Post harvest soil nutrient status and nutrient uptake by crop and weed as influenced by the pre and post emergence herbicides application in maize

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ABSTRACT

Field experiment was conducted at the Annamalai University, Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai Nagar to study the post harvest soil nutrient status and nutrient uptake by crop and weed as influenced by the pre and post emergence herbicides application in maize during (Feb - June) 2015. The experiment was laid out in randomized block design with three replications and nine treatments. The treatment details are *viz.*, Weedy check (T_1), Lumax 440 ZC W/V @ 2.5 lit ha^{-1} on 3 DAS (T_2), Lumax 440 ZC W/V @ 3 lit ha^{-1} on 3 DAS (T_3), Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS (T_4), S-metolachlor 96% EC @ 1lit ha^{-1} on 3 DAS (T_5), Mesotrione 48% SC @ 208 ml ha^{-1} on 3 DAS (T_6), Atrazine 50 WP @ 2 Kg ha^{-1} on 3 DAS (T_7), Paraquat dichloride 24% SL @ 2 lit ha^{-1} on 10 DAS (T_8) and twice hand weeding at 20 and 40 DAS (T_9). All the treatments were found to be significantly influenced the grain and stoves yield of maize, nutrient uptake by maize and weeds and post harvest soil nutrient status. The result of the study clearly showed that pre-emergence application of Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS (T_4) significantly registered higher grain and stover yield of maize, more uptake of nutrients by maize and lesser uptake of nutrients by weeds and higher availability of post harvest soil nutrient status. However, it was on par with twice hand weeding at 20 and 40 DAS (T_9). Weedy check (T_1) recorded the higher weed population resulting in lesser grain yield, which inturn lesser uptake of nutrients by maize crop.

INTRODUCTION

Maize (corn) along with wheat and rice is one of the world's most important food crops. Maize provides food to the human beings and feed to the cattle. During recent years, maize is being increasingly used as a feedstock and for the production of bio ethanol. It contributes a lot to the economy of the country, as it is a rich source of food and feed and also provides raw materials for the industry. In recent years, corn oil is becoming popular among the people due to its non-cholesterol character. In addition, its products like corn starch, corn flakes, gluten germ cake, lactic acid, alcohol and acetone are either directly consumed as a food or used by various industries like paper, textile and fermentation etc. The cereals occupy about 54per cent of the total cropped area of which maize occupies about 3.61 per cent of the total cropped area of India. It accounts for 9 per cent of the total food grain production in the country. In India, maize is grown in an area of 8.78 m ha with a production of 21.76 m t. The average productivity of maize in India is about 2478 kg ha^{-1} as against the world average of 4860 kg ha^{-1} (Anon., 2013).

Protecting maize from weeds is very much essential to avoid heavy losses caused by them in maize yield and gain quality. Controlling of weeds in maize in the critical period presumes most importance for realizing higher yield. Because weeds emerge fast and grow rapidly competing with the crop severely for growth resources viz., nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages of maize. Further, wide spacing in maize allows faster growth of variety of weed species which reduces the photosynthetic efficiency, dry matter production and distribution to economical parts and there by reduces sink capacity of crop resulting in poor grain yield (Vaid *et al.*, 2010). Labour component in agriculture is becoming scarce, not available at time and prohibitive cost (Dalal and Nandkar, 2010). Yield losses due to weed infestation vary from 28- 93% depending on the type of weed flora and their intensity, stage, nature and duration of crop weed competition (Sharma and Thakur 1998). The critical period of crop weed competition in corn range from 1 to 8 weeks after sowing. In order to realize the maximum yield potential of maize, weed management becomes indispensable during this period. Chemical weed management by using pre - or post-emergence herbicides can lead to the efficient and cost effective control of weeds during critical period of crop weed competition, which may not be possible in manual or mechanical weeding due to its high cost of cultivation. Keeping these in view, field experiment was conducted during summer season (February to June-2015) at Annamalai University, Experimental Farm, Annamalainagar, to study the Post harvest soil nutrient status and nutrient uptake by crop and weed as influenced by the pre and post emergence herbicides application in maize

