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STUDIES ON THE INFLUENCE OF DIFFERENT HERBICIDES ON YIELD AND YIELD COMPONENTS IN MAIZE

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Abstract

The field experiment to evaluate the efficacy of sequential application of different herbicides on yield and yield components in maize was conducted during *kharif* 2014 at Main Agricultural Research Station Dharwad, Karnataka. The experiment consisted of 15 treatments involving four pre emergence herbicides. Grain yield and stover yield of maize was significantly influenced by different weed control treatments. Significantly higher grain yield (77.23 q/ha) and stover yield (10.32t/ha)was recorded with Atrazine @ 1 kg *a.i.* ha^{-1} + two hoeings fb Atrazine @ 1 kg *a.i.* ha^{-1} followed by Atrazine @ 1 kg *a.i.* ha^{-1} + two hoeings fb 2, 4-D @ 1 kg *a.i.* ha^{-1} with grain yield of 74.88 q/ha and stover yield of 10.28t/ha and significantly lower grain yield (35.22 q/ha) and stover yield (05.12t/ha) was noticed in unweeded control. The higher values for the yield components like cob length, cob girth, number of seed rows per cob, number of seeds per cob, seed weight per cob, test weight, shelling percent and harvest index were observed with Atrazine @ 1 kg *a.i.* ha^{-1} + two hoeings fb Atrazine @ 1 kg *a.i.* ha^{-1}

Key words: Atrazine, 2-4-D and Hoeing.

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop in the world after wheat and rice with an area of 182 M ha, production of 987 M. tonnes with an increase of 12.7 per cent in production every year and productivity of 5423 kg per ha.Weeds are one of the most important constraints in maize production. They cause 12.8% yield loss world over despite weed control measures and 29.2 per cent in case of no weed control. Therefore, weed control is an important management practice for maize production that should be carried out to ensure optimum maize yield. Several weed species that are strong competitors, compete with the maize crop and thus decrease the yield. About 25-30 per cent area is grown under maize and farmers seldom use herbicides. In many instances the weed flourishes even after critical period of crop-weed competition and many times it is difficult to control these weeds due to incessant rains by cultural operations. Besides this, manual weeding is also difficult under such circumstances due to non-availability, inefficient and costly labour. In order to control the weeds for longer period of the crop growth, there is need for a post-emergence herbicides (30- 35 days after sowing) on sequential basis for control of weeds. Keeping above facts in view, a field experiment was taken up to know the effect of sequential application of herbicides on the yield and yield components in maize.

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Material and Methods

The experiment was conducted at Main Agricultural Research Station ,College of Agriculture, Dharwad during *kharif* 2014 with three replications and fifteen treatments and the treatments were

1. Pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} +1 hoeing at 20 DAS.
2. Pre-emergence application of Pendimethalin @ 1.0 kg $aiha^{-1}$ +1 hoeing at 20 DAS.
3. Pre-emergence application of 2, 4–D @ 1.0 kg *a.i.* ha^{-1} +1 hoeing at 20 DAS.
4. Pre-emergence application of Metribuzin @ 0.5 kg *a.i.* ha^{-1} +1 hoeing at 20 DAS.
5. Pre-emergence application of Atrazine @ 1.0 kg $aiha^{-1}$ fb Atrazine @ 1.0 kg $aiha^{-1}$ at 25 DAS.
6. Pre-emergence application of Atrazine @ 1.0 kg $aiha^{-1}$ fb 2,4-D @ 1.0 kg $aiha^{-1}$ at 25 DAS.
7. Pre-emergence application of Atrazine @ 1.0 kg $aiha^{-1}$

fb Pendimethalin @ 1.0 kg aiha^{-1} at 25 DAS.

