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Influence of sequential application of pre and post-emergence herbicides in maize (*Zea mays* L.)

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Abstract
A field experiment was conducted during *kharif*, 2017 at the Main Agricultural Research Station, agriculture college farm, Raichur to study the "influence of sequential application of pre and post-emergence herbicides in maize (*Zea mays* L.).". The experiment was laid out in Randomized Complete Block Design with three replications and twelve treatments. The experimental site was infested with broad leaved weeds, grasses and sedges. Amongst broad leaved weeds, *Euphorbia geniculata* was the dominant while in grasses, *Brachiaria eruciformis* was most prevalent and only one sedge *Cyprus rotundus* occurred. Based on the results, it was concluded that sequential application of herbicide treatments like, atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS (T_8) recorded significantly higher plant height, leaf area, leaf area index (LAI), dry matter production at all stages of crop growth, grain yield, stover yield, harvest index and lower weed index (7933 kg ha^{-1}, 9433 kg ha^{-1}, 45.68 % and 5.33 % respectively) and it was followed by application of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb topramezone 33.6 % SC @ 75 g a.i. ha^{-1} (POE) at 30 DAS (7637 kg ha^{-1}, 9117 kg ha^{-1}, 45.58 % and 8.86 %, respectively) and atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS (7027 kg ha^{-1}, 8527 kg ha^{-1}, 45.17 % and 16.15 %, respectively) and these treatments were found on par with each other. Whereas, hand weeding twice at 25 and 50 DAS (8380 kg ha^{-1}, 9867 kg ha^{-1}, 45.92 % and 0.00, respectively) was superior over other treatments.

Keywords: Maize, sequential application atrazine, tembotrione, topramezone and halosulfuron

Introduction
Maize (*Zea mays* L.), a cereal kernel produced worldwide, assume importance to subsistence and commercial farmers alike while occupying a prominent position in global agriculture. It is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions, soil types, biodiversity and management practices. It is also efficient converter of solar energy into dry matter, as it is C4 type of crop. Hence, it has the highest genetic yield potential among the cereals. Maize is known as queen of cereals because of its high production potential and wider adaptability. It is the most important cereal crop after wheat and rice, grown in virtually every suitable agricultural region of the globe. In India, it is cultivated as a food as well as feed crop under varying soil, topography, seasons and management practices throughout the country. It is mostly grown as rainfed crop during *Kharif* faces a formidable weed problem, which competing severely for growth resources and the yield loss may extend from 33 to 50 Per cent (Sharma *et al.*, 2000) [10]. Maximum yield loss due to weed competition occur during the first 3-6 weeks, *i.e.*, before the canopy has developed thick enough to smother the weeds (Shad *et al.*, 1993) [8]. Wider row spacing and initial slow crop growth makes maize highly sensitive to weed competition upto 6 weeks of growth period (Nagalakshmi *et al.*, 2006) [6]. Thus, to realize optimum yields maize demands during the initial six weeks of crop growth thorough weed management which is considered critical for crop weed competition otherwise the extent of nutrient loss varies from 30-40% of the applied (Mundara *et al.*, 2002) [5]. Weeds being a serious negative factor in crop production are responsible for marked loss (28-100%) in crop yield (Pandey *et al.*, 2001) [7]. Atrazine, recommended as a pre-emergence herbicide, is not effective against some of the weeds, both grassy and non grassy as well as the sedge *Cyperus rotundus*. Hence, there is need for some alternate post-emergence herbicide which can provide broad spectrum weed control in *Kharif* maize without affecting the growth and yield of crop. Keeping in view the above facts, the present investigation was carried out to know the influence of sequential application of pre and post-emergence herbicides in maize (*Zea mays* L.) at AICRP on weed management plot, Main Agriculture Research Station, College of agriculture, University of Agricultural Sciences, Raichur, during *Kharif*, 2017.

