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Weed Dry Matter, Weed Control Efficiency and Nutrient Uptake by Weeds as Affected by Weed Management Practices in Maize

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Abstract A field experiment was conducted to study the effect of sequential application of herbicides on microbial activities and yield of maize. Six herbicides namely Glyphosate, Paraquat, Glufosinate Ammonium, Saflufenacil, Halosulfuron and Imazathapyr were tried as a post emergence in addition to pre-emergence application of Atrazine. Totally nine treatments were tested using randomized block design having three replications with three controls weedy check, weed free check and standard recommended package of practices (RPP). All all the growth stages weed free check was recorded higher weed control efficiency (WCE) and total drymatter of weeds than rest of the weed control methods. However after application of post emergence herbicides Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1} was recorded with WCE of 92.12% next to weed free check. At all the DAS, T_8 (weed free check) was recorded significantly lower uptake of nutrients and T_9 (weedy check) registered significantly higher uptake of N, P and K. T_3 (Atrazine @ 1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1}), T_7 (Atrazine @ 1 kg ha^{-1} + 2 IC + 1 HW) and T_1 (Atrazine @ 1 kg ha^{-1} fb Clyphosate @ 2.5 kg ha^{-1}) were recorded lower uptake of N at 20, 40 and 60 DAS. Similar trend was observed for P and K uptake.

Keywords Herbicides, Weed dry matter, Nutrient uptake, Weed control efficiency, Maize

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Introduction

Weed infestation is one of the major constraints for low yield of maize as weeds compete with crop plants for essential inputs. Weed deplets 30—40% of applied nutrients from the soil. The quantities of growth factors used by weeds are thus unavailable to the

crop. Sequential use of pre and post emergent herbicides at temporal variation may help in avoiding the problem of weeds throughout the maize growth stages. The increased use of pesticides in agricultural soils causes the contamination of the soil with toxic chemicals. When pesticides are applied, the possibilities exist that these chemicals may exert certain effects on non-target organisms, including soil microorganisms. The microbial biomass plays an important role in the soil ecosystem where they fulfill a crucial role in nutrient cycling and decomposition. During the past four decades, a large number of herbicides have been introduced as pre and post-emergent weed killers in many countries of the world. There is an increasing concern that herbicides not only affect the target organisms (weeds) but also the microbial communities present in soils and these non-target effects may reduce the performance of important soil functions. The current study was taken up with the objectives to find out efficacy of pre and post emergent herbicides at temporal variation to manage the weeds in maize and to see the effect of herbicides on soil microbes.

Materials and Methods

A field experiment was conducted during *kharif* 2014 at Main Agriculral Researrch Station (MARS), College of Agriculture, Dharwad which is situated at 15°29′ N latitude, 74°59′ E longitudes and at an altitude of 689 m above mean sea level and it comes under Northern Transition Zone (Zone-8) of Karnataka. The soil of the experimental site was black clayey soil with pH 7.1, available N, P_2O_5 and K_2O 229, 34, and 484 kg/ha, respectively. Treatments comprised of six herbicides namely Glyphosate (2.5 kg/ha), Paraquat (1 kg/ha), Glufosinate ammonium (0.375 kg/ha), Saflufenacil (75 g/ha), Halosulfuron (90 g/ha) and Imazathapyr (75 g/ha) were tried as post emergence (Directed spray) in addition to pre-emergence application of Atrazine (1 kg/ha) along with Atrazine + 2 interculture + 1 hand weeding weed free and weedy check. Totally nine treatments were tested using randomized block design having three replications. The test variety was 900 M Gold and the crop received a rainfall of 633.5 mm during crop growing period. The weed infestation was predominantly consisted of grassy weeds, broad leaved weeds and sedges. Dry weight of weeds was recorded at 20, 40, 60 DAS and at harvest. The weeds were uprooted from the destructive sampling in an area of 0.25 m^2 and were oven dried to a constant weight at 70 °C and the dry weight of weeds was taken and expressed in g m^2.