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MATERIALS AND METHODS

Field Experiment was conducted at the Experimental farm, Annamalai University, Annamalainagar during (Febraury – June) 2015 to study the post harvest soil nutrient status and nutrient uptake by crop and weed as influenced by the pre and post emergence herbicides application in maize. The experimental farm is geographically located at 11°24' North latitude and 79°44' East longitude with an altitude of 5.79 m above mean sea level. The weather at Annamalai nagar is moderately warm with hot summer months. During the cropping period received a rainfall of 162.9 mm with distribution over 10 rainy days. The soil of the experimental field is clay loam in texture. The fertility status of the soil was found to be low in available nitrogen (216 kg ha^{-1}), medium in available phosphorus (19 kg ha^{-1}) and high in available potassium (315 kg ha^{-1}). The maize hybrid Pioneer 30B07 was chosen for the study. The experiment was laid out in randomized block design with three replications and nine treatments. The treatment details are *viz.*, Weedy check **(**Control) - (T_1), Lumax 440 ZC W/V @ 2.5 lit ha^{-1} on 3 DAS - (T_2), Lumax 440 ZC W/V @ 3 lit ha^{-1} on 3 DAS - (T_3), Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS - (T_4), S - metolachlor 96% EC @ 1 lit ha^{-1} on 3 DAS - (T_5), Mesotrione 48% SC @ 208 ml ha^{-1} on 3 DAS - (T_6), Atrazine 50 WP @ 2 Kg ha^{-1} on 3 DAS - (T_7), Paraquat dichloride 24% SL @ 2 lit ha^{-1} on 15 DAS - (T_8) and Hand weeding twice at 20 and 40 DAS - (T_9). The recommended seed rate of 15 kg ha^{-1} was used for the trail. The seeds were sown by dibbling with a spacing of 60 X 20 cm. The fertilizers were applied to the experimental field as per the recommended manurial schedule of 135:62.5:50 kgs of N, P_2O_5 and K_2O ha^{-1}. The entire dose of phosphorus, potassium and half dose of nitrogen was applied as basal. The remaining half dose of nitrogen was top dressed in two equal splits at 25 and 45 days after sowing. As per the treatment schedule required quantity of pre and post emergence herbicides were sprayed with knapsack sprayer fitted with flood jet nozzle using 600 litres of water ha^{-1}. Pre emergence herbicides *viz.*, Lumax 440 ZC W/V (S - Metolachlor 27.1% + Mesotrione 2.71% + Atrazine 10.2%W/W), S - Metolachlor 96% EC, Mesotrione 48% SC, Atrazine 50 WP were sprayed on 3 DAS and post emergence herbicide *viz.*, Paraquat dichloride 24% SL was sprayed on 15 DAS with adequate soil moisture. Hoeing and hand weeding was done as per treatment schedule. Need based plant protection measures were taken up based on the economic threshold level of pest and disease. Grains were separated, dried, cleaned and grain yield was recorded plot wise at 12 per cent moisture content. The grain yield was computed to Kg ha^{-1}.

The data on various characters studied during the course of investigation were statistically analyzed as suggested by Gomez and Gomez (1984). For significant results, the critical difference was worked out at 5 per cent probability level and statistical conclusions were drawn.

Plant/weed analysis

The plant / weed samples after estimation of dry matter were chopped and powdered by using a Willey mill and were analysed for N, P and K contents.

Analytical methods employed for plant /weed were as under

Particulars	Author(s)	Method
N content	Humphries, 1956	Micro Kjeldahl method
P content	Jackson (1973)	Spectro photometer using triacid digestion method
K content	Jackson (1973)	Flame photometer using triacid extract

Soil analysis

The post harvest composite soil samples were collected after the harvest of rice and analysed for post harvest available nutrients.Analytical methods employed for soil were as under

Particulars	Author(s)	Method
Available N	Subbiah and Asija (1956)	Alkaline permanganate method
Available P	Olsen *et al.* (1954)	Colorimeter method
Available K	Stanford and English (1949)	Flame photometric method

