

Research Article

Weed Management in Maize with New Herbicides

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Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore during *Kharif*, 2015 in sandy clay loam soil to study the effect of different herbicides on growth and yield of maize. Based on the results, it is concluded that application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE recorded higher grain yield (6274 kg ha⁻¹), net return (Rs.50,827 ha⁻¹) and B:C ratio (2.22) and it was followed by application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS, which recorded grain yield, net return and B:C ratio of 6412 kg ha⁻¹, Rs.49,141 ha⁻¹ and 2.08, respectively.

Keywords: Maize, pre and post emergence herbicides, growth and yield

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Introduction

Maize is the third most important grain crop in India after rice and wheat with respect to area and productivity. It has wide ecological adaptability and is grown in almost all parts of the country extending from extreme semi-arid to sub-humid and humid regions. The crop is also popular in low and mid-hill areas of Western and North Eastern regions. It has the highest yield potential, which is influenced by multi various factors *viz.*, weeds, nutrients, pests and diseases. Amongst all, weeds account for 28 to 100 % yield loss [1]. Weeds compete with crop plants for light, space, water and nutrients, especially during the early stages of growth as they are more adapted to agro-ecosystems than crop plants. Wide spacing in maize allows luxuriant growth of varied weed species, which reduces the photosynthetic efficiency, dry matter production and partitioning to economic parts and there by reduces sink capacity of crop resulting in poor grain yield [2].

Weeds also exudates substances from roots and leaves which are toxic to crop plants. This causes severe interference with normal crop growth, leading to reduction in yield and quality. The competitive effect of a given density of weeds with the crop depends on the length of the period they remain in the field. The relationship between the duration of competition and crop yield reduction is approximately sigmoidal. The critical stage of crop weed competition in maize crop is from 30 to 45 days from sowing [3]. Controlling of weeds in maize during the critical period assumes great importance for realizing higher yield. Though hand weeding is effective, it is highly expensive. Moreover, heavy demand of labour during peak period and its scarcity necessitates the use of herbicides as a method of control for suppressing the weeds. Chemical weed control being cost effective and less labour dependent is recommended to overcome this constraint [4]. Each herbicide has its own spectrum of weed control which leads to its efficacy and use in the field. Nevertheless, farmers are applying only atrazine as pre emergence herbicide and to certain extent 2, 4 D Na salt for controlling weeds at present. These herbicides control only broad leaved weeds. New herbicides with broad spectrum of weed control are highly essential for effective control of grasses, sedges and broad leaved weeds. Hence, the present study was carried out to find out the effect of new herbicides on weed density, growth and yield of maize.

Materials and Methods

Field experiment was carried out at Department of Millets, Tamil Nadu Agricultural University, Coimbatore during *Kharif*, 2015 to study the effect of different herbicides on growth and yield of maize. The soil was sandy clay loam and low in available N (137 kg/ha), medium in available P (11.1 kg/ha) and high in available K (455 kg/ha) with a pH of 8.15. The experiment was laid out in a Randomized Complete Block Design (RCBD) with the following treatments *viz.*, T₁ - Control (weedy check), T₂ - Weed free, T₃ - Atrazine @ 1.5 kgai/ha as pre emergence, T₄ - Atrazine (0.75

kgai /ha) + Pendimethalin (0.75kg ai/ha) as pre emergence, T₅ - Atrazine (0.75 kgai/ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE, T₆ - Halosulfuron@ 90 g/ha at 25 DAS , T₇ - Atrazine @ 1.5 kgai/ha as pre emergence fb Halosulfuron 90 g/ha at 25 DAS , T₈ - Tembotrione @ 120 g ai/ha as PoE at 25 DAS ,T₉ - Pendimethalin (1kg ai/ha) as pre emergence fbAtrazine (0.75 kg ai/ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE and T₁₀- Atrazine @ 1.5 kgai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS and replicated thrice. Maize hybrid CO H(M) 6 was sown with recommended spacing of 60 x 25 cm. Observations on weed density, weed dry matter ,yield attributes and yield were recorded.



