Effect of pre-and post-emergence herbicides application on weed flora, yield, and economics in Kharif maize (*Zea mays L.)*

ABSTRACT

Nowadays labor charges have significantly increased the production cost of maize in India. Hence, to overcome this problem a field experiment entitled "Effect of pre-and post-emergence herbicides on weed flora, yield, and economics in Kharif maize (*Zea mays L.*)" was conducted at Crop Research Center, ITM University, Gwalior during the Kharif season of 2021. The texture of the experimental field was sandy loam, having a pH of 7.6, organic carbon of 0.34, and available N, P_2O_5, and K_2O of 164, 19.6, and 416.7 kg/ha, respectively. The field experiment was laid out in RBD (Randomized Block Design) with nine treatments and three replications. The results showed that among the herbicide treatments a significant reduction in the total weed density and dry matter of different weed flora were recorded with Atrazine 50 % WP 1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE, and found at par with Metribuzin 70% WP 400 g/ha fb Topramezone 33.6% SC 25.2 g/ha. Concerning the yield of maize, Atrazine 50 % WP PE fb Topramezone 33.6% SC POE 1000 fb 25.2 g/ha, recorded significantly higher values of grain yield and stover yield of maize, as compared to other herbicide treatments. It may be concluded that Atrazine 50 % WP1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE, recorded highest WCE (91.25%) and superior with respect to grain yield of maize (5365 kg/ha) and economics (Net return Rs. 84377 and BCR Rs. 2.36) over all the weed control treatments.

Keywords: PE (Pre-emergence), POE (Post-emergence), Weed density, Weed control efficiency (%), Weed flora,

1. INTRODUCTION

Maize (*Zea mays L.*) belongs to the family Poaceae. The origin of maize in Mexico and Central America (Schnabel *et al.,* 2009) [1]. As a C4 crop, it is also an effective converter of solar energy into dry matter. As a result, among cereals, it has the largest genetic yield potential. So, it is called the "Queen of cereals" and now it called as king of cereals because of its higher productivity (2014-15). It is grown in India as both a food and a fodder crop under a variety of soil, topographical, seasonal, and management conditions. The different types of corn are grown all over the world. On an area of 194 million ha, about 1148 m tons of maize are currently produced together by more than 170 nations, with average productivity of 5.75 t ha^{-1}. Maize is farmed on 9.2 million ha of land in India with a 27.8 m tons production (Anonymous, 2020) [2]. In India, the average productivity of maize has been 2.43 t/ha, and Madhya Pradesh has a tune of 5.7% of the total production of the country in 2020. Maize is an excellent feed for chickens, pigs, and other animals. Its composition is around 11.2% protein, 8% oil, 70% carbohydrates, 2.3 % crude fiber, and 10.4% albumins with 1.4% being ash (Raut *et al.,* 2017) [3]. Due to its low gluten (protein) content, its flour is considered a healthy diet for those with heart disease (Rasool and Khan, 2016) [4]. Several factors affect the maize crop growth and development among them weed infestation causes yield losses during the Kharif season ranging from 28 to 100 per cent. (Patel *et al.*, 2006) [5]. The major weeds that affected the maize in the Kharif season i.e., *Cyperus rotundus, Cynodon dactylon, Cyanotis oxillaris, Commelina benghalensis, Denebra arabica, Tridax procumbens, Lagasca mollis, Euphorbia hirta, Euphorbia geniculata, Digera arvensis, Parthenium hysterophorus, Phyllanthus niruri, Celosia Argentina,* and *Acalypha indica.* So, controlling these major weeds might boost the crop output. In comparison to un-weeded fields, weed management methods in maize produced yields that were 65 to 90 per cent greater (Barla *et al.,* 2016 [6]; Kumawat *et al.,* 2019 [7]). In some countries like the Philippines, India, China, and Thailand formers are doing the integrated weed management system to reduce the chemical usage of weed management practices. However, many weed-control strategies like physical, and mechanical weed control methods influenced effective control of weeds but hand weeding is expensive and lack of labor availability farmers are shifting to chemical weed management practice. So, herbicide spraying is the best strategy for weed control, because it has a broad spectrum of weed control, is less expensive, and is quicker, during the complete crop growth season without causing harm to the environment. Therefore, solo application and tank-mix combinations of herbicides as pre- and post- emergence were tried in the present investigation. So, keeping all these aspects and objectives in view, the study was conducted to find out effective and economical herbicides for weed management in Kharif maize.