8. Pre-emergence application of Atrazine @ 1.0 kg aiha^{-1} fb metribuzin @ 0.5 kg aiha^{-1} at 25 DAS.
9. Pre-emergence application of Atrazine @ 1.0 kg aiha^{-1} fb 2 hoeing at 20 and 35 DAS fb Atrazine @ 1.0 kg aiha^{-1} at 35 DAS
10. Pre-emergence application of Atrazine @ 1.0 kg aiha^{-1} fb 2 hoeing at 20 & 35 DAS fb Pendimethalin @ 1.0 kg aiha^{-1} at 35 DAS.
11. Pre-emergence application of Atrazine @ 1.0 kg aiha^{-1} fb 2 hoeing at 20 and 35 DAS fb 2,4–D @ 1.0 kg aiha^{-1} at 35 DAS.
12. Pre-emergence application of Atrazine @ 1.0 kg aiha^{-1} fb 2 hoeing at 20 and 35 DAS fb Metribuzin @ 0.5 kg aiha^{-1} at 35 DAS.
13. Weed free check.
14. Unweeded control.
15. RPP (Recommended Package of Practice) (PE Atrazine @ 1 kg a.iha^{-1} + 1IC + 1HW

The maize hybrid CP-818 was sown on 7th july 2015 at a spacing of 60cm × 30cm.The crop was fertilized with 150:75:35.5 N:P_2O_5:K_2O ha-^{1} Pre-emergence herbicides were sprayed next day of sowing. Sequential application of herbicides was used as directed sprays at 20 and 35 days after sowing using 750 ltrs of spray solution per hectare.

Observations on yield and yield components like grain yield, stover yield, cob length, cob girth, number of seed rows per cob,number of seeds per cob, seed weight per cob test weight, shelling percent and harvest index were observed at harvest.

Results and Discussion

The important monocotyledon weeds observed in the experimental plot were *Parthenium hysterophoous* L. *Commelina benghalensis* L., *Alternentra sessilis* (L.), *Phyllanthus niruri* L., *Euphorbia geniculata* (L.) Orteg., *Corchorus trilocularis* L., *Cynotis cristata* L., andamong the monocot weeds, *Denebra retroflexa, Digera arvensis* Forsk., *Cynodon dactylon* (L.) Pers., *Brachiaria eruciformis*, whereas *Cyperus rotundus* was the only sedge. While Birendra *et al.,* (2013) noticed *Amaranthus viridis, Cynodon dactylon, Cyperus rotundus, Echinochloa colonum, Echinochloa crusgalli, Eleusine indica, Phyllanthus niruri, Euphorbia hirta, Commelina benghalensis* and *Parthenum hysterophorus* in the maize fields.

Among the herbicide treatments, pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeing fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (**T_9**) recorded significantly higher yield ha^{-1} followed by weed free check (table 1). The higher yield ha^{-1} also observed with pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**). The treatment unweeded control recorded lowest yield ha^{-1}. In case of stover yield, pre-emergence application of Atrazine @ 1 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (**T_9**) and pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**) recorded significantly higher yield (t/ha) followed by weed free check. However the lowest stover yield was noticed with unweeded control. Similar results were observed by Nuraky, F. and Ruhmary, H, (2013) in maize.

The treatment pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (**T_9**) and pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**) recorded higher cob length and cob girth compared to all other treatments. The lowest cob length and cob girth were noticed with unweeded control. Higher grain weight per plant was recorded with pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (**T_9**) followed by pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**). These results are in agreement with the findings of Kannur (2008) in maize.

The grain weight per plant was the main contributory factor for yield. Higher maize grain weight per plant was due to cumulative effect of total dry matter production, its translocation and accumulation in reproductive parts. Higher weight per cob was noticed in pre-emergence application of Atrazine @ 1 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (**T_9**) and pre-emergence application of Atrazine @1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**) followed by weed free check (**T_{13}**). However, the lowest weight per cob was noticed with unweeded control. Similar results were noticed by Nagdeve *et al.*. (2014) in maize. There were no significant differences among treatments with respect to number of rows per cob and number of grains per row.

Table 1: Yield and yield attributes of maize as influenced by weed control methods.

