistence activity of pre-emergence application of atrazine. The results are in line with the findings of Malviya et al. (2012) and Kamble et al. (2005).

B) Growth, yield attributes and yield of maize

Different weed management practices significantly influenced the growth, yield attributes and yield of maize crop (Table 1). Alachlor @ 1.5 kg a.i ha^{-1} with one hand weeding on 30 DAS (T_2) recorded significantly higher values of growth maize crop and are at par with hand weeding twice on 15 and 30 DAS(Table 1). Significantly increased dry matter production of maize under these treatments could be attributed to less weed competition, maximum weed control efficiency, improved nutrient uptake. This might have which might lead to the increased plant height which ultimately provided better growth environment to the crop as the weed density and dry matter recorded in these treatments was significantly less enabling the crop to put forth satisfactory growth. This is in line with the findings of Sinha et al. (2001) and Srividya et al. (2011).

Significant yield attributes and grain yield was recorded with alachlor @ 1.5 kg a.i ha^{-1} as pre-emergence with one hand weeding on 30 DAS, which was in parity with hand weeding twice on 15 and 30 DAS(Table 2). This was due to lesser crop weed competition for growth resources throughout the crop growth period and availability of congenial environment for better expression of growth and yield potential. Similar findings were reported by Pandey et al. (2001), Sunitha et al. (2011) and Sandhya Rani and Karuna Sagar (2013).

C) Economics

Cost of cultivation, gross and net returns varied due to different weed management practices. Alachlor @ 1.5 kg a.i ha^{-1} with one hand weeding on 30 DAS fetched higher B:C ratio of 2.48(Table 3). This is mainly due to higher seed yield with this treatment, which has extended weed free environment upto harvest leads to better growth and yield attricuting character of maize.

IV. CONCLUSIONS

It may be concluded thatAlachlor @ 1.5 kg a.i ha^{-1} with one hand weeding on 30 DAS appeared to be best in reducing weed growth and producing maximum grain yield.

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Table 1. Growth, weed density and weed control efficency of hybrid maize as influenced by different weed control treatments

	Treatments	Plant height (cm) (at harvest)	Weed density (No. m^{-2})		Weed Control Efficiency (%)	
			20 DAS	40 DAS	20 DAS	40 DAS
T_1	Alachlor @ 1.5 kg a.i ha^{-1} (PE)	221.0	36.48 (6.08)	42.61 (6.57)	80.48	73.12
T_2	Alachlor @ 1.5 kg a.i ha^{-1} + one hand weeding on 30 DAS	244.6	20.19 (4.55)	31.46 (5.65)	90.33	89.41
T_3	Alachlor @ 1.5 kg a.i ha^{-1} + one mechanical weeding with power weeder on 30 DAS	226.7	31.58 (5.66)	27.24 (5.27)	82.79	74.53
T_4	Atrazine @ 0.25 kg a.i ha^{-1} (PE)	205.1	41.84 (6.51)	46.58 (6.86)	69.65	61.2
T_5	Atrazine @ 0.25 kg a.i ha^{-1}+ one hand weeding on30 DAS	228.4	30.91 (5.60)	24.41 (4.99)	73.71	66.77
T_6	Atrazine @ 0.25 kg a.i ha^{-1}+ one mechanical weeding with power weeder on 30 DAS	208.2	33.26 (5.81)	28.97 (5.43)	71.69	63.15
T_7	Pendimethalin @ 0.75 kg a.i ha^{-1} (PE)	208.6	44.81 (6.73)	49.64 (7.08)	64.89	50.89
T_8	Pendimethalin @ 0.75 kg a.i ha^{-1} + one hand weeding on 30 DAS	199.5	33.32 (5.82)	24.78 (5.03)	66.34	55.57
T_9	Pendimethalin @ 0.75 kg a.i ha^{-1} + one mechanical weeding with power weeder on 30 DAS	196.4	39.71 (6.34)	28.54 (5.39)	63.55	52.36
T_{10}	Hand weeding twice on 15 and 30 DAS	235.7	27.26 (5.27)	20.87 (4.62)	84.08	77.53
T_{11}	Mechanical weeding with power weeder twice on 15 and 30 DAS	231.0	32.82 (5.77)	44.36 (6.70)	83.59	76.19
T_{12}	Unweeded control	170.7	98.49 (9.95)	134.35 (11.61)	-	-
	Sed	5.5	0.48	0.34		
	CD (P=0.05)	11.5	1.00	0.70		