2. MATERIALS AND METHODS

The field experiment was conducted during the Kharif season of 2021 at Crop Research Center, ITM University, Gwalior. The geographical location of the experimental field was 26.22 North (N) and 78.18 East (E). and situated at an altitude of 196 meters above the mean sea level. The Research Center falls under the grid region of Madya Pradesh. The experiment consisted of the following treatments which include: Atrazine 50 % WP PE 1000 g/ha (T1), Tembutrione 42% SC POE 100 g/ha (T2), Topramezone 33.6% SC +Adjuvant POE 25.2 g/ha (T3), Metribuzin 70% WP 400 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE (T4), Atrazine 50 % WP 1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE (T5), Metribuzin 70% WP 400 g/ha PE fb Tembutrione 42% SC 100 g/ha POE (T6), Atrazine 50 % WP 1000 g/ha PE fb Tembutrione 42% SC 100 g/ha POE (T7), weed-free (T8), and weedy check (T9). The experiment was laid out in Randomized block design (RBD) with a total of 9 treatments and 3 replications. All the herbicides were applied solo and, in a combination as pre-emergence, at next day after sowing fb post-emergence at 2-3 leaf stage of weeds were applied uniformly with the help of a knapsack sprayer, using 500 liters of water/ha. The maize variety “DKC 9178 (hybrid variety)” was sown with a seed rate of 20 kg/ha, and maintained a geometry of 60cm X 25cm. All the agronomic practices and plant protection measures were applied to all the plots to grow the crop. Observation recorded the following characteristics: Total weed density (no/m^2), weed dry matter at 60 DAS, weed control efficiency (%) at the harvest stage of the crop, grain yield, stover yield (kg/ha), and economics, net return (Rs/ha), B-C ratio of different weed control treatments. The effect of the treatment was evaluated using the "F" test if the "F" test indicated their significance then the critical difference at a 5% level of probability was used to compare the levels of treatment significance.

3. RESULT AND DISCUSSION:

The experimental field was mainly infested with different types of weed flora which consisted of grassy weeds i.e., *Cynodon dactylon, Chloris barbata, Dactyloctenium aegyptium, Brachiaria reptans,* etc, broadleaf weeds i.e., *Commelina benghlensis*, *Digera arvensis, Phyllanthus niruri, Parthenium hysterophorus, Acalypha indica*, *Amaranthus viridis, and Trianthema portulacastrum,* etc. Only one sedge i.e., *Cyperus rotundus* was recorded. The data recorded in **Table1** revealed that all weed control treatments recorded a significant difference in total weed density (no/m^2), and weed dry matter accumulation (g/m^2) at 60 DAS of the crop. The significantly lower values of weed density and weed dry matter accumulation (50.2 no/m^2 and 44.86 g/m^2 respectively) were recorded with Atrazine 50 % WP 1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE, it is superior over all herbicide treatments and found at par with Metribuzin 70% WP 400 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha, followed by the application of Atrazine 50 % WP 1000 g/ha PE fb Tembutrione 42% SC 100 g/ha POE, and Metribuzin 70% WP 400 g/ha PE fb Tembutrione 42% SC 100 g/ha POE, as compared to other herbicide treatments. In case of the solo applied herbicide treatments were Tembutrione SC 100 g/ha POE, Atrazine 50 % WP PE 1000 g/ha, and Topramezone 33.6% SC +Adjuvant POE 25.2 g/ha, recorded significantly higher weed density and weed dry matter accumulation as compared to all the herbicide treatments. Significantly higher values of weed density and weed dry matter were recorded with a weedy check plot as compared to all weed control treatments, due to the uncontrol of weeds. Similar results are conformity with (Rana *et al.,* 2017[8] and Sundari *et al.,* 2019 [9]). As concerned with weed control efficiency (%) the Atrazine 50 % WP 1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE was recorded higher value of weed control efficiency (91.25%) as compared to all the herbicide treatments. The weed control efficiency and weed index have an inverse relationship. So, treatments that recorded the highest weed control efficiency eventually recorded the lowest weed index because the highest weed control efficiency improves the grain yield. Similar findings were found by (Larbi *et al.,* 2013 [10], Damalas *et al.,* 2018 [11], and Triveni *et al.,* 2017 [12]).