Table 1. Total dry matter of weeds m^{-2} as influenced by weed control methods in maize. IC : Inter cultivation HW : Hand Weeding fb : followed by, All the above mentioned post-emergent (T_1—T_6) herbicides sprayed as directed spray at 45 DAS, * Transformed values [√ (x + 0.5)], Figures in the parenthesis indicate original values.

Treatments		TDM of weeds (g m^{-2}) 20 DAS	40 DAS	60 DAS	Harvest
T_1	-Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1} (Directed spray)	3.49* (12.13)	7.15 (50.66)	2.87 (7.73)	3.30 (10.40)
T_2	-Atrazine @ 1 kg ha^{-1} fb Paraquat @ 1 kg ha^{-1} (Directed spray)	3.55 (12.26)	7.15 (50.80)	3.34 (10.66)	4.54 (20.13)
T_3	-Atrazine @ 1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1} (Directed spray)	3.11 (9.60)	6.84 (46.40)	2.93 (8.13)	3.38 (10.93)
T_4	-Atrazine @ 1 kg ha^{-1} fb Saflufenacil @ 75 g ha^{-1} (Directed spray)	3.34 (10.66)	6.70 (44.40)	3.15 (9.46)	4.12 (16.53)
T_5	-Atrazine @ 1 kg ha^{-1} fb Halosulfuron @ 90 g ha^{-1} (Directed spray)	3.29 (11.06)	7.23 (51.86)	4.34 (18.53)	4.70 (21.73)
T_6	-Atrazine @ 1 kg ha^{-1} fb Imazathapyr @ 75 g ha^{-1} (Directed spray)	3.51 (12.53)	7.22 (51.60)	4.96 (24.26)	4.65 (21.33)
T_7	-atrazine @ 1 kg ha^{-1} + 2 IC + 1 HW (RPP standard check)	3.23 (10.00)	4.11 (16.53)	3.67 (13.06)	5.63 (31.20)
T_8	-Weed free check	1.98 (3.46)	3.00 (8.66)	1.76 (2.66)	2.56 (6.13)
T_9	- Weedy check	6.60 (43.06)	9.52 (90.26)	9.96 (98.93)	8.52 (72.13)
SEm±		0.31	0.22	0.22	0.19
CD (0.05)		0.92	0.65	0.65	0.56

Weed control efficiency (%)

Weed control efficiency (WCE) denotes the magnitude of weed reduction due to the weed control treatments. The weed control efficiency was calculated by using the formula given by Misra and Tosh [1].

$$WCE\,(\%) = \frac{\text{Dry weight of weeds in weedy check (g)} - \text{Dry weight of weeds in treatment plot (g)}}{\text{Dry weight of weeds in weedy check (g)}} \times 100$$

Results and Discussion

Total dry weight of weeds

Total dry weight of weeds differed significantly due to various weed control methods (Table 1). At all the maize growth stages, the highest weed dry weight was recorded with T_9 (weedy check). It was mainly due to higher and uninterrupted growth of weeds which made best use of growth resources. On the other hand lower weed dry weight was recorded with T_8 (weed free check). There were no significant differences in weed dry weight among herbicide treatments before application of post emergence herbicides but after application of post emergence herbicides at 60 DAS, T_1 (Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1}) (2.87 g m^{-2}) and T_3 (Atrazine @ 1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1}) (2.93 g m^{-2}) were recorded lower weed dry weight next to weed free check. T_4 (Atrazine @ 1 kg ha^{-1}) (3.34 g m^{-2}) and T_7 (Atrazine @ 1 kg ha^{-1} + 2 IC + 1 HW) (3.67 g m^{-2}) were next in order. This could be attributed to the good effect of directed spray of herbicides which resulted in reduced dry matter production by the weeds. These results were in conformity with the earlier findings [2—4].

Weed control efficiency

Weed control efficiency (WCE) differed significantly with different weed control methods at various crop growth stages (Table 2).

