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RESEARCH NOTE

Effect of post emergence herbicides on weed growth and yield of irrigated maize

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A field experiment was conducted to study the effect of post emergence herbicides on weed growth and yield of irrigated maize at Regional Agricultural Research Station Vijaypura, during *kharif* 2014. Results revealed that, next to the weed free check (6.65 t ha^{-1}), Atrazine 50% WP @ 1.0 kg a.i./ha as pre emergence followed by one hand weeding with inter culturing at 40-45 DAS recorded higher grain yield (6.14 t ha^{-1}) and straw yield (6.87 t ha^{-1}) and this was followed by Topramezone 33.6% SC @ 33.6 g a.i./ha +MSO adjuvant as post emergence at 20-25 DAS due to improvement in yield attributing characters like cob length, cob girth and grain weight per cob. Next to the weed free check, lower total weed population m^{-2} (1.73), weed dry weight m^{-2} (6.56 g) and higher weed control efficiency (86.88 %) were recorded with Atrazine 50% WP @ 1.0 kg a.i./ha as pre emergence followed by one HW with IC at 40-45 DAS and which was followed by post emergence application of Topramezone 33.6% SC @ 33.6 g a.i./ha +MSO adjuvant at 20-25 DAS (2.93, 9.19 g and 74.22%, respectively).

Key words: Grain yield, Herbicides, Maize, Post emergence

Maize (*Zea mays* L.) is as an economically important cereal crop used as food, feed and for other industrial products. In India, it ranks fourth after rice, wheat and sorghum in area and production. In the country, maize occupies an area of 9.42 million hectares with the production of 22.26 million tonsat an average productivity of 2.58 t/ha. In Karnataka, it occupies an area of 1.38 million hectares with the production of 4.00 million tons and an average productivity is 2.88 t/ha (Anon., 2014). Weeds emerge fast and grow rapidly competing with the crop severely for resources *viz.,* nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages of maize. Further, wide space provided to the crop allows fast growth of variety of weed species causing a considerable reduction in yield by affecting the growth and yield components. Thus, the extent of reduction in grain yield of maize has been reported to be in the range of 33 to 50% depending on the intensity and persistence of weed density in standing crop (Sharma *et al.,* 2000). It is well established that, 30 to 60 days is the most critical period for crop-weed competition in maize. Hence, managing weeds during this period is most critical for higher yields. Hand weeding though efficient method, is laborious, costly, more time consuming and unsuitable for large farms. Labour is often in short supply during the early stages of crop growth when weeds must be controlled and untimely weeding causes significant crop losses. The choice of any weed control measure therefore, depends largely on its effectiveness and economics. Because of increased cost and non-availability of manual labour in required quantity for hand weeding, herbicides not only control the weeds timely and effectively, but also offer a great scope for minimizing the cost of weed control irrespective of situation.

A field experiment was conducted during *kharif* 2014 at Regional Agricultural Research Station Vijaypura, UAS, Dharwad (Karnataka).There were 13 treatments as detailed in Table 1. The experiment was laid out in randomized complete block design with three replications. The soil of the experimental site belongs to Vertisols (medium deep black soil). Seeds of maize hybrid 900M Gold was sown at a row spacing 60 cm and intra row spacing of 20 cm. Initially 2-3 seeds were hand dibbled per hill at a required spacing and 20 days after sowing, thinning was done by keeping one healthy plant per hill.The crop was fertilized with 150:65:65 kg NPK per ha.Nitrogen application was made in five splits; half at the time of sowing and remaining was top dressed in equal quantities at 21, 37, 51, and 69 days after sowing. Entire quantities of P_2O_5 and K_2O were applied as basal dose at the time of sowing. All the cultural methods were adopted as per the state recommended package of practices. Irrigations were given as per the crop requirement. Pre-emergence herbicide was sprayed uniformly on the soil immediately after sowing of the crop. Post- emergence herbicides were applied uniformly on the weeds (as directed spray) at 20-25 DAS as per treatments by using 750 litres of spray solution ha^{-1}.

During the study, important grassy (Monocot) and broad leaved (Dicot) weeds observed in association with maize crop in the experimental site were *Cynodon dactylon, Dinebra retroflexa(*Vahl.), *Cyperus rotundus, Commelina benghalensis* L., *Convovulus arvensis, Cyanotis cucculata, Euphorbia hirta, Euphorbia geniculata, Corchorous trilocularis, Phyllantus niruri* L., *Portulaca oleracea* L., *Parthenium hysterophorus* L. and *Abitulon indicum.*

Results revealed that, among the treatments, significantly higher grain yield of maize (6.65 t ha^{-1}) was obtained with weed free check (Table 1). Among the chemical weed control treatments, Atrazine 50% WP @ 1.0 kg a.i./ha as pre emergence followed by one hand weeding with interculturing at 40-45 DAS (6.14 t ha^{-1}) recorded significantly higher grain yield and it was at par with Topramezone 33.6% SC @ 33.6 g a.i./ha +MSO adjuvant at 20-25 DAS (5.69 t ha^{-1}). Significantly higher grain yield obtained with these treatments is attributed to positive association between yield contributing characters *viz.,* cob length, cob girth and grain weight cob^{-1} (Table 1).These results are in conformity with the findings of Shamima *et al.* (2012) and Niranjan Kumar *et al*. (2012).

