Plant Archives Vol. 19 No. 2, 2019 pp. 2465-2468 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

RESPONSE OF IRRIGATED MAIZE TO NEW HERBICIDES

A. Sundari*, S. Kalaisudarson, A.P. Srinivasaperumal, S. Subashchandran and R. Gowtham

Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar–608 002 (T.N.) India.

Abstract

Field experiments were conducted during summer and *kharif*, 2017 to evolve a suitable weed management programme for irrigated hybrid maize. The experiments were laid out in randomised block design, replicated thrice with ten treatments *viz.,* unweeded control, twice hand weeding on 20 and 40 DAS, pre-emergence application of atrazine 1.0 kg/ha, metribuzin 1.0 kg/ha, post emergence application tembotrione 100 g/ha, topramezone 75 g/ha and combinations of pre and post emergence herbicide application. From the results, it is concluded that pre-emergence application of atrazine 1.0 kg/ha on 3 DAS followed by post-emergence application of tembotrione 100 g/ha on 21 DAS was recorded the least weed count, weed biomass, nutrient removal by weeds and the highest weed control index, growth parameters, yield parameters and yield and proved to be an efficient and economically feasible technology to manage the weeds and to realize better returns from the irrigated hybrid maize.

Key words **:** Pre emergence herbicide, Post emergence herbicide, Tembotrione, Topramezone, Weed management.

Introduction

Maize (*Zea mays* L.) is the third important cereal crop next to rice and wheat. Maize has been an important cereal crop because of its high production potential compared to any other cereal crop and adaptability to wide range of environments. Since the crop has very high genetic yield potential, it is called as the 'Queen of cereals'. Comparing the production potential of maize, the low productivity of maize in India is attributed to several reasons. A wider row spacing and sowing of the crop with onset of monsoon provides a favorable environment for growth of problematic weeds. Almost all type of weeds *viz.,* grassy, broad leaved weeds and sedges infest the maize field. The extent of nutrient loss varies from 30-40 per (Mundra *et al*., 2002). Weeds being a serious negative factor in crop production are responsible for marketable yield loss of 28-100 per cent (Pandey *et al*., 2001). Maize needs a weed free period of 20 to 60 days after sowing for higher yields (Selvakumar and Sundari, 2008). Herbicides offer convenient, easy, and flexible and an efficient option of weed control. Due to the fact, the labour is scarce and expensive, chemical weed control is gaining wider acceptability with the farmers. A wide range of new herbicides are available to suit all crops and cropping systems to control a diverse spectrum of weeds. Because of severe infestation of annual and perennial weeds in irrigated maize, the potential yield is generally not realized. This study was chosen to evaluate the relative efficiency of new herbicides for the management of weeds in maize.

***Author for correspondence :** E-mail : sundariagronomy@gmail.com

Materials and Methods

Field experiments were conducted to find out the response of irrigated maize to new herbicides during summer and *kharif*, 2017 in the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar which is located at 11˚24' North latitude and 79˚41' East longitude, at an altitude of 5.79 meters above mean sea level. The soil of the experimental field was clayloam in texture with 0.63 per cent organic carbon having pH 7.8 and EC 0.47 ds/m. It was low, medium and high in available N, P and K, respectively. Irrigated maize hybrid S6750 was sown at 15 kg/ha with 60×20 cm spacing. The crop was grown with recommended package of practices except weed management. Ten treatments comprising unweeded control, twice hand weeding at 20 and 40 DAS, pre-emergence application of atrazine, metribuzin 1.0 kg/ha on 3 DAS, post emergence application of tembotrione

100 g/ha, topramezone 75 g/ha on 21 DAS and their combination were tried in randomized block design with three replication with plot size of 5×4m. The herbicides *viz.,* tembotrione and topramezone were selective new post-emergence for the control of broad leaved and grassy weeds in maize. All the herbicides were applied with manually operated knapsack sprayer fitted with flood jet nozzle at a spray volume of 500 l/ha. Weed count and weed biomass were recorded at 60 DAS. Weed count was subjected to "x+0.5 transformation. Weed control index was calculated by using the formula suggested by Mishra and Tosh, 1979.

$$WCI\% = \frac{\begin{matrix}Weed\ biomass\ in\ unweeded\ control\ plot \\ -\ Weed\ biomass\ in\ treated\ plot\end{matrix}}{Weed\ biomass\ in\ unweeded\ control\ plot} \times 100$$

Growth, yield parameters and economic yield were recorded in respective treatment. Cost of cultivation was calculated by taking current market prices of inputs while monetary return was obtained by multiplying grain yield with market price of grain and stover. The benefit: cost (B:C) ratio was calculated by dividing the net returns by cost of cultivation. The critical difference at 5% level of profitability was calculated for testing the significance of difference between any two means where ever 'F' test was significant.