In weed control efficiency (WCE), total weed dry weight was taken into account which consists of different weed species which will be varying in their proportions. As such it will not reveal the individual weed species effect. WCE of treatment normally decreases over time or as the date of observation advances. Performance of crop is directly proportional to the weed control efficiency and inversely proportional to the weed index. In the present study, at 20, 40 and 60 DAS and also at harvest, T_8 (weed free check) was recorded higher WCE than rest of the weed control methods. There was no significant differences among herbicide treatments before application of post emergence herbicides. After pre-emergence application of Atrazine, the weed control efficiency in each herbicides treatment did not varied significantly as common herbicide was used

Table 2. Weed control index (%) as influenced by weed control methods in maize. IC : Inter cultivation HW : Hand Weeding fb : followed by, All the above mentioned post-emergent (T_1—T_6) herbicides sprayed as directed spray at 45 DAS.

	Treatments	Weed control index (%) 20 DAS	40 DAS	60 DAS	Harvest
T_1	-Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1} (Directed spray)	72.40	43.71	92.12	85.56
T_2	-Atrazine @ 1 kg ha^{-1} fb Paraquat @ 1 kg ha^{-1} (Directed spray)	71.27	43.68	89.14	71.89
T_3	-Atrazine @ 1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1} (Directed spray)	77.36	48.18	91.73	84.84
T_4	-Atrazine @ 1 kg ha^{-1} fb Saflufenacil @ 75 g ha^{-1} (Directed spray)	75.19	50.57	90.40	77.13
T_5	-Atrazine @ 1 kg ha^{-1} fb Halosulfuron @ 90 g ha^{-1} (Directed spray)	73.91	42.61	81.09	69.98
T_6	-Atrazine @ 1 kg ha^{-1} fb Imazathapyr @ 75 g ha^{-1} (Directed spray)	70.37	42.75	75.56	70.43
T_7	-Atrazine @ 1 kg ha^{-1} + 2 IC + 1 HW (RPP standard check)	76.81	81.50	86.62	56.46
T_8	-Weed free check	91.89	90.19	97.26	91.55
T_9	-Weedy check	-	-	-	-
	SE±	4.96	2.73	1.54	2.42
	CD (0.05)	14.87	8.17	4.63	7.27

Table 3. Nutrient uptake by weeds (kg ha^{-1}) as influenced by weed control methods in maize. IC : Inter cultivation HW : Hand weeding fb : followed by, All the above mentioned post-emergent (T_1—T_6) herbicides sprayed as directed spray at 45 DAS.

Treatments	20 DAS			40 DAS			60 DAS			Harvest		
	N	P	K	N	P	K	N	P	K	N	P	K
T_1 -Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1} (Directed spray)	2.13	0.58	0.90	8.00	2.61	4.09	1.36	0.26	0.63	1.77	0.72	0.85
T_2 -Atrazine @ 1 kg ha^{-1} fb Paraquat @ 1 kg ha^{-1} (Directed spray)	2.00	0.67	1.04	8.76	2.41	4.83	2.01	0.49	1.01	3.30	1.25	1.91
T_3 -Atrazine @ 1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1} (Directed spray)	1.58	0.51	0.72	7.96	2.58	3.82	1.57	0.34	0.67	1.90	0.68	0.96
T_4 -Atrazine @ 1 kg ha^{-1} fb Saflufenacil @75 g ha^{-1} (Directed spray)	2.01	0.54	0.64	7.35	1.97	3.09	1.70	0.44	0.66	2.59	1.16	1.39
T_5 -Atrazine @ 1 kg ha^{-1} fb Halosulfuron @ 90 g ha^{-1} (Directed spray)	1.99	0.65	0.85	9.01	2.75	4.57	4.05	0.93	1.64	3.88	1.38	2.26
T_6 -Atrazine @ 1 kg ha^{-1} fb Imazathapyr @ 75 g ha^{-1} (Directed spray)	2.16	0.72	1.00	9.11	2.66	4.54	5.43	1.13	2.13	3.73	1.44	2.44
T_7 -Atrazine @ 1 kg ha^{-1} + 2 IC + 1 HW (RPP standard check)	1.69	0.57	0.72	2.77	0.97	1.46	2.79	0.58	1.14	5.69	2.23	4.52
T_8 -Weed free check	0.59	0.10	0.14	1.51	0.39	0.39	0.46	0.09	0.12	0.96	0.36	0.32
T_9 -Weedy check	7.36	2.65	3.66	15.68	5.77	9.27	21.24	5.76	10.21	14.15	5.36	8.81
SEm±	0.39	0.14	0.19	0.62	.20	0.32	1.11	0.17	0.32	0.31	0.16	0.92
CD (0.05)	1.17	0.42	0.56	1.87	0.59	0.97	3.32	0.52	0.96	0.93	0.49	2.76

