



STUDIES ON THE EFFECTS OF WEED MANAGEMENT THROUGH NEW GENERATION HERBICIDES ON THE GROWTH AND YIELD OF HYBRID MAIZE

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Abstract

Field investigation was carried out to study the productivity and profitability enhancement of hybrid maize (*Zea mays* L.) through weed management at the experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai nagar, Tamil Nadu, India. The field experiment was conducted during February–May, 2015. The experiment was laid out in randomized block design (RBD) and replicated thrice with different treatment schedule viz., T₁–Unweeded control, T₂–Twice hand weeding at 15 DAS and 30 DAS, T₃–Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS alone, T₄–Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS + hand weeding at 30 DAS, T₅– Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS + post-emergence application of 2,4-D sodium salt 80% WP @ 1 kg a.i ha⁻¹ at 30 DAS, T₆– Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS alone, T₇– Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + one hand weeding at 30 DAS. Among the seven treatments weed density at 30, 60 and 90 DAS and weed biomass were significantly lower in T₇–Early post-emergence herbicide tembotrione application @ 120.8 ml ha⁻¹ at 15 DAS followed by one hand weeding at 30 DAS. Regarding yield attributes the same treatment T₇ recorded significantly higher yield contributing characters viz., cob length, cob diameter, number of grains cob⁻¹ to remaining weed management treatments.

Key words: Hand weeding, Pre – emergence, Atrazine, Tembotrione, 2,4 –D, WCE.

1. Introduction

Maize is the third important cereal crop in the world in terms of acreage and is called the ‘Queen of cereals’. Maize accounts for the major share of the coarse grain production; showing a steady upward trend over the last decade on growing demand (poultry feed and industrial use) and increasing productivity (better hybrid seeds). Increasing adoption of improved hybrid particularly single cross hybrids, has encouraged farmers to bring more are under maize cultivation. Worldwide maize is cultivating with an area of 161.02 million hectares, production of 822.7 million tonnes and a productivity of 5109 kg ha⁻¹. In India maize

accounts area of 91.85 million hectare, production of 21.81 million tonnes with average yield of 2.63 tonnes (Anonymous, 2010).

Being a potential crop in India maize occupies important place as food (25 per cent), animal feed (12 per cent), poultry feed (49 per cent), industrial products mainly starch (12 per cent) and 1 per cent each in brewery and seed (Dass *et al.*, 2008).

Maximum crop productivity loss is caused by weeds and about 33 per cent the potential production is lost due to weed competition. Management of weeds is considered to be an important factor for achieving higher productivity, weed control in maize can be highly sophisticated because of

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wider spacing. Mechanical control of weeds growing between the rows is labour intensive. Hence weed control in developed countries is done by using herbicides. Chemical weed control is a better supplement to conventional method and forms an integral part of the modern crop production. It is quick, more effective, time and labour saving method than others (Saini and Angiras, 1998). However the choice of weed management practice is largely depend on effectiveness and economics.

In India, Tamil Nadu owing to high labour cost for weed management practice is trending towards manual hand weeding to herbicidal application. So there is a need to make a comparative study of different weed management techniques to develop a suitable weed management method, which should be efficient and cost effective and environmentally safe.

The objectives of this study were taken with following facts:

- To study the effect of weed management practices *viz.*, Pre-emergence herbicide, post-emergence herbicide, early post-emergence herbicide and manual hand weeding on weeds in maize crop.
- To evaluate the weed control efficiency of various weed management practices.
- To know and how to increase the productivity and profitability of maize crop through weed management.

2. Materials and Methods

Field experiment was conducted in the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during "summer" 2015 to evaluate the effect of weed control measures on the growth and yield of maize.

The experiment site is situated at 11° 24' N latitude and 79°44' E Longitude at a altitude of 5.79 m above mean sea level. The weather at Annamalai nagar is moderately warm with hot summer months. The maximum temperature ranges from 20.6° C to 37.8° C with a mean of 33.8° C and the minimum temperature ranges from 20.8° C to 27.3° C with a mean of 23.8° C .

The relative humidity ranges from 88 to 72 per cent with a mean of 82 per cent. The mean hour of bright sunshine is 9.5. The mean annual rainfall received is 1500 mm. the soil of the experimental farm is classified as udic chromustert (clay) according to FAO/UNESCO (1974). The soil is deeply clay, low in available nitrogen, medium in available phosphorous and high in available potassium.

The experiment was laid out in randomized block design (RBD) and replicated thrice with different treatment schedule *viz.*, T₁–Unweeded control, T₂–Twice hand weeding at 15 DAS and 30 DAS, T₃–Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS alone, T₄–Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS + hand weeding at 30 DAS, T₅–Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS + post-emergence application of 2,4-D sodium salt 80% WP @ 1 kg a.i ha⁻¹ at 30 DAS, T₆–Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS alone, T₇– Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + one hand weeding at 30 DAS.