Results and Discussion

Weed observations

The experimental field was dominated by *Trianthema portulacastrum* L., *Cyperus rotundus* L., *Cyandon dactylon* L., and *Echinochola crusgalli* L. All the weed control treatments exerted significant influence on the population of these weeds, whereas, because of sporadic occurrence, the other weeds were not significantly influenced by the treatments. Pre-emergence application of atrazine 1.0 kg/ha at 3 DAS followed by post-emergence application of tembotrione 100 g/ha on 21 DAS and twice hand weeding on 20 and 40 DAS were registered the least of all weed parameters and superior over the other treatments.

The least total weed biomass of 10.41g/m and the highest WCI of 94 % were recorded in pre - emergence application of atrazine 1.0 kg/ha DAS + post emergence application of tembotrione 100 g/ha on 21 DAS and was on par with twice hand weeding. This was followed by pre-emergence application of atrazine + post emergence application of topramezone 75 kg/ha on 21 DAS. Unweeded control encouraged higher weed population with the highest weed parameters (Fig.1). The excellent performance of atrazine and tembotrione were due to better control of weeds. By virtue of its efficacy against broad leaved and grassy annual weeds and performed significantly superior in reducing the all type of weeds compared to all other treatments and thereby it is superior in registering a significantly higher reduction in total weed count.

Atrazine to have a half-life of 8 days with a higher solubility and made itself easily available in the solution, with a better sorption/adsorption equilibrium. Thereby the herbicide was able to act better on the germinating weed seeds. Tembotrione being a post-emergence herbicide, the late emerged weeds may be controlled because of its higher solubility. Tembotrione is a triketone herbicide it inhibits the enzyme 4-hydroxy-phenylpyruvate dioxygense (HPPD). As a result the formation of carotenoids is disrupted. The development of bleaching starts at the youngest tissues of the aerial plant parts. Bleached plants then wilt and development extensive necrosis before they finally die. This process is rapid, as the herbicide exerts its full effect within few days. Similar result was also reported by Santel (2009). By repeated hand hoeing the weed infestation was controlled in an effective manner under twice hand weeding treatment, which registered comparable lesser values of all the weed parameters. This is in line with Swetha *et al*., 2015. There was vigorous growth of weed in unweeded control treatment resulted in the highest removal of N, P and K nutrients. This is in conformity with the findings of Sinha *et al*. (2005). While pre-emergence application or atrazine followed by post emergence application tembotrione recorded the least loss of nutrients by weeds followed by twice hand weeding (Table 1). It can be explained in the light of the facts that these treatments controlled the weeds effectively, might have made more nutrients available to

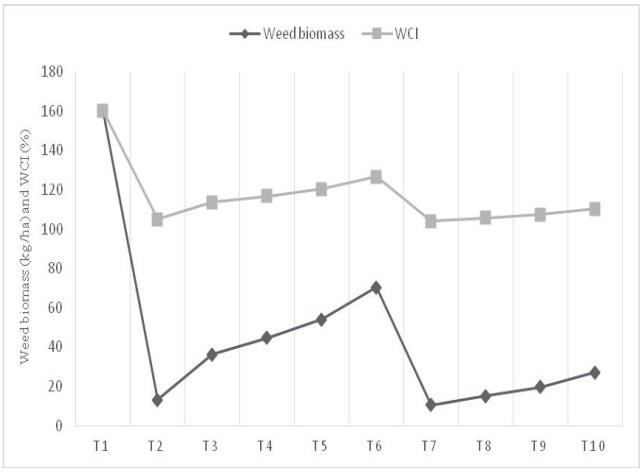

Fig. 1: Effect of herbicidal treatments on weed biomass and WCI.

crop consequently encouraged higher concentration of nutrients and there by higher uptake of nutrients by the crop resulted in more yield.

