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Response of weed management to grain yield and nutrients uptake in maize (*Zea mays* L.)

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ABSTRACT

A field experiment was conducted during summer season 2015 at College Farm, Department of Agronomy, N.M. College of Agriculture, Navsari Agricultural University, Navsari in clay soil. There were ten treatments, involving two pre-emergence, three tank mixtures, one post-emergence, one soil mulching, one sugarcane trash mulching, weed free and weedy check. Significantly higher grain and straw yield were registered under weed free treatment (6566 and 8135 kg ha^{-1}, respectively), which was statistically at par with atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1}(6267 and 7921 kg ha^{-1}) as PE, alachlor @ 1.5 kg ha^{-1}+ atrazine @ 0.5 kg ha^{-1}(5918 and 7316 kg ha^{-1}) as PE, atrazine @ 0.75 kg ha^{-1}+ 2.4 D @0.5 kg ha^{-1}(5820 and 7276 kg ha^{-1}) as PE, atrazine @ 0.75 kg ha^{-1} (5680 and 6856 kg ha^{-1}) as PE and atrazine as PoE @ 1.5 kg ha^{-1} at 30 DAS (5619 and 6819 kg ha^{-1}), while weed control through sugarcane trash mulch @ 5 t ha^{-1} and alachlor @ 1.5 kg ha^{-1} PE were also at par in case of straw yield. Significantly higher nutrients uptake by grains and straw was observed under weed free condition, which was statistically at par with atrazine @ 0.75 kg ha^{-1}+ pendimethalin @ 0.75 kg ha^{-1} PE, alachlor @ 1.5 kg ha^{-1}+ atrazine @ 0.5 kg ha^{-1} PE, atrazine @ 0.75 kg ha^{-1}+ 2.4 D 0.5 @ kg ha^{-1} PE and only atrazine @ 0.75 kg ha^{-1}. Highest uptake by weeds was recorded under weedy check treatment. Itrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1} PE registered significantly lower uptake of nutrients, while significantly higher uptake of nutrients registered under weed control by inter-culturing at 30 and 45 DAS fb HW.

Key words: Herbicide, nutrient uptake, soil mulch, tank mixture, yield

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the world in agricultural economy both as food and fodder crop and is regarded as queen of cereals. Maize grains are used for human consumption, feed for poultry and livestock, for extraction of edible oil and also for starch and glucose industry. It is called a miracle crop with very high yield potential. In India, maize is grown over an area of 9.34 million ha with an annual production of about 24.35 million tons and an average productivity of about 2583 kg ha^{-1}. Gujarat occupies an area of 461 hectares with a production of 692 tons and productivity of 1501 kg ha^{-1} (IIMR, 2014). Weeds emerge fast, grow rapidly and compete with the crop for growth resources viz., nutrients, moisture, sunlight and space during entire vegetative growth and early reproductive stages of maize. They also transpire conserved moisture and absorb large quantities of nutrients from the soil. Further, wide space provided to the maize allows fast growth of variety of weed species causing a considerable reduction in yield by affecting the growth and yield attributing components. Presence of weeds reduces the photosynthetic efficiency, dry matter production and distribution to economical parts, thereby reducing sink capacity of crop resulting in poor grain yield. Thus, the extent of reduction in grain yield of maize has been reported

to be in the range of 33 to 50 per cent depending on type of weed species in standing crop. It is well established that 30 to 60 DAS is the most critical period for crop-weed competition in maize. In recent agricultural activities, the chemical method of weed control is becoming the ultimate weed management strategy. Chemical weed control has been found to offer this efficiency and effectiveness since the weeds could be managed even before they emerge. With the efficient control by herbicides, the plant gets free access to water, nutrients, light and space without competition. The chemicals are more systemic and persistent; thus resulting in an effective, efficient and longer period of weed control (Ali et al., 2003). Mulching is a recent and important non-chemical weed control method. Different organic mulches lower the increase in soil moisture, soil temperature and decrease weed density and increase the crop yield (Sinkeviciene et al., 2009). Keeping all these aspects in view, an attempt was made to find out effective herbicides for weed management in maize under south Gujarat condition.