Among the herbicide treatments, next to weed free check, Atrazine 50% WP @ 1.0 kg a.i./ha as pre emergence followed

Table 1. Grain and straw yield , its parameters as influenced by different weed management treatments

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Weed Index (%)	Cob length (cm)	Cob girth (cm)	Grain weight per cob (g)
T_1: Atrazine @ 1.0 kg a.i./ha (PE) fb 1 HW +1 IC at 40-45 DAS	6.14	6.87	8.00	16.37	15.67	152.53
T_2:2,4-D (Na salt) @ 0.50 kg a.i./ha (PoE) at 20-25 DAS	5.10	5.56	23.00	14.31	13.85	124.58
T_3:2,4-D (Na salt)@ 1.00 kg a.i./ha (PoE) at 20-25 DAS	5.48	5.64	18.00	14.68	13.87	133.80
T_4:2,4-D (Na salt)@ 1.50 kg a.i./ha (PoE) at 20-25 DAS	5.65	5.83	15.00	15.35	14.06	143.59
T_5:2,4-D (amine salt)@ 0.5 kg a.i./ha (PoE) at 20-25 DAS	4.86	5.52	26.92	14.11	14.00	124.27
T_6:2,4-D (amine salt)@ 1.00 kg a.i./ha (PoE) at 20-25 DAS	5.25	5.58	20.82	14.65	14.42	132.05
T_7:2,4-D (amine salt)@ 1.50 kg a.i./ha (PoE) at 20-25 DAS	5.60	5.76	15.93	14.94	14.19	141.87
T_8:Topramezone@ 25.2 g a.i./ha +MSO (PoE) at 20-25 DAS	5.19	5.58	21.94	14.56	14.32	130.13
T_9:Topramezone@ 33.6 g a.i./ha +MSO (PoE) at 20-25 DAS	5.69	5.90	14.42	15.39	14.18	147.20
T_{10}:Atrazine@ 0.50 kg a.i./ha (PoE) at 20-25 DAS	5.17	5.56	22.25	14.51	14.15	129.81
T_{11}:Atrazine@ 1.0 kg a.i./ha (PoE) at 20-25 DAS	5.54	5.65	16.86	14.86	13.78	137.29
T_{12}:Weed free check	6.65	7.03	0.00	17.42	16.97	164.00
T_{13}:Weedy check	4.18	4.40	37.19	11.98	12.16	102.17
S.Em± 0.22	0.31	3.41	0.72	0.55	7.44	
C.D. (P=0.05)	0.66	0.92	9.97	2.10	1.60	21.72

PoE= post emergence PE= pre emergence DAS= days after sowing
HW= hand weeding IC= Intercultivation fb= followed by

Table 2. Weed dynamics and weed control efficiency at 60 DAS of maize as influenced by different weed management treatments