Materials and methods

Field experiment was carried out in plot No.152 at New Farm of AICRP on weed management, Main Agriculture Research Station, College of agriculture, University of Agricultural Sciences, Raichur, during *Kharif*, 2017 to study the "influence of sequential application of pre and post-emergence herbicides in maize (*Zea mays* L.)." The soil type was vertisol (medium deep black soil) and it was medium in available nitrogen (298.65 kg/ha), available phosphorus (24.50 kg/ha) and available potassium (225.72 kg/ha) with a pH of 8.21. The experiment was laid out in a Randomized Complete Block Design (RCBD) with the following treatments *viz.*, T_1 - 2,4-D sodium salt 80 % WP @ 2000 g a.i.ha^{-1} at 20 DAS, (T_2 - Atrazine 50 % WP @ 1000 g a.i. ha^{-1} at 20 DAS, T_3 - Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} at 20 DAS, T_4 - Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} at 20 DAS, T_5 - Topramezone 33.6 % SC @ 75 g a.i. ha^{-1} at 20 DAS, T_6 - Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb 2,4-D 80 % WP @ 2000 g a.i. ha^{-1} (POE) at 30 DAS, T_7 - Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Atrazine 50 % WP @ 1000 g a.i. ha^{-1} (POE) at 30 DAS, T_8 - Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS, T_9 - Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS, T_{10} - Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Topramezone 33.6 % SC 75 g a.i. ha^{-1} (POE) at 30 DAS, T_{11} - Hand weeding twice at 25 and 50 DAS, T_{12}: Weedy check and replicated thrice. Maize hybrid NK - 6240 was sown with recommended spacing of 60 x 20 cm. Observations on weed density, weed dry matter, weed control efficiency, weed index, growth parameters and yield were recorded. Harvest index (HI) was calculated using following formulae given by Donald (1962) [3].

$$HI\ (\%) = \frac{\text{Economic yield (t ha}^{-1})}{\text{Biological yield (t ha}^{-1})} \times 100$$

Biological yield = (Kernel yield + Stover yield)

Leaf area index (LAI) was calculated by using below mentioned formula given by (Watson, 1952) [13].

$$LAI = \frac{\text{Leaf area per plant (dm}^2)}{\text{Land area occupied by the plant (dm}^2)}$$

Results and Discussion

Weed flora of the experimental site

The major weeds appeared in the experimental field at all the stages of observation were *Cyperus rotundus* among sedges, *Alternanthera sessilis*, *Commelina benghalensis*, *Digera arvensis*, *Euphorbia hirta*, *Euphorbia geniculata*, *Phyllanthus fraternus*, *Parthenium hysterophorus* and *Portulaca oleracea* among broad leaf weeds, *Cynodon dactylon*, *Brachiaria eruciformis* and *Dinebra retroflexa* as grassy weeds.

Effect on crop growth and yield

Significantly higher plant height (83.11, 218.80, 226.93 and 228.27 cm, respectively), leaf area (43.66, 91.73, 93.48 and 91.12 dm^2, respectively), leaf area index (3.64, 7.64, 7.79 and 7.59, respectively) and total dry matter production in maize (21.08, 132.09, 355.73 and 365.04 g plant^{-1}, respectively) at 30, 60, 90 DAS and at maturity (Table 1,2 and 3) were recorded under hand weeding at 25 and 50 DAS (T_{11}). Among the different weed management options, sequential application of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS (T_8) recorded significantly higher plant height (22.73 and 19.38 %, respectively), leaf area (51.51 and 46.38, %, respectively), leaf area index (51.33 and 46.40 %, respectively) and total dry matter production (53.69 and 82.76 %, respectively) at 60 and 90 DAS and it was found to be on par with spray of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb topramezone 33.6 % SC @ 75 g a.i. ha^{-1} (POE) 30 DAS (T_{10}) and atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) 30 DAS (T_9). Similar trend was noticed at 30 DAS and at harvest. Significantly lowest plant height, leaf area, leaf area index and dry matter production was observed in weedy check (T_{12}) than remaining treatments under study.

Sequential application of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS (T_8) recorded significantly higher grain stover yield (234 and 193 %, respectively) and it was found to be on par with spray of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb topramezone 33.6 % SC @ 75 g a.i. ha^{-1} (POE) at 30 DAS (T_{10}) (225 and 186 %, respectively) and atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS (T_9) (207 and 174 %, respectively). Significantly lowest grain and stover yield (3396 and 4896kg/ha) was observed in weedy check (T_{12}) as compared other treatments (Table 4). This might be due to greater availability of nutrients under lower weed competition, which might have promoted higher production and better translocation of photosynthates from source to sink. Pre-emergence herbicides alone could not improve the yield as they failed to reduce the weed germination and growth during the later part of the critical period of crop weed competition. Similar results were also reported by Ahmed and Susheela (2012) [1], Dharmendra *et al.* (2017) [2], Sivamurugan *et al*. (2017) [11] and Hargilas (2017) [4].