Treatments	Yield (q/ha)	Stover yield (t/ha)	Cob length (cm)	Cob girth (cm)	Cob weight (g)	No seed rows/cob
T_1 - Pre-emergence application of Atrazine @ 1.0 kg *a.i.* /ha + 1 hoeing at 20 DAS	59.39^{d}	8.44^{f}	15.73^{ab}	13.86^{b-d}	191.4^{f}	13.47^{a-d}
T_2 - Pre-emergence application of Pendimethaline @ 1.0 kg ai/ha + 1 hoeing at 20 DAS	60.62^{cd}	8.50^{f}	15.56^{ab}	13.82^{b-d}	177.4^{i}	13.60^{a-c}
T_3 - Pre-emergence application of 2,4–D@ 1.0 kg *a.i.* /ha + 1 hoeing at 20 DAS	62.56^{b-d}	8.51^{f}	15.70^{ab}	13.68^{cd}	182.8^{h}	13.34^{a-d}
T_4 - Pre-emergence application of metribuzine @ 0.5 kg *a.i.* /ha + 1 hoeing at 20 DAS	37.05^{e}	5.22^{h}	13.50^{bc}	13.07^{de}	126.2^{l}	12.53^{d}
T_5 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb Atrazine @ 1.0 kg ai/ha at 25 DAS	62.39^{b-d}	8.52^{f}	15.46^{ab}	13.89^{a-d}	158.0^{k}	13.06^{cd}
T_6 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb Pendimethaline @ 1.0 kg ai/ha at 25 DAS	61.05^{cd}	8.47^{f}	15.93^{a}	13.84^{b-d}	164.0^{j}	13.23^{b-d}
T_7 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2,4-D @ 1.0 kg ai/ha at 25 DAS	67.59^{bc}	9.26^{d}	16.00^{a}	14.17^{a-c}	195.6^{e}	14.16^{ab}
T_8 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb metribuzine @ 0.5 kg ai/ha at 25 DAS	62.95^{b-d}	8.51^{f}	15.17^{ab}	13.93^{a-d}	178.6^{i}	13.33^{a-d}
T_9 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb Atrazine @ 1.0 kg ai/ha	77.23^{a}	10.32^{a}	17.19^{a}	14.80^{a}	224.2^{a}	14.27^{a}
T_{10} - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb Pendimethaline @ 1.0 kg ai/ha	67.19b^{c}	9.10^{e}	16.27^{a}	13.96^{a-d}	206.8^{c}	14.13^{ab}
T_{11} - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb 2,4–D@ 1.0 kg ai/ha	74.88^{a}	10.28^{ab}	17.10^{a}	14.43^{a-c}	209.6^{b}	14.20^{ab}
T_{12} - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb metribuzine @ 0.5 kg ai/ha	68.36^{b}	9.50^{c}	16.67^{a}	14.26^{a-b}	185.8^{g}	13.73^{a-c}
T_{13} - Weed free check	76.11^{a}	10.24^{b}	16.50^{a}	14.67^{ab}	208.4^{bc}	14.25^{a}
T_{14} - Unweeded control	35.22^{e}	5.12^{i}	12.97^{c}	12.56^{e}	105.2^{m}	12.53^{d}
T_{15} - RPP (Recommended Package of Practice)	58.31e	8.20^{g}	16.47^{a}	13.86^{b-d}	199.0^{d}	14.00^{a-c}
S. Em±	2.22	0.02	0.73	0.28	0.66	0.29
LSD (5%)	6.35	0.07	2.09	0.79	1.90	0.85