Biometric observations on weed count, weed dry weight, weed control efficiency at 30, 60, and 90DAS were recorded. Observations on growth components of maize *viz.*, Plant height, LAI and DMP yield components like cob length, cob diameter, grain number per cob, Test weight, no of grains cob⁻¹, grain weight cob⁻¹ were recorded. Yield parameters of grain and stover yield from each net plot was recorded and expressed in Kg ha⁻¹.

Chemical analysis of crop and weed samples for nitrogen, phosphorous, and potassium content was carried out for the computation of nutrient uptake by crops and nutrient removed by weeds. The values were expressed in Kg ha⁻¹. The expenditure incurred from sowing to harvest was worked out as cost of cultivation and expressed as Rs ha⁻¹. Total income obtained from grain stover yield was calculated for individual treatments. Gross and net returns were worked out and presented.



The observations collected during the experiments in respect of crop and weeds statistically analysed using the procedure outlined by Panse and Sukhantme(1978). WCI values were transformed by angular transformation and that of the weeds counts by the formula $\sqrt{x + 0.5}$ before statistical analysis for significant results, the critical difference was worked out at 5 per cent probability level to draw statistical conclusions.

3. Result and Discussion

Result on Weeds

The treatment T₇ – Early-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + One hand weeding at 30 DAS registered reduction in all the population of predominant weeds accompanied by least weeds dry matter. Highest weed control efficiency and least nutrient depletion by weeds in the experiment. This treatment was followed by T₂ – Twice hand weeding at 15 DAS and 30 DAS by manually. T₅ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5DAS + Post-emergence application of 2,4-D sodium salt 80% WP @ 1kg a.i ha⁻¹ at 30 DAS and T₄ – Pre-emergence application of atrazine 50% WP @ 1.25kg a.i ha⁻¹ at 5 DAS + One hand weeding at 30 DAS were on par with each other in weed management. Weed count at different stages, Weed dry matter is the most important parameter to assess the weed competitiveness for the growth and productivity of the crop. Maize is more prone to the yield reduction accompanied with higher weed biomass.

Significant reduction of weed biomass was recorded in T₇ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + One hand weeding at 30 DAS. Early post application of tembotrione at 15 DAS inhibit the 4-HPPD enzyme and the weeds are shown a albedo effect, which was chlorophyll content in the weeds are get removed, due to inhibition of chlorophyll production weeds in a tembotrione treated plot were died and the remaining germinated weeds are removed by hand weeding on 30 DAS. In general the broad leaved weed in a maize crop was effectively controlled by

tembotrione. Hence the weed biomass in 30, 60 and 90 DAS was significantly lower than other herbicide treated and controlled plot. T₁ – Unweeded control plot recoded significantly higher weed biomass. The effect of tembotrione on weeds to 4-HPPD (hydroxyphenylpyruate dioxygenase) inhibition or bleaching of chlorophyll was fall in line with the reports of Van Almsick and Andreas (2009).

Studies on Maize

Regarding various growth components viz., plant height, leaf area index, dry matter production with the exception of hundred grain weight were significantly influenced by the treatment T₇ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + One hand weeding at 30 DAS. This treatment was followed by T₂ – Twice hand weeding a 15 DAS and 30 DAS by manually. T₅ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha⁻¹ at 5 DAS + Post-emergence application of 2,4-D sodium salt 80% WP @ 1kg a.i ha⁻¹ at 30 DAS and T₄ – Pre-emergence application of atrazine 50% WP @ 1.25t kg a.i ha⁻¹ at 5 DAS + One hand weeding at 30 DAS were on par with each other in yield attributes. The least was recorded in the treatment T₁ – Unweeded control plot.

Regarding the interaction in weed management practices T₇ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + One hand weeding at 30 DAS excelled all other treatments.

Improved nutrient uptake by maize and crop vigour with elimination of weed competition right from sowing of the crop there by offering perfect and prolonged weed control might have contributed to increased plant height in treatments. This was reported by Sunitha *et al.* (2010). The higher values of yield attributes viz., number of cob m⁻² and number of grains cob⁻¹ were also found remarkably increased through T₇ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + One hand weeding at 30 DAS. This could have resulted in higher photosynthesis assimilate partitioning to the sink, ultimately contributing to production of



filled grains cob⁻¹ The results are in consonance with reports of Ning *et al.* (2015). Regarding grain and stover yield the treatment T₇ recorded superior grain yield of maize. It might be due to better control of weeds in experimental plot. And also providing a weed free environment which was favorable to crop growth. Severe weed competition in unweeded plot to maize reasoned for grain yield reduction. This result was lined up with Gharde *et al.* (2015).