Growth attributes, yield attributes and yield

In general *kharif* crop performed better than summer crop because of prevalence of favorable weather parameters. The deleterious effect of the weed competition was reflected on growth performance of the crop. This could be realized with significantly higher plant height in treatments that offered weed free environment in the early stage of the crop growth. Effective weed control and reduced weed competition in maize by pre-emergence application of atrazine 1.0 kg/ha on 3 DAS + post emergence application to tembotrione 100 g/ha on 21 DAS enabled the crop with higher nutrient saving and uptake and recorded significantly higher cob length, cob diameter, number of grains/cob and grain yield (6352 kg/ha) and stover yield and enabled the with better crop growth and yield attributes especially in a determinate crop like maize, which was ultimately reflected on the highest yield of the crop. Similar findings was reported by Shantiveerayya and Agasimani (2002). Twice hand weeding was on par because it could offer satisfactory weed control by thorough weeding.This was followed by pre-emergence application of atrazine 1.0 kg/ha on 3 DAS + post emergence application of topramezone 75 g/ha on 21 DAS. The least of all parameters were recorded with unweeded control. (Table 2). This may be due to severe weed competition throughout the crop growth.

Table 1: Effect of pre and post herbicides on total weed count and nutrient removal by weeds (mean of two seasons).

Treatment	Total weed count at 60 DAS	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
T_1	(156.27)*12.52	54.21	29.21	47.47
T_2	(51.12)7.18	17.32	11.01	16.21
T_3	(90.47)9.55	28.45	18.23	27.61
T_4	(100.14)10.03	33.1	19.54	30.23
T_5	(105.61)10.30	37.23	21.4	36.43
T_6	(121.12)11.0	42.39	24.11	41.32
T_7	(50.28)7.11	16.22	9.85	14.95
T_8	(63.73)8.00	19.1	13.43	18.32
T_9	(75.61)8.72	22.2	15.58	22.7
T_{10}	(88.59)9.43	25.63	17.25	24.62
S.Em±	0.571.20	0.721.52	0.561.18	0.611.30
CD (p= 0.05)				

*Figures in the parenthesis indicates original values.

T_1, Unweeded control; T_2, Twice hand weeding at 20 and 40 DAS; T_3, Pre-emergence application of atrazine 1.0 kg/ha on 3DAS; T_4, pre-emergence application of metribuzin 1.0 kg/ha on 3DAS; T_5, post-emergence application of tembotrione 100g ha^{-1} on 21DAS; T_6, post-emergence application topramezone 75g/ha on 21 DAS; T_7, T_3+ T_5; T_8, T_3+ T_6; T_9, T_4+ T_5; T_{10}, T_4+ T_6.

Economics

The economic parameters for maize were calculated and presented in Table 3. The highest gross return was registered with pre-emergence application of atrazine 1.0 kg/ha on 3 DAS followed by post emergence application of tembotrione 100 g/ha on 21 DAS. The least gross return was registered with unweeded control. The highest benefit: cost ratio (3.18) was obtained with pre-emergence application of atrazine 1.0 kg/ha on 3 DAS + post emergence

Table 2: Effect of pre and post emergence herbicides on plant height, yield attributes, grain and stover yield of maize (mean of two seasons).

Treatment	Plant height (cm)			Cob length (cm)	Cob diameter (cm)	Number of grains/ cob	Grain yield (kg/ha)	Stover yield (kg/ha)
	30 DAS	60 DAS	Harvest					
T_1	69.34	126.90	186.70	14.01	4.40	179.14	3210	7232
T_2	93.83	174.56	257.20	22.80	9.81	369.20	6202	9070
T_3	85.45	158.42	223.17	18.11	7.44	288.41	5265	8434
T_4	82.73	152.47	212.87	17.22	6.39	260.72	4626	8275
T_5	79.64	146.33	204.50	16.10	5.65	224.33	4230	7965
T_6	75.87	139.5	196.12	15.00	5.01	201.20	3786	7642
T_7	95.50	176.86	264.20	23.40	10.12	382.60	6352	9216
T_8	92.05	171.14	249.51	21.55	9.22	353.51	6026	8905
T_9	90.14	167.22	241.23	20.60	8.65	331.43	5782	8749
T_{10}	88.13	163.11	232.47	19.22	8.02	308.31	5585	8592
S.Ed CD (p=0.05)	0.811.72	1.443.04	3.397.12	0.380.80	0.150.33	6.4213.50	72.38152.0	73.33154.0