MATERIALS AND METHODS

A field experiment was conducted during the summer season of 2015 at College Farm, Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari on clayey soil. There were ten treatments involving two pre- emergence herbicides (alachlor @ 1.5 kg ha^{-1} and atrazine @ 0.75 kg ha^{-1}), three tank mixture application of herbicide alachlor @ 1.5 + atrazine @ 0.5 kg ha^{-1}, atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1} and atrazine @ 0.75 kg ha^{-1} + 2.4 D @ 0.5 kg ha^{-1} as PE, one post-emergence herbicide of atrazine @ 1.5 kg ha^{-1}, 30 DAS, one soil mulching (Inter-culturing at 30 and 45 DAS fb and weeding), one sugarcane trash mulching @ 5 t ha^{-1}, weed free and weedy check. The experiment was laid out in a randomized block design with three replications having net plot size of 4.2 m × 3.0 m. The crop was fertilized with 120 kg N and 60 kg P_2O_5 per ha through urea and SSP, respectively. Half of N and all of P_2O_5 was applied at the time of sowing and remaining N was top dressed at 30 DAS. Besides fixed cost of cultivation, variable cost on spray and cost of herbicides in each treatment was worked out to obtain total cost of production.

The net income was obtained after deducting cost of cultivation from value of produces as samples from grain, straw, central core of cob and weeds were taken separately for the estimation of nutrient content from each treatment from all the three replications. Chemical studies pertaining to nitrogen, phosphorus and potassium content and their uptake by maize and weeds were respectively determined by Kjeldahl's method, Vanadomolybdo Phosphoric acid yellow color method and Flame photometric method. Black (1979) and Jackson (1973) while the estimation of available Nitrogen, Phosphorus and Potassium from soil were carried out by Olsen's method; Alkaline potassium permanganate method and flame photometer suggested by Jackson (1973). The expenses including the cost of input specially fertilizers (NPK) applied to each treatments was calculated on the basis of prevailing local charges. Net returns of each treatment were calculated by deducting the total cost of cultivation from the gross returns.

RESULTS AND DISCUSSION

Yield

The grain and straw yield (kg ha^{-1}) were significantly influenced by different weed management treatments. Significantly higher grain and straw yield were registered under weed free treatment (6566 and 8135 kg ha^{-1}, respectively), which was statistically at par with atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1}(6267 and 7921 kg ha^{-1}) as PE, alachlor @ 1.5 kg ha^{-1}+ atrazine @ 0.5 kg ha^{-1}(5918 and 7316 kg ha^{-1}) as PE, atrazine @ 0.75 kg ha^{-1}+ 2.4 D 0.5 @ kg ha^{-1} (5820 and 7276 kg ha^{-1}) as PE, atrazine @ 0.75 kg ha^{-1} (5680 and 6856 kg ha^{-1}) as PE and atrazine as PoE @ 1.5 kg ha^{-1} at 30 DAS (5619 and 6819 kg ha^{-1}), while weed control through sugarcane trash mulch @ 5 t ha^{-1} and alachlor @ 1.5 kg ha^{-1} PE were also at par in case of straw yield. Among herbicide treatment, T8 recorded significantly higher with grain yield (6267 kg ha^{-1}) followed by T7 and T9. The lowest grain and straw yield (3505 and 5526 kg ha^{-1},

respectively) were recorded under weedy check (T1). The better performance of yield under weed free condition might be due to effective control of weeds and higher weed control efficiency as well as lower weed index observed, which cumulatively facilitated the crop to utilize more nutrients and water for better growth and development in terms of various yield attributing characters. These findings corroborate the results of Mathukia et al. (2014), Dobariya et al. (2015) and Samant et al. (2015) in maize (Table 1).

Table 1. Grain yield, straw yield, nutrients uptake by weeds and maize as influenced by weed management