Result and discussions

Nutrient removal by weeds

Among the weed control measures, pre emergence application of Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS (T_4) significantly recorded the lowest nutrient removal by weeds of 11.68, 6.92 and 16.40 kg of N, P_2O_5 and K_2O ha^{-1} respectively. This might be due longer persistence of the chemicals and consequent suppression of weed population which influenced lower weed biomass and resulted in least uptake of N, P and K by weeds under this treatment. The results confirm the findings of Srinivas and Satyanarayana (1996). This treatment followed by on par with twice hand weeding (T_9) and it was recorded total nutrient removal by weeds of 12.77, 7.40 and 17.67 kg of N, P_2O_5 and K_2O ha^{-1}. The highest nutrient removal by weeds were recorded in T_1 (control) with 34.65, 20.53 and 31.44 kg of N, P_2O_5 and K_2O ha^{-1} respectively. This might be attributed to luxuriant growth of unchecked weeds in weedy check treatment which competed dominantly with the crop plants for nutrients. The results are line with the earlier findings of priyanakharibam (2014).

Nutrient uptake by maize crop

Among the treatments, Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS (T_4) excelled other treatments by recording the highest nutrient uptake of 154.03 kg ha^{-1} of N, 40.41 kg ha^{-1} of P_2O_5 and 134.77 kg ha^{-1} of K_2O. However, this treatment was on par with twice hand weeding (T_9) by registering higher nutrient uptake of 152.43 kg ha^{-1} of N, 39.56 kg ha^{-1} of P_2O_5 and 132.99 kg ha^{-1} of K_2O. This could possibly be attributed to higher weed control efficiency resulting in more favorable environment for growth and development of crop plants apparently due to the lesser weed competition. The results conformed to the findings of Srinivas and Satyanarayana (1996). Hand weeding twice was next in order

of N, P and K uptake of maize. The better removal of weeds at early stage favoured the vigorous growth of plant, without any crop weed competition and sustained nutrient availability leads to better uptake of NPK by the crop. This is on consonance with the reports of Sinha *et al.* (2000). The treatment control (T_1) recorded the lowest uptake of 126.91 kg ha^{-1} of N, 26.65 kg ha^{-1} of P_2O_5 and 109.42 kg ha^{-1} of K_2O. The increased weed number and lower dry matter production of maize in weedy check plots led to reduced N, P and K uptake by crop. The observation was in line with the findings of Malviya and Sing (2007).

Grain and Stover Yield

All the treatments significantly influenced the grain and stover yields**.** Among the treatments Lumax 440 ZC W/V @ 3.5 lit ha^{-1}on 3 DAS (T_4) significantly registered the highest grain yield of 6418 kg ha^{-1} and stover yield of 9627 kg ha^{-1}. Efficient weed control during the critical period of crop weed competition, higher LAI and sustained availability of nutrients for uptake of the crop contributed to higher post flowering photosynthesis and assimilate portioning to sink, might be reason for higher grain and stover yield. Similar results have been discussed by Kamble *et al.* (2015). However, this treatment on par with twice hand weeding (T_9), which was registered the grain yield of 6268 kg ha^{-1} and stover yield of 9402 kg ha^{-1} . This might be due to better removal of weeds at early stage favoured the growth and yield components, which is reflected registering higher grain and stover yield of maize with this treatment (Haque *et al.* 2013). The next in order of ranking were T_3 and T_4. Among the herbicide application, Mesotrione 48% SC @ 280 ml ha^{-1} on 3 DAS registered lower yield attributes and yield of maize. This might be due to inadequacy of herbicide required to control weeds during cropping period. Similar finds have been reported by Patel *et al*. (2006). The lowest grain yield of 2163 kg ha^{-1} and stover yield of 3244 kg ha^{-1} were recorded in weedy check. This could be attributed to greater removal of nutrients by weeds and severe crop weed competition resulted in poor source and sink development with lesser yield components and yield of crop. This was conformity with the findings of Riaz *et al.* (2007).