T_1, Unweeded control; T_2, Twice hand weeding at 20 and 40 DAS; T_3, Pre-emergence application of atrazine 1.0 kg/ha on 3DAS; T_4, pre-emergence application of metribuzin 1.0 kg/ha on 3DAS; T_5, post-emergence application of tembotrione 100g ha^{-1} on 21DAS; T_6, post-emergence application topramezone 75g/ha on 21 DAS; T_7, T_3+ T_5; T_8, T_3+ T_6; T_9, T_4+ T_5; T_{10}, T_4+ T_6.

Table 3: Effect of pre and post herbicides on economics of maize (mean of two seasons).

Treatment	Cost of cultivation (×10^{3} ₹ /ha)	Gross income (×10^{3} ₹ /ha)	Net income (×10^{3} ₹ /ha)	B:C ratio
T_1	36.46	60.99	24.52	1.67
T_2	42.19	117.83	75.64	2.68
T_3	37.19	100.03	62.84	2.28
T_4	38.73	87.89	49.16	2.28
T_5	38.43	80.37	41.93	2.09
T_6	38.43	71.93	33.49	1.87
T_7	39.56	125.92	86.35	3.18
T_8	39.56	114.49	74.92	2.89
T_9	41.30	109.85	68.55	2.65
T_{10}	41.30	106.11	64.80	2.56

T_1, Unweeded control; T_2, Twice hand weeding at 20 and 40 DAS; T_3, Pre-emergence application of atrazine 1.0 kg/ha on 3DAS; T_4, pre-emergence application of metribuzin 1.0 kg/ha on 3DAS; T_5, post-emergence application of tembotrione 100g ha^{-1} on 21DAS; T_6, post-emergence application topramezone 75g/ha on 21 DAS; T_7, T_3+ T_5; T_8, T_3+ T_6; T_9, T_4+ T_5; T_{10}, T_4+ T_6.

application of tembotrione 100 g/ha on 21 DAS (Table 3). This may be due to better weed control, which enabled the crop to use nutrients, light, moisture effectively thereby enhancing the yield. Pre emergence application of atrazine followed by topramezone 75 g/ha came next in order and registered benefit: cost ratio of 2.89.

The efficient and economic weed management in hybrid maize could be achieved by integrating pre-emergence application of atrazine 1.0 kg/ha on 3 DAS with post emergence application of tembotrione 100 g/ha on 21 DAS.

References

Mishra, A. and G.C. Tosh (1979). Chemical weed control studies in dwarf wheat. *Indian Journal of Research. Orissa Univ. Agric. And Tech.,* **10:** 1-16.

Mundra, S.L., A.K. Vyas and P.L. Maliwal (2002). Effect of weed and nutrient management on nutrient uptake by maize (*Zea mays* L.) and weed. *Indian Journal Agronomy,* **47:** 378-383.

Pandey, A.K., V. Prakash, R.D. Singh and V.P. Mani (2001). Integrated weed management in maize (Zea mays). *Indian Journal Agronomy,* **46(2):** 260-265.

Selvakumar, T. and A. Sundari (2002). Weed management in maize + pulse inter cropping system. *Green farming,* **(9):** 26-28.

Santel, H.J. (2009). Laudis® OD-a new herbicide for selective post emergence weed control in corn (*Zea mays* L.). *Bayer crop Science Journal,* **62(1):** 95-108.

Shantiveerayya, H. and C.A. Agasimani (2012). Effect of herbicides on weed control and productivity of maize (*Zea mays* L.). *Karnataka Journal of Agricultural Science,* **25 (1):** 137-139.

Sinha,S.P., S.M.Prasad and S.J.Singh (2005). Nutrient utilization by winter maize weeds as influenced by integrated weed management. *Indian Journal Agronomy*, **50(4):** 303-304.

Swetha, K. (2015). Weed management with new generation herbicides in kharif maize. M.Sc (Ag.) Thesis, college of agriculture, Professor Jayashankar telangana state agricultural university, Rajendranaga, Telangana, India.