General view of experimental field



Crop stage: Knee high stage
Pendimethalin (1kg ai/ha) as pre emergence fb
Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha)
at 25 DAS as PoE (T₉)



Crop stage: Grain filling stage
Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine
(0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS
as PoE (T₉)



Size of cob influenced by weed management practices

Results and Discussion

The data on the effect of different herbicides on weed density and weed dry weight on 50 DAS and at harvest of maize are given in **Table 1**.

Effect of herbicides on weed density and dry weight on 50 DAS

Experimental results revealed that weed management practices evinced significant influence on weed density and weed dry weight. Application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75kg ai/ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T₉) recorded significantly the lesser grassy weed count (4.93 No m⁻²) and weed dry weight (16.60 g m⁻²) on 50 DAS and it was statistically on par with the application of Atrazine @ 1.5

kgai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS(T_{10}). With respect to Sedges, application of Atrazine @ 1.5 kgai/ha as pre emergence fb Tembotrione@ 120 g ai/ha as PoE at 25 DAS(T_{10}) recorded significantly the lesser weed count (1.06 No m^{-2}) and weed dry weight (0.81 g m^{-2}) on 50 DAS and it was comparable with application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T_9). In respect of broad leaved weeds, application of Atrazine @ 1.5 kgai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS(T_{10}) evinced complete control on BLW count on 50 DAS and it was significantly superior to application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T_9), which recorded (2.58 No m^{-2}) and weed dry weight of (2.94 g m^{-2}). The results are in accordance with the findings of Swetha *et al.*, (2015) [5]

Table 1 Effect of different herbicides on weed density and weed dry weight on 50 DAS and at harvest of maize

Treatments	Weed density (No/m ²)50 DAS			Weed density (No/m ²) At harvest		Weed dry weight (g/m ²) 50 DAS			Weed dry weight (g/m ²) At harvest	
	Grasses	Sedges	BLW	Grasses	BLW	Grasses	Sedges	BLW	Grasses	BLW
T₁	66.7 (8.15)	0	23 (4.78)	184.7 (13.4)	26.7 (5.16)	44.41	0	11.8	191.3	15.8
T₂	0	0	0	0	0	0	0	0	0	0
T₃	44.3 (6.61)	0	0.33 (0.34)	146 (12.05)	3.33 (1.81)	28.69	0	0.16	200.7	2.27
T₄	29.3 (5.41)	2 (1.4)	0.67 (0.68)	143.3 (11.87)	7.33 (2.65)	19.69	0.9	0.3	190.7	4.53
T₅	48.7 (6.95)	0.33 (0.34)	0	123.3 (11.1)	1.33 (1.16)	34.94	0.17	0	155.3	1.13
T₆	56.7 (7.51)	0	2.67 (1.64)	155.3 (12.4)	7.67 (2.73)	41.56	0	1.27	107.3	5.57
T₇	61.3 (7.83)	0	0	134 (11.43)	1.33 (1.16)	42.23	0	0	208.3	0.97
T₈	49.3 (6.98)	1 (0.82)	8.67 (2.93)	150.7 (12.25)	2 (1.4)	33.81	0.53	3.47	173.3	1.47
T₉	24.7 (4.93)	2.33 (1.54)	6.67 (2.58)	105.3 (10.24)	0.67 (0.68)	16.6	1.11	2.94	121.3	0.57
T₁₀	27 (5.19)	1.67 (1.06)	0	72.67 (8.48)	0.67 (0.68)	18.24	0.96	0	136.7	0.53
SEd	0.58	0.35	0.32	1.27	0.39	5.95	0.31	0.85	28.85	2.46
CD	1.23	0.74	0.66	2.66	0.82	12.5	0.65	1.8	60.61	5.17

($p=0.05$)

Figures in parenthesis are ($\sqrt{+0.5}$) transformed values.

Effect of herbicides on weed density and dry weight at harvest

At harvest, application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS (T_{10}) recorded significantly the lesser grassy weed count (8.48 No m^{-2}) and weed dry weight (136.7 g m^{-2}) and it was comparable with the application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T_9). In respect of density of BLW, there was no significant difference between T_{10} and T_9 . The results confirm the findings of Saini and Angiras (1998) [6]. Application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T_9) recorded lower weed dry weight (121.3 g m^{-2}) of grassy weeds which was comparable with application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS(T_{10}) at harvest. With respect to BLW, application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS (T_{10}) registered lower weed dry weight (0.53 g m^{-2}) which was comparable with application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T_9). Similar results were reported by Hatti *et al.*, 2014 [7].