Harvest Index (%)

Data on harvest index of maize indicated that treatments did vary significantly among themselves due to various weed management treatments employed and are presented in Table 4.

There were significant differences with harvest index due to different weed management treatments and hand weeding twice at 25 and 50 DAS recorded significantly higher harvest index (45.92 %). Among different herbicide treatments, follow up application of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS (T_8) recorded significantly higher harvest index (45.68 %) and it was found to be on par with spray of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb topramezone 33.6 % SC @ 75 g a.i. ha^{-1} (POE) at 30 DAS (T_{10}) (45.58%), atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS (T_9) (45.17 %), atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb 2,4-D 80 % WP @ 2000 g a.i. ha^{-1} (POE) at 0-3 DAS fb 30 DAS (T_6) (45.15 %) and atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb atrazine 50 % WP @ 1000 g a.i. ha^{-1} (POE) at 0-3 DAS fb 30 DAS (T_7) (44.68 %) and post emergent herbicide application alone treatments like, tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} at 20 DAS (T_3) (44.58 %) and topramezone 33.6 % SC @ 75 g a.i. ha^{-1} at 20 DAS (T_5) (44.41 %) were also on par with each

other. Significantly lowest harvest index (40.30 %) was recorded with weedy check (T_{12}) treatment than rest of the treatments. Similar line o work was also conducted by Nagalakshmi *et al*. (2006) [6] and Srividya (2010) [12].

Weed Index

Data pertaining to weed index computed on the basis of maximum grain yield is presented in Table 4. It showed that weedy check (T_{12}) recorded the higher yield loss of 59.47 per cent. However, lowest weed index (0.00 %) was observed with hand weeding twice at 25 and 50 DAS (T_{11}) followed by application of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS (T_8) (5.33 %), atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb topramezone 33.6 % SC @ 75 g a.i. ha^{-1} (POE) at 30 DAS (T_{10}) (8.86 %) and atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS (T_9) (16.15 %) as compared to all other treatments. This clearly indicated that the sequential use of pre-emergence herbicides followed by post-emergence spray at 30 DAS was the most effective approach in controlling weeds and thus resulted in recording significantly lower values for weed index. These findings are in conformity with the findings of Shantveerayya *et al*. (2012) [9].

Table 1: Plant height at different growth stages of maize as influenced by different weed management practices

Treatment		Plant height (cm)			
		30 DAS	60 DAS	90 DAS	At harvest
T_1:	2,4-D sodium salt 80 % WP @ 2000 g a.i. ha^{-1} at 20 DAS	58.87	187.15	194.50	195.15
T_2:	Atrazine 50 % WP @ 1000 g a.i. ha^{-1} at 20 DAS	57.67	182.78	192.50	193.15
T_3:	Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} at 20 DAS	65.70	199.42	208.37	209.02
T_4:	Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} at 20 DAS	62.22	189.77	198.10	198.75
T_5:	Topramezone 33.6 % SC @ 75 g a.i. ha^{-1} at 20 DAS	65.20	198.80	205.27	205.93
T_6:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb 2,4-D 80 % WP @ 2000 g a.i. ha^{-1} (POE) at 30 DAS	68.71	204.13	209.97	210.73
T_7:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Atrazine 50 % WP @ 1000 g a.i. ha^{-1} (POE) at 30 DAS	66.76	201.98	207.20	209.85
T_8:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS	78.13	215.77	221.47	222.61
T_9:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS	72.20	207.73	215.00	215.77
T_{10}:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Topramezone 33.6 % SC 75 g a.i. ha^{-1} (POE) at 30 DAS	76.16	214.87	216.40	217.05
T_{11}:	Hand weeding twice at 25 and 50 DAS	83.11	218.80	226.93	228.27
T_{12}:	Weedy check	48.33	164.57	173.57	174.22
S.Em. ±		2.18	3.53	3.66	3.62
C.D. (P=0.05)		6.39	10.35	10.75	10.62

PRE= pre-emergence POE = post emergence DAS= days after sowing Fb= followed by
WP= Wetteble powder WDG= Water dispersible granule SC= Soluble concentrate

Table 2: Leaf area and leaf area index at different growth stages of maize as influenced by different weed management practices