Treatment		Yield (kg ha^{-1})		Nutrients uptake by weeds (kg ha^{-1})			Nutrients uptake by maize (kg ha^{-1})					
		Grain	Straw				Grain			Straw		
				N	P	K	N	P	K	N	P	K
T1	Weedy check	3505	5526	3.32	1.13	1.02	52.4	15.4	16.1	64.0	11.1	16.4
T2	Weed free	6566	8135	-	-	-	105.6	32.5	32.2	104.4	18.7	26.2
T3	Weed control through soil mulch (Interculturing at 30 and 45 DAS *fb* HW)	5228	5910	1.37	0.51	0.43	82.8	25.4	25.6	75.9	13.4	18.7
T4	Weed control through trash mulch (Sugarcane trash @ 5 t ha^{-1})	5513	6752	1.07	0.40	0.35	87.9	26.2	26.3	82.6	14.6	20.4
T5	Pre-emergence application of Alachlor @ 1.5 kg ha^{-1}	5460	6536	0.95	0.36	0.32	86.6	26.3	26.2	81.9	15.9	19.8
T6	Pre-emergence application of Atrazine @ (0.75 kg ha^{-1})	5680	6856	0.91	0.35	0.31	89.8	27.1	27.2	85.1	14.9	21.4
T7	Pre-emergence application of Alachlor @ 1.5 kg ha^{-1}+ Atrazine @ 0.5 kg ha^{-1}	5918	7316	0.58	0.22	0.19	92.4	26.6	27.7	91.3	15.6	24.3
T8	Pre-emergence application of Atrazine @ 0.75 kg ha^{-1}+ Pendimethalin @ 0.75 kg ha^{-1}	6267	7921	0.52	0.19	0.17	100.2	30.0	29.4	96.8	18.1	24.7
T9	Pre-emergence application of Atrazine @ 0.75 kg ha^{-1}+ 2.4 D 0.5 @ kg ha^{-1}	5820	7276	0.63	0.22	0.19	92.4	26.9	27.8	90.0	16.2	22.4
T10	Post emergence application of Atrazine @ 1.5 kg ha^{-1}30 DAS	5619	7210	1.22	0.46	0.39	87.9	27.0	26.2	83.9	14.2	20.9
	S.Em. ±	312.3	505.7	0.093	0.027	0.032	5.36	1.50	1.735	6.50	1.23	1.64
	C.D at 5 %	999.1	1617.7	0.30	0.088	0.11	17.14	4.80	5.55	20.79	3.95	5.25
	C.V. %	9.73	12.68	13.76	10.94	14.99	10.57	10.16	11.38	13.15	13.98	13.21

Nutrients uptake

Significantly higher nitrogen uptake by grains and straw was observed under weed free condition (105.6 and 104.4 kg ha^{-1}, respectively), which was statistically at par with atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1} PE, alachlor @ 1.5 kg ha^{-1} + atrazine @ 0.5 kg ha^{-1} PE, atrazine @ 0.75 kg ha^{-1}+ 2.4 D 0.5 @ kg ha^{-1} PE and only atrazine @ 0.75 kg ha^{-1}. Significantly higher phosphorus uptake by grain and straw was recorded by weed free treatment (32.5 and 18.7 kg ha^{-1}, respectively), which was at per with pre-emergence application of atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1} in case of grain, while T8, T9, T5, T7 and T6 (18.1, 16.2, 15.9, 15.6 and 14.9 kg ha^{-1}, respectively) in case of straw. Significantly maximum potassium uptake by grains and straw were observed under treatment T2 (32.2 and 26.2 kg ha^{-1}), which was statistically at par with T8, T9, T7 and T6 (29.4, 27.8, 27.7 and 27.2 kg ha^{-1}) in case of grains, while T8, T7, T9 and T6 (24.7, 24.3, 22.4 and 21.4 kg ha^{-1}) in case of straw production. The uptake by weeds was significantly high under weedy check (3.20, 1.15 and 1.02 kg ha^{-1} nitrogen, phosphorus and potassium, respectively). Among the different weed management treatments, atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1} PE registered significantly lower uptake of nutrients (0.52, 0.19 and 0.17 kg ha^{-1}, N, P and K, respectively), while significantly higher uptake of nutrients (1.37, 0.51 and 0.43 kg ha^{-1}, N, P and K, respectively) registered under weed control by inter-culturing at 30 and 45 DAS fb HW. The nutrient uptake is a function of yield and nutrient concentration in plant. The higher uptake of nutrients might be due to better development of crop resulting lesser crop weed competition. Thus, improvement in uptake of N, P and K might be attributed to their concentration in grain and straw and associated with higher grain and straw yields. The findings for the nutrients uptake was followed the pattern of those were reported by Kour et al. (2014) and Samant et al. (2015) in maize. To recommend the atrazine @ 0.75 kg ha^{-1} + pendimethalin @ 0.75 kg ha^{-1} PE is economically better than the rest of the treatments.

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