Effect of herbicides on growth and yield of maize

The data on the effect of different herbicides on growth, yield and economics of maize are given in **Table 2**.

Table 2 Effect of different herbicides on growth, yield and economics of maize

Treatments	Plants (000'/ha) 25DAS	50% tasseling (Days)	Plant height (cm) at harvest	100 seed weight (g)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Net return (Rs.ha ⁻¹)	B:C ratio
T ₁	61.8	50.7	169.4	34.61	4284	7281	23626	1.60
T ₂	64.5	53.7	230.2	37.94	6821	11753	51079	2.04
T ₃	63	51.7	192.1	35.52	5824	10606	45566	2.12
T ₄	63.2	52.3	194.9	35.64	5905	10697	46778	2.15
T ₅	63.8	52.7	205.2	36.91	6172	10894	49607	2.19
T ₆	62.1	51.3	178.6	34.76	4881	8743	28966	1.67
T ₇	63.4	52.0	197.3	36.38	6026	10725	44433	2.00
T ₈	62.7	51.3	186.7	35.16	5409	9876	36046	1.82
T ₉	64	53.0	209.2	37.32	6274	11102	50827	2.22
T ₁₀	64.3	53.3	218.6	37.66	6412	11328	49141	2.08
SE d	1.63	1.18	14.7	0.996	342.1	675.5		
CD (p=0.5)	NS	NS	30.9	2.09	719	1419		

The different weed management practices failed to exert any significant effect on plants/ha on 25 DAS and 50% tasseling. Nevertheless, the plant height at harvest was significantly influenced by different weed management practices. Weed free condition (T₂) recorded significantly the higher plant height (230.2 cm) at harvest and it was comparable with T₁₀(218.6 cm) and T₉(209.2 cm). Weed free condition (T₂) recorded the highest 100 seed weight, grain and stover yield of 37.94 g, 6821 kg ha⁻¹ and 11753 kg ha⁻¹, respectively. The highest grain yield obtained under weed free condition was mainly due to minimum crop-weed competition throughout the crop growth period, thus enabling the crop for maximum utilization of nutrients, moisture, light and space which favoured growth and yield components. The results are in accordance with the findings of Hatti *et al.*, (2014) and Shantveerayyahawaldar and Agasimani, 2012 [7, 8]. This was comparable with application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS (37.66 g, 6412 kg ha⁻¹ and 11328 kg ha⁻¹) and application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (37.32 g, 6274 kg ha⁻¹ and 11102 kg ha⁻¹). Higher grain yield in these treatments could be attributed to the lower weed density and dry matter accumulation of weeds. These results corroborate with the findings of Swetha *et al.* (2015) and Janjic *et al.* (1983) and Roy *et al.* (2008) [5, 9, 10]. The lowest grain yield of 4284 kg ha⁻¹ was recorded in control (weedy check).

In respect of economics, application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE (T₉) registered the highest net return (Rs.50827 ha⁻¹) and B:C (2.22) and it was followed by application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS (T₁₀) which registered the net return and B:C of Rs.49141 and 2.08, respectively.

Conclusion

From the experimental results, it could be concluded that application of Pendimethalin (1kg ai/ha) as pre emergence fb Atrazine (0.75 kg ai /ha) + 2,4-D Amine (0.4 kg ai/ha) at 25 DAS as PoE recorded higher grain yield (6274 kg ha⁻¹), net return (Rs.50,827 ha⁻¹) and B:C ratio (2.22) and it was followed by application of Atrazine @ 1.5 kg ai/ha as pre emergence fb Tembotrione @ 120 g ai/ha as PoE at 25 DAS, which recorded grain yield, net return and B:C ratio of 6412 kg ha⁻¹, Rs.49,141 ha⁻¹ and 2.08, respectively. These two combinations of herbicides were found to be more suitable for obtaining higher grain yield, net return and B:C ratio.

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Publication History

Received 17th Apr 2017
Revised 08th May 2017
Accepted 10th May 2017
Online 30th May 2017

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