Treatment		Leaf area (dm^2 plant^{-1})				Leaf area index (LAI)			
		30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1:	2,4-D sodium salt 80 % WP @ 2000 g a.i. ha^{-1} at 20 DAS	31.09	67.90	71.21	69.06	2.59	5.66	5.93	5.75
T_2:	Atrazine 50 % WP @ 1000 g a.i. ha^{-1} at 20 DAS	30.10	65.73	69.94	67.79	2.51	5.48	5.83	5.65
T_3:	Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} at 20 DAS	34.48	75.66	79.44	77.29	2.87	6.31	6.62	6.44
T_4:	Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} at 20 DAS	32.29	74.67	76.41	73.84	2.69	6.22	6.37	6.15
T_5:	Topramezone 33.6 % SC @ 75 g a.i. ha^{-1} at 20 DAS	33.43	75.18	77.22	75.07	2.79	6.26	6.43	6.26
T_6:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb 2,4-D 80 % WP @ 2000 g a.i. ha^{-1} (POE) at 30 DAS	38.31	78.91	84.49	82.34	3.19	6.58	7.04	6.86
T_7:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Atrazine 50 % WP @ 1000 g a.i. ha^{-1} (POE) at 30 DAS	36.32	77.73	82.16	80.01	3.03	6.48	6.85	6.67
T_8:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS	42.09	88.83	90.48	88.28	3.51	7.40	7.54	7.36
T_9:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS	40.99	86.22	87.57	84.52	3.42	7.18	7.30	7.04
T_{10}:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Topramezone 33.6 % SC 75 g a.i. ha^{-1} (POE) at 30 DAS	41.69	86.45	88.24	86.09	3.47	7.20	7.35	7.17
T_{11}:	Hand weeding twice at 25 and 50 DAS	43.66	91.73	93.48	91.12	3.64	7.64	7.79	7.59
T_{12}:	Weedy check	27.60	58.63	61.81	58.85	2.30	4.89	5.15	4.90
S.Em. ±		0.77	1.00	1.54	1.59	0.06	0.08	0.13	0.13
C.D. (P=0.05)		2.27	2.93	4.53	4.66	0.19	0.24	0.38	0.39

PRE= pre-emergence POE = post emergence DAS= days after sowing fb= followed by
WP= Wetteble powder WDG= Water dispersible granule SC= Soluble concentrate

Table 3: Dry matter production at different growth stages of maize as influenced by different weed management practices

Treatment		Dry matter production in maize plant (g plant^{-1})			
		30 DAS	60 DAS	90 DAS	At harvest
T_1:	2,4-D sodium salt 80 % WP @ 2000 g a.i. ha^{-1} at 20 DAS	9.96	86.50	274.47	277.43
T_2:	Atrazine 50 % WP @ 1000 g a.i. ha^{-1} at 20 DAS	9.72	82.52	264.95	272.48
T_3:	Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} at 20 DAS	12.33	96.57	295.95	300.96
T_4:	Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} at 20 DAS	11.58	93.85	288.20	295.05
T_5:	Topramezone 33.6 % SC @ 75 g a.i. ha^{-1} at 20 DAS	12.07	94.70	291.33	297.03

T_6:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb 2,4-D 80 % WP @ 2000 g a.i. ha^{-1} (POE) at 30 DAS	13.65	105.73	308.37	316.93
T_7:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Atrazine 50 % WP @ 1000 g a.i. ha^{-1} (POE) at 30 DAS	13.17	101.28	303.14	310.38
T_8:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS	19.21	117.73	340.92	346.43
T_9:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS	18.43	115.11	332.36	338.81
T_{10}:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Topramezone 33.6 % SC 75 g a.i. ha^{-1} (POE) at 30 DAS	18.68	115.46	336.80	342.46
T_{11}:	Hand weeding twice at 25 and 50 DAS	21.08	132.09	355.73	365.04
T_{12}:	Weedy check	10.07	76.60	186.54	195.09
S.Em. ±		0.29	0.93	2.94	2.90
C.D. (P=0.05)		0.86	2.72	8.63	8.51

PRE= pre-emergence POE = post emergence DAS= days after sowing fb= followed by
WP= Wetteble powder WDG= Water dispersible granule SC= Soluble concentrate

Table 4: Yield attributes as influenced by different weed management practices in maize