Post harvest soil nutrient status

The treatment Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS (T_4) significantly recorded the highest post harvest soil available nutrient of 186.12 kg ha^{-1} of N, 26.31 kg ha^{-1} of P_2O_5 and 231.04 kg ha^{-1} of K_2O respectively. This could be attributed to the weed free condition during entire crop growth period, that is reflected on more NPK status in end of the experiment was reported by Gul and Khanday (2015). This treatment by on par with twice hand weeding (T_9) recorded the post harvest soil available nutrient of 181.77 kg ha^{-1} of N, 25.69 kg of ha^{-1} P_2O_5 and 229.64 kg ha^{-1} of K_2O respectively. The lowest post harvest soil available nutrient of 140.27 kg ha^{-1} of N, 9.86 kg ha^{-1} of P_2O_5 and 208.86 kg ha^{-1} of K_2O respectively was recorded in control (T_1). This might be due to increased removal of nutrients by the weeds. The results confirm the findings of Srinivas and Satyanarayana (1996) and Mundra *et al.* (2002).

Table 1. Effect of pre and post emergence herbicides on nutrient removal by weeds and maize crop

TREATMENTS	Nutrient removal by weeds (kg ha^{-1})			Nutrient uptake by the maize (kg ha^{-1})		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
T_1- Control	34.65	20.53	31.44	126.91	26.65	109.42
T_2- Lumax 440 ZC W/V @ 2.5 lit ha^{-1} on 3 DAS	19.83	10.54	21.87	146.43	37.31	128.65
T_3- Lumax 440 ZC W/V @ 3 lit ha^{-1} on 3 DAS	16.36	8.91	19.65	149.53	38.41	130.88
T_4- Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS	11.68	6.92	16.40	154.03	40.41	134.77
T_5- S-Metalachlor 96% EC @ 1lit ha^{-1} on 3 DAS	31.29	18.09	27.96	137.23	33.06	121.14
T_6- Mesotrione 48% SC @ 208 ml ha^{-1} on 3 DAS	32.84	11.48	29.67	133.13	30.96	118.27
T_7- Atrazine 50 WP @ 2 Kg ha^{-1} on 3 DAS	23.96	13.32	23.93	144.13	36.08	126.30
T_8- Paraquat dichloride 24% SL @ 2 lit ha^{-1} on 15 DAS	26.53	15.49	25.88	140.83	34.66	123.78
T_9- Hand weeding at 20 and 40 DAS.	12.77	7.40	17.67	152.43	39.56	132.99
SEd	1.73	0.61	1.03	1.22	0.51	0.90
CD(p=0.05)	3.68	1.31	2.20	2.64	1.20	1.92

Table 2. Effect of pre and post emergence herbicides on grain and stover yields and post harvest soil available nutrient status in maize

TREATMENTS	Grain Yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Post harvest soil available nutrient (kg ha^{-1})		
			N	P_2O_5	K_2O
T_1- Control	2163	3244	140.27	9.86	208.86
T_2- Lumax 440 ZC W/V @ 2.5 lit ha^{-1} on 3 DAS	5285	7927	171.17	21.66	225.24
T_3- Lumax 440 ZC W/V @ 3 lit ha^{-1} on 3 DAS	5796	8694	176.57	23.76	227.54
T_4- Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS	6418	9627	186.12	26.31	231.04
T_5- S-Metalachlor 96% EC @ 1lit ha^{-1} on 3 DAS	3957	5935	153.67	16.22	218.14
T_6- Mesotrione 48% SC @ 208 ml ha^{-1} on 3 DAS	3348	5022	147.27	13.72	214.74
T_7- Atrazine 50 WP @ 2 Kg ha^{-1} on 3 DAS	4993	7489	165.57	20.47	223.74
T_8- Paraquat dichloride 24% SL @ 2 lit ha^{-1} on 15 DAS	4417	6625	159.77	18.10	221.04
T_9- Hand weeding at 20 and 40 DAS.	6268	9402	181.77	25.69	229.64
SEd	142.5	247.2	2.59	0.81	0.89
CD(p=0.05)	301.3	524.2	5.51	1.72	1.9

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