The figures in the parenthesis indicate transformed values

Table 2. Yield attributesand yield of hybrid maize as influenced by different weed control treatments

	Treatments	No. of cobs $plant^{-1}$	No. of grain rows cob^{-1}	No. of grains row^{-1}	No. of grains cob^{-1}	Grain yield (kg ha^{-1})
T_1	Alachlor @ 1.5 kg a.i ha^{-1} (PE)	1.00	14.53	29.27	425.41	6431
T_2	Alachlor @ 1.5 kg a.i ha^{-1}+ one hand weeding on 30 DAS	1.13	15.40	31.33	482.79	7115

T_3	Alachlor @ 1.5 kg a.i ha^{-1} + one mechanical weeding with power weeder on 30 DAS	1.00	14.40	30.00	431.81	6584
T_4	Atrazine @ 0.25 kg a.i ha^{-1} (PE)	1.00	13.87	29.8	413.04	5959
T_5	Atrazine @ 0.25 kg a.i ha^{-1}+ one hand weeding on30 DAS	1.06	14.33	30.2	432.16	6218
T_6	Atrazine @ 0.25 kg a.i ha^{-1}+ one mechanical weeding with power weeder on 30 DAS	1.00	14.47	30.93	447.56	6053
T_7	Pendimethalin @ 0.75 kg a.i ha^{-1} (PE)	1.00	13.87	28.67	397.68	5581
T_8	Pendimethalin @ 0.75 kg a.i ha^{-1}+ one hand weeding on 30 DAS	1.06	14.53	27.93	407.12	5793
T_9	Pendimethalin @ 0.75 kg a.i ha^{-1}+ one mechanical weeding with power weeder on 30 DAS	1.00	14.00	29.07	405.84	5711
T_{10}	Hand weeding twice on 15 and 30 DAS	1.13	14.93	31.07	463.89	6855
T_{11}	Mechanical weeding with power weeder twice on 15 and 30 DAS	1.06	14.60	29.67	433.12	6714
T_{12}	Unweeded control	1.00	13.33	24.40	325.41	4967
	Sed	0.11	0.34	0.8	15.62	162
	CD (P=0.05)	NS	0.7	1.67	32.4	335

Table 3. Economics of different weed control treatments in maize

	Treatments	Cost of cultivation	Gross return	Net return	B: C ratio
T_1	Alachlor @ 1.5 kg a.i ha^{-1}	40297	94260	53963	2.34
T_2	Alachlor @ 1.5 kg a.i ha^{-1}+ one hand weeding on 30 DAS	41984	104240	62256	2.48
T_3	Alachlor @ 1.5 kg a.i ha^{-1}+ one mechanical weeding with power weeder on 30DAS	40860	96475	55615	2.36
T_4	Atrazine @ 0.25 kg a.i ha^{-1}	39136	87370	48234	2.23
T_5	Atrazine @ 0.25 kg a.i ha^{-1}+ one hand weeding on 30 DAS	41384	91160	49776	2.20
T_6	Atrazine @ 0.25 kg a.i ha^{-1}+ one mechanical weeding with power weeder on 30DAS	40260	88700	48440	2.20
T_7	Pendimethalin @ 0.75 kg a.i ha^{-1}	39036	81820	42784	2.10
T_8	Pendimethalin @ 0.75 kg a.i ha^{-1}+ one hand weeding on 30 DAS	41284	84900	43616	2.06
T_9	Pendimethalin @ 0.75 kg a.i ha^{-1}+ one mechanical weeding with power weeder on 30 DAS	38936	83700	44764	2.15
T_{10}	Hand weeding twice on 15 and 30 DAS	42832	100410	57578	2.34
T_{11}	Mechanical weeding with power weeder twice on 15 and 30 DAS	41336	98380	57044	2.38
T_{12}	Unweeded control	38336	65340	27004	1.70