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Treatments	No seeds /cob	Seed wt/cob (g)	Test wt (g)	Harvest Index	Shelling (%)	Weed index
T_1 - Pre-emergence application of Atrazine @ 1.0 kg *a.i.* /ha + 1 hoeing at 20 DAS	488.0^{b-d}	187.3^{f}	36.4^{a-c}	41.3^{a}	81.0^{j}	22.0^{bc}
T_2 - Pre-emergence application of Pendimethaline @ 1.0 kg ai/ha + 1 hoeing at 20 DAS	514.7 $^{a-d}$	165.4^{k}	34.3^{bc}	41.6^{a}	83.6^{g}	20.4^{cd}
T_3 - Pre-emergence application of 2,4–D@ 1.0 kg *a.i.* /ha + 1 hoeing at 20 DAS	472.3^{cd}	153.3^{n}	35.5^{a-c}	42.2^{a}	81.0^{j}	17.8^{ef}
T_4 - Pre-emergence application of metribuzine @ 0.5 kg *a.i.* /ha + 1 hoeing at 20 DAS	373.7^{d}	165.6^{l}	33.7^{c}	41.5^{a}	78.6^{k}	53.5^{a}
T_5 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb Atrazine @ 1.0 kg ai/ha at 25 DAS	457.7^{cd}	186.2^{g}	36.1^{a-c}	42.3^{a}	86.6^{cd}	18.0^{ef}
T_6 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb Pendimethaline @ 1.0 kg ai/ha at 25 DAS	549.7 $^{a-c}$	177.3^{i}	36.2^{a-c}	41.8^{a}	85.7^{f}	19.8^{de}
T_7 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2,4-D @ 1.0 kg ai/ha at 25 DAS	560.3 $^{a-c}$	190.2^{c}	38.1^{ab}	42.5^{a}	86.7^{c}	11.2^{g}
T_8 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb metribuzine @ 0.5 kg ai/ha at 25 DAS	538.7 $^{a-c}$	0174.3^{j}	36.4^{a-c}	42.5^{a}	83.2^{h}	17.0^{f}
T_9 - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb Atrazine @ 1.0 kg ai/ha	635.3 ^{ab}	195.5^{a}	38.9^{a}	42.7^{a}	87.4^{a}	2.8^{i}
T_{10} - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS 0 fb Pendimethaline @ 1.0 kg ai/ha	543.7 $^{a-c}$	187.4^{e}	36.4^{a-c}	42.3^{a}	86.5^{de}	11.9^{g}
T_{11} - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb 2,4–D@ 1.0 kg ai/ha	602.0 $^{a-c}$	193.2^{b}	38.2^{a}	42.5^{a}	87.3^{ab}	5.6^{h}
T_{12} - Pre-emergence application of Atrazine @ 1.0 kg ai/ha fb 2 hoeing at 20 & 35 DAS fb metribuzine @ 0.5 kg ai/ha	556.0 $^{a-c}$	178.6^{h}	37.8^{ab}	41.9^{a}	86.4^{e}	10.2^{g}
T_{13} - Weed free check	649.0^{a}	189.1^{d}	38.6^{a}	42.7^{a}	87.2^{b}	-
T_{14} - Unweeded control	373.3^{d}	100.1^{o}	33.4^{c}	40.7^{a}	73.1^{l}	53.7^{a}
T_{15} - RPP (Recommended Package of Practice)	493.3 $^{b-d}$	159.4^{m}	36.9^{a-c}	41.79^{a}	82.5^{i}	23.3^{b}
S. Em±	44.9	0.02	1.15	0.61	0.06	0.72
LSD (5%)	128.1	0.05	3.28	1.75	0.17	2.06

IC : Inter cultivation **HW**: Hand Weeding **fb**: followed by *a.i.* : Active ingredient Means followed by the same lower case letter/s in a column do not differ significantly by DMRT (P = 0.05)

Higher shelling percentage and partitioning efficiency (HI) were noticed with pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (**T_9**) and pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**) compared to all other treatments. Significantly higher test weight was observed in pre-emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings at 20 and 35 DAS fb post emergence application of Atrazine @ 1.0 kg *a.i.* ha^{-1} (T_9) and Atrazine @ 1.0 kg *a.i.* ha^{-1} + two hoeings at 20 and 35 DAS fb post emergence application of 2, 4-D @ 1.0 kg *a.i.* ha^{-1} (**T_{11}**). The improvement in grain weight and test weight could be attributed to better translocation of metabolites for grain development. It was due to reduced weed competition in these treatments. These results are in conformity with the findings of Walia *et al.* (2007).

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