Treatments	Weed density (60 DAS)	Weed dry matter (60 DAS)	WCE (%)
1) Atrazine 50 % WP (1000 g)	10.11 (101.76)	8.72 (84.61)	73.60
2) Tembutrione 42% SC (100 g)	10.45 (108.72)	9.42 (88.34)	71.90

3) Topramezone 33.6% SC +Adjuvant (25.2 g)	8.92 (79.12)	8.70 (84.24)	78.90
4) Metribuzin 70% WP fb Topramezone 33.6% SC (400 fb 25.2 g)	7.46 (55.3)	6.79 (46.12)	90.94
5) Atrazine 50 % WP fb Topramezone 33.6% SC (1000 fb 25.2 g)	7.12 (50.2)	6.73 (44.86)	91.25
6) Metribuzin 70% WP fb Tembutrione 42% SC (400 fb 100 g)	8.40 (70.1)	7.27 (52.4)	89.57
7) Atrazine 50 % WP fb Tembutrione 42% SC (1000 fb 100 g)	8.37 (69)	7.20 (51)	89.80
8) Weed Free	0.00	0.00	100
9) Weedy Check	13.72 (187.9)	13.36 (178.2)	0
SEm±	0.23	0.23	-
CD at (5%)	0.67	0.70	-

Table1: Total weed density (no/m^2), Weed dry matter (g/m^2) at 60 DAS, and Weed control efficiency (%) at the harvest stage of the crop (115DAS) as influenced by different weed control treatments.

Note: Data analyzed by X=√x+0.5 transformed values and in parenthesis are the original values.

The data recorded in **Table2** concerned with the yield of maize affected significantly due to different weed control treatments. The weed-free plot recorded significantly higher values of grain yield, and stover yield (5475 and 6656 kg/ha respectively). Among the herbicide treatments Atrazine 50 % WP 1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE, recorded higher values of grain yield, and stover yield (5365 and 6652 kg/ha respectively) and found at pat with Metribuzin 70% WP 400 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha, followed by the application of Atrazine 50 % WP 1000 g/ha PE fb Tembutrione 42% SC 100 g/ha POE, as compared to all the herbicide treatments. The treatments which have lower values of weed dry matter and higher weed control efficiency resulted in significantly higher grain yield and stover yield of maize. Similar findings are in conformity with (Swetha *et al.,* 2015 [13], Teame *et al.,* 2018 [14], and Kurre *et al.,* 2018 [15]). The highest values of net return and benefit-cost ratio (Rs. 84377.17 and Rs. 2.36 respectively), were recorded with Atrazine 50 % WP 1000 g/ha PE fb Topramezone 33.6% SC 25.2 g/ha POE. However, weed-free, Metribuzin 70% WP fb Topramezone 33.6% SC 400 fb 25.2 g/ha, Atrazine 50 % WP PE fb Tembutrione 42% SC POE 1000 fb 100 g/ha, and Metribuzin 70% WP PE fb Tembutrione 42% SC POE 400 fb 100 g/ha, were recorded nearer values.

Table2: Yield and economics of maize as influenced by different weed control treatments.

Treatments	Grain yield	Stover yield	Net Return	Benefit-Cost
1) Atrazine 50 % WP (1000 g)	4325.56	5632.82	65477.16	2.04

2) Tembutrione 42% SC (100 g)	4137.76	5397.75	58559.48	1.68
3) Topramezone 33.6% SC +Adjuvant (25.2 g)	4569.50	5809.16	67635.72	1.93
4) Metribuzin 70% WP fb Topramezone 33.6% SC (400 fb 25.2 g)	5311.20	6603.49	82434.26	2.26
5) Atrazine 50 % WP fb Topramezone 33.6% SC (1000 fb 25.2 g)	5365.24	6652.79	84377.17	2.36
6) Metribuzin 70% WP fb Tembutrione 42% SC (400 fb 100 g)	4970.24	6211.10	72125.29	1.83
7) Atrazine 50 % WP fb Tembutrione 42% SC (1000 fb 100 g)	5163.76	6455.40	80237.32	2.26
8) Weed Free	5475.38	6656.15	83121.29	2.13
9) Weedy Check	2859.63	3826.78	33349.49	1.05
SEm±	183.05	167.69	-	-
CD at (5%)	548.78	502.74	-	-

4. CONCLUSION

The application of Atrazine 50 % WP 1000 PE fb Topramezone 33.6% SC 25.2 g/ha POE, recorded the highest weed control efficiency and superior with respect to grain yield (5365 kg/ha) and economics (Net return Rs 84377 and benefit-cost ratio Rs 2.36) of maize over rest of the treatments.

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