Treatments		Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Weed index (%)
T_1:	2,4-D sodium salt 80 % WP @ 2000 g a.i. ha^{-1} at 20 DAS	4697	6197	42.98	43.95
T_2:	Atrazine 50 % WP @ 1000 g a.i. ha^{-1} at 20 DAS	3943	5533	41.60	52.94
T_3:	Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} at 20 DAS	6160	7657	44.58	26.49
T_4:	Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} at 20 DAS	5297	6797	43.80	36.79
T_5:	Topramezone 33.6 % SC @ 75 g a.i. ha^{-1} at 20 DAS	5967	7467	44.41	28.80
T_6:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb 2,4-D 80 % WP @ 2000 g a.i. ha^{-1} (POE) at 30 DAS	6667	8100	45.15	20.44
T_7:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Atrazine 50 % WP @ 1000 g a.i. ha^{-1} (POE) at 30 DAS	6307	7807	44.68	24.74
T_8:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS	7933	9433	45.68	5.33
T_9:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Halosulfuron 75 % WDG @ 90 g a.i. ha^{-1} (POE) at 30 DAS	7027	8527	45.17	16.15
T_{10}:	Atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb Topramezone 33.6 % SC 75 g a.i. ha^{-1} (POE) at 30 DAS	7637	9117	45.58	8.86
T_{11}:	Hand weeding twice at 25 and 50 DAS	8380	9867	45.92	0.00
T_{12}:	Weedy check	3396	4896	40.30	59.47
S.Em. ±		322	330	0.56	NA
C.D. (P=0.05)		944	967	1.63	

PRE= pre-emergence POE = post emergence DAS= days after sowing Fb= followed by
WP= Wetteble powder WDG= Water dispersible granule SC= Soluble concentrate

Conclusion

It is concluded that among the herbicide treatments, sequential application of atrazine 50 % WP @ 500 g a.i. ha^{-1} (PRE) at 0-3 DAS fb tembotrione 34.4 % SC @ 125 g a.i. ha^{-1} (POE) at 30 DAS was found to be most effective in controlling complex weeds of associated with maize.

References

1. Ahmed AMA, Susheela R. Weed management studies in *Kharif* maize. The J Res. 2012; 40(3):121-123.
2. Dharmendra KK, Vikram B, Abhinandan S, Mritunjay K, Prasad SS. Impact of herbicides on yield, economics and phytotoxicity in *Kharif* maize. The Pharma Innovation J. 2017; 6(11):190-192.
3. Donald CM. In search of yield. J Australian Inst. Agric. Sci. 1962; 28:171-178.
4. Hargilas. Evaluation of new herbicides to control weed flora and to enhance the profitability of maize in Southern Rajasthan. Biennial Conference of the Indian Society of Weed Science on ‘’Doubling Farmers Income by 2022: The role of weed Science’’ MPUA & T, Udaipur, India, March, 2017, 100.
5. Mundara SL, Vyas AK, Maliwal PL. Effect of weed and nutrient management on nutrient uptake by maize (*Zea mays* L.) and weed. Indian J Agron. 2002; 47(3):378-383.
6. Nagalakshmi KVV, Chandrasekhar, Subbaiah G. Weed management for efficient use of nitrogen in rabi maize (*Zea mays* L.). Andhra Agric. J. 2006; 53(1-2):14-16.
7. Pandey AK, Prakash V, Singh RD, Mani VP. Integrated weed management in maize. Indian J Agron. 2001; 46:260-265.
8. Shad RA, Chatha MQ, Nawaz H. Weed management studies in maize. Pakistan J Agric. Res. 1993; 14 (1):44-50.
9. Shantveerayya H, Agasimani CA, Halikatti SI, Ramesh B, Patil CR, Ningnur BT *et al.* Effect of herbicides weed control and productivity of maize (*Zea mays* L.). Karnataka J Agric. Sci. 2012; 25(1):137-139.
10. Sharma AR, Toor AS, Sur HS. Effect of interculture operations and scheduling of atrazine application on weed control and productivity of maize (*Zea mays* L.) in shiwalik foot hills of Punjab. Indian. J Weed. Sci. 2000; 70:757-761.
11. Sivamurugan AP, Ravikesavan R, Yuvaraja A, Singh AK, Jat SL. Weed management in maize with new herbicides. Chem. Sci. Rev. Lett. 2017; 6(22):1054-1058.
12. Srividya S. Effect of tillage and herbicide use on the growth and yield of maize. M.Sc (Ag) Thesis submitted to Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad, 2010.
13. Watson DJ. The physiological basis of variation in yield. Adv. Agron. 1952; 4:101-145.