Economics

Regarding the net return, return rupee⁻¹ invested were higher with T₇ - Early post-

emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha⁻¹ at 15 DAS + One hand weeding at 30 DAS. The least net return, return rupee⁻¹ invested was obtained under T₁ - Unweeded control plot. Increased grain and stover yields due to efficient weed control measures in right time with the right method might have been responsible for increased return per rupee invested in the best performance treatment T₇. The above results is in line with the reports of Chetan *et al.* (2015).

Table 1: Effect of weed management on dry weight of total weeds at 30, 60 and 90 DAS (kg ha⁻¹) and WCE at 90 DAS (%) of hybrid maize

Treatment	Dry weight of total weeds (kg ha ⁻¹)			WCE at 90 DAS (%)
	30 DAS	60 DAS	90 DAS	
T ₁ -Unweeded control	(190.46) 13.81	(166.76) 12.93	(209.24) 14.48	-
T ₂ -Twice hand weeding at 15 DAS and 30 DAS	(40.84) 6.43	(35.88) 6.03	(47.92) 6.69	79.66
T ₃ -Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha-1 at 5 DAS alone	(139.92) 11.84	(119.22) 10.94	(148.26) 12.19	38.94
T ₄ -Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha-1 at 5 DAS + hand weeding at 30 DAS	(50.83) 7.16	(44.91) 6.73	(58.31) 7.66	75.89
T ₅ - Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i ha-1 at 5 DAS + post-emergence application of 2,4-D sodium salt 80% WP @ 1 kg a.i ha-1 at 30 DAS,	(49.96) 7.10	(43.23) 6.61	(55.69) 7.49	76.43
T ₆ -Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha-1 at 15 DAS alone	(100.26) 10.03	(87.08) 9.35	(108.45) 10.43	46.27
T ₇ - Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha-1 at 15 DAS + one hand weeding at 30 DAS.	(32.37) 5.73	(28.34) 5.37	(35.56) 5.99	87.42
S.E _d	0.12	0.09	0.11	-
CD (P=0.05)	0.27	0.21	0.26	-



Table 2: Effect of weed management on crop LAI at Harvesting stage and DMP at 90 DAS of hybrid maize

Treatments	LAI at Harvest stage	DMP at 90 DAS
T ₁ – Unweeded control	2.93	3726.71
T ₂ – Twice hand weeding at 15 DAS and 30 DAS	6.61	11969.78
T ₃ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i. ha ⁻¹ at 5 DAS alone	5.84	10476.71
T ₄ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i. ha ⁻¹ at 5 DAS + One hand weeding at 30 DAS	6.33	11477.16
T ₅ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i. ha ⁻¹ at 5 DAS + Post-emergence application of 2,4-D sodium salt 80% WP @ 1kg a.i. ha ⁻¹ at 30 DAS	6.39	11637.14
T ₆ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha ⁻¹ at 15 DAS alone	6.12	11143.81
T ₇ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha ⁻¹ at 15 DAS + one hand weeding at 30 DAS	6.82	12302.69
S.E _d	0.08	157.21
CD (P=0.05)	0.18	331.48

Table 3: Effect of weed management on grain and stover yield (kg ha⁻¹) and economics of crop cultivation on hybrid maize

Treatment	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Cost of cultivation (Rs. ha ⁻¹)	Gross income (Rs. ha ⁻¹)	Net income (Rs. ha ⁻¹)	Benefit cost ratio
T ₁ – Unweeded control	1027.31	2736.41	32173.00	20881.00	-11292.00	0.64
T ₂ – Twice hand weeding at 15 DAS and 30 DAS	5798.66	10581.8	37173.00	92269.90	55096.90	2.48
T ₃ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i. ha ⁻¹ at 5 DAS alone	3768.46	7342.28	33798.00	60196.90	26398.90	1.78
T ₄ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i. ha ⁻¹ at 5 DAS + One hand weeding at 30 DAS	5262.87	9266.87	34673.00	83573.05	48900.05	2.41
T ₅ – Pre-emergence application of atrazine 50% WP @ 1.25 kg a.i. ha ⁻¹ at 5 DAS + Post-emergence application of 2,4-D sodium salt 80% WP @ 1kg a.i. ha ⁻¹ at 30 DAS	5321.42	9594.26	34298.00	84616.30	50318.30	2.46
T ₆ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha ⁻¹ at 15 DAS alone	4471.69	8399.19	34415.60	71270.35	36854.70	2.07
T ₇ – Early post-emergence application of tembotrione 42% SC (34.4% w/w) @ 120.80 ml ha ⁻¹ at 15 DAS + one hand weeding at 30 DAS	6986.98	11068.72	36915.50	110339.70	73424.20	3.25
S.E _d	115.29	153.31	-	-	-	-
CD (P=0.05)	251.23	334.07	-	-	-	-



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