in these treatments. But at 60 DAS, T_8 (weed free check)was recorded with higher WCE (97.26%) as compared to other treatments. The next best treatments were T_1 (Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1}) (92.12%), T_3 (Atrazine @ 1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1}) (91.73%), T_4 (Atrazine @ 1 kg ha^{-1} fb Saflufenacil @ 75 g ha^{-1}) (90.04%) and T_2 (Atrazine @ 1 kg ha^{-1} fb Paraquat @ 1 kg ha^{-1}) (89.14%) which were found on par with each other. It was due to lower weed population and total dry weight of weeds in these treatments due to better control of weeds following exposure to post emergent treatment. Similar kind of result were observed by Shantveerayya et al. [2] and Hatti et al. [5].

Nutrient uptake by weeds

Weed population was highest in weedy check as mentioned earlier. The nutrient uptake by weeds in weedy check was also highest because weeds dominated the crop and ground was completely covered with weeds (Table 3). After post emergence application of herbicides the lower nutrient uptake by weeds was observed with T_1 (Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1}), T_2 (Atrazine @ 1 kg ha^{-1} fb Paraquat @ 1 kg ha^{-1}), T_3 (Atrazine @1 kg ha^{-1} fb Glufosinate ammonium @ 0.375 kg ha^{-1}) and T_4 (Atrazine @ 1 kg ha^{-1} fb Saflufenacil @ 75 g ha^{-1}). This was due to better control of weeds at critical period of cropweed competition which resulted in availability of space and nutrients to the maize as evidenced from the beneficial effect on the crop growth because of the synergetic effect of pre-emergence herbicides with post emergence herbicides contributed to control the weed density and lower biomass production thereby reducing the uptake of nutrients by the weeds at all the maize growth stages. Similar results were earlier observed [6—8].

It is concluded that after application of post emergence herbicides Atrazine @ 1 kg ha^{-1} fb Glyphosate @ 2.5 kg ha^{-1} was recorded with highest WCE of 92.12% among the herbicides and lowest total weed dry matter and less uptake of major nutrients.

References

1. Misra A, Tosh GC (1979) Chemical weed control studies on dwarf wheat. J Res Orissa Unv Agric and Tech 10 : 1—6.
2. Shantveerayya H, Agasimani CA, Halikatti SI, Babu R, Patil CR, Ningnur BT (2012) Effect of herbicide weed control and

productivity of maize (*Zea mays* L.). Karnataka J Agric Sci 25 : 137—139.

3. Chougala VR (2013) Evaluation of sequential application of pre and post emergence herbicides for weed management in maize. MSc (Agric) thesis. Univ Agric Sci Dharwad, Karnataka, India.
4. Patil PI (2014) Effect of sequential application of pre and post emergence herbicides in rainfed maize (*Zea mays* L.). MSc (Agric) thesis. Univ Agric Sci Dharwad, Karnataka, India.
5. Hatti V, Sanjaya MT, Ramachandraprasad TV, Kalyanmurthy KN, Kumbar B, Shrusti (2014) Effect of new herbicide molecules on yield, soil microbial biomass and their phytotoxicity on maize (*Zea mays* L.) under irrigated conditions. Bio Scan 9 : 1127—1130.
6. Ishrat DH, Hunshal CS, Malligwad LH, Chimmad VP (2012) Effect of pre and post emergence herbicides on weed control in maize. Karnatataka J Agric Sci 25 : 392—394.
7. Kamble TC, Kakade SU, Nemade SU, Pawar RV, Apotikar VA, (2005) Integrated weed management in hybrid maize. Crop Res 29 : 396—400.
8. Singh S, Hiremath SM, Yadav SL, Meena LK, Chouhan BS (2014) Growth and yield of maize as influenced by integrated weed management practices. Ann Agric and Biol Res 19 : 422—424.