Treatments	Monocot weed population /m^2	Dicot weed population/m^2	Total weed population /m^2	Total weed dry weight /m^2 (g)	Weed control efficiency (%)
T_1 : Atrazine @ 1.0 kg a.i./ha (PE) fb 1 HW +1 IC at 40-45 DAS	1.51*(1.89)	1.10* (0.77)	1.73* (2.66)	6.56*(42.53)	86.88
T_2 : 2,4-D (Na salt)@ 0.50 kg a.i./ha (PoE) at 20-25 DAS	3.23 (9.94)	2.66 (6.61)	4.13(16.56)	12.98(168.20)	47.99
T_3 : 2,4-D (Na salt)@ 1.00 kg a.i./ha (PoE) at 20-25 DAS	3.00 (8.50)	2.34(5.11)	3.76(13.61)	11.85(140.40)	57.13
T_4 : 2,4-D (Na salt)@ 1.50 kg a.i./ha (PoE) at 20-25 DAS	2.83 (7.50)	2.20(4.39)	3.51(11.89)	10.72(114.53)	64.52
T_5 : 2,4-D (amine salt)@ 0.5 kg a.i./ha (PoE) at 20-25 DAS	3.06 (8.89)	3.18(9.67)	4.36(18.55)	12.58(158.53)	51.65
T_6 : 2,4-D (amine salt)@ 1.00 kg a.i./ha (PoE) at 20-25 DAS	3.03 (8.78)	2.57(6.16)	3.92(14.94)	11.94(142.13)	56.35
T_7 : 2,4-D (amine salt)@ 1.50 kg a.i./ha (PoE) at 20-25 DAS	2.89 (7.89)	2.21(4.44)	3.57(12.33)	11.61(134.40)	58.79
T_8 : Topramezone@25.2 g a.i./ha +MSO (PoE) at 20-25 DAS	2.72 (6.94)	2.65(6.56)	3.73(13.50)	10.95(119.60)	63.22
T_9 : Topramezone@ 33.6 g a.i./ha +MSO (PoE) at 20-25 DAS	2.34 (5.00)	1.89(3.17)	2.93(8.17)	9.19(84.00)	74.22
T_{10} : Atrazine@ 0.50 kg a.i./ha (PoE) at 20-25 DAS	2.77 (7.28)	2.66 (6.61)	3.79(13.89)	11.41(131.28)	60.18
T_{11} : Atrazine@ 1.0 kg a.i./ha (PoE) at 20-25 DAS	2.73 (7.27)	2.30(4.89)	3.50(12.16)	10.83(116.80)	64.00
T_{12} : Weed free check	0.71 (0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	100.00
T_{13} : Weedy check	4.10 (16.33)	4.56 (20.33)	6.10(36.6)	18.07(326.47)	0.00
S.Em± 0.16	0.17	0.17	0.38	2.62	
C.D. (P=0.05)	0.49	0.49	0.51	1.10	7.68

* Square root transformed values and the figures in parentheses indicate the original values.
PoE= post emergence PE= pre emergence DAS= days after sowing HW= Hand weeding IC=Intercultivation fb=followed by

by one hand weeding with interculturing at 40-45 DAS recorded significantly lower number of monocot weeds (1.51 /m^2) and it was attributed to application of pre emergence herbicide which prevented the germination of weeds and in later stages, hand weeding and interculturing helped to control the late emerged weeds effectively. The findings are in conformity with the results of Dobariya *et al.* (2015).Treatments receiving post emergence herbicides recorded lower population of monocot weeds *i.e.*

Topramezone 33.6% SC @ 33.6 g a.i./ha + MSO adjuvant at 20-25 DAS (2.34) was on par with Topramezone 33.6% SC @ 25.2 g a.i./ha +MSO adjuvant at 20-25 DAS (2.72). This might be due to selective control of monocot weeds by these chemicals. Similarly, in case of reducing dicot weed population Topramezone 33.6% SC @ 33.6 g a.i./ha +MSO adjuvant at 20-25 DAS (1.89 /m^2) was more effective and it was on par with 2,4-D (Na salt) 80% WP @ 1.50 kg a.i./ha at 20-25 DAS (2.20 /m^2) as PoE.

Among the post emergence herbicides, Topramezone 33.6% SC @ 33.6 g a.i./ha +MSO adjuvant at 20-25 DAS (2.93 g/m^2) was effective in reducing the total dry weight of weeds followed by Topramezone 33.6% SC @ 25.2 g a.i./ha +MSO adjuvant at 20-25 DAS (3.73 g/m^2). This could be attributed to better control of weeds by these herbicides even at later stages of crop growth which resulted in lower number of weeds and reduced dry matter production by weeds. These results are in agreement with the findings of Kannur (2008).

Higher weed control efficiency was recorded with Atrazine 50% WP @ 1.0 kg a.i./ha as pre emergence followed by one hand weeding with interculturing at 40-45 DAS (86.88 %) followed by Topramezone 33.6% SC @ 33.6 g a.i./ha +MSO adjuvant at 20-25 DAS (74.22 %) (Table 2). It could be attributed to better weed control of weeds owing to lower dry weight of weeds throughout the crop growth period. These results corroborate the findings of Deshmukh *et al.* (2009) and Shantveerayya *et al.* (2012). Weed index was significantly lower with Atrazine 50% WP @ 1.0 kg a.i./ha as pre emergence followed by one hand weeding with interculturing at 40-45 DAS (8.00 %) and this was at par with Topramezone 33.6% SC @ 33.6 g a.i./ha + MSO adjuvant at 20-25 DAS (14.42 %) (Table 2). This was mainly due to improved crop growth as a consequence of effective control of weeds and reduction in the crop weed competition. These results are in close conformity with the findings of Shantveerayya *et al.* (2012).

Conclusion

Topramezone 33.6% SC @33.6 g a.i./ha + MSO adjuvant as post emergence at 20-25 DAS was as effective as with the already recommended practice of Atrazine 50% WP @ 1.0 kg a.i./ha as pre-emergence followed by one hand weeding and interculturing at 40-45 DAS in controlling the weeds and resulting in higher grain yield.

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