J. Soils and Crops 33 (1) 147-151, June 2023

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

STUDIES ON WEED MANAGEMENT PRACTICES ON GROWTH AND YIELD OF *KHARIF* MAIZE (*Zea mays* L.)

K. T. Jadhav[1], S. S. Mane[2], R. K. Sathe[3] and V.S. Gavande[4]

ABSTRACT

The present investigation entitled " Studies on weed management practices on growth and yield of *kharif* maize (*Zea mays* L.)" was carried out during *kharif* 2019 at Experimental Farm, College of Agriculture, Badnapur, Dist.-Jalna, VNMKV, Parbhani, Maharashtra (India). Randomized Block design was used for study comprised of ten treatments *viz.*, T_1-Atrazine 50 %WP @ 1 kg a.i ha^{-1} (PE), T_2- 2,4 –D Dimethyl Amine salt 58 % SL @ 1 kg a.i. ha^{-1} (PoE), T_3-Topramezone 33.6 % SC @ 67.2 g a.i ha^{-1} (PoE at 15 DAS), T_4-Topramezone 33.6% SC @ 25.2 g a.i ha^{-1} (PoE at 15 DAS), T_5-Tembotrione 42% SC@ 105 g a.i ha^{-1} (PoE at 15 DAS), T_6- Topramezone 33.6 % SC @ 25.2 g a.i ha^{-1} +Atrazine 50%WP @ 250 g a.i. ha^{-1} (PoE at 15DAS), T_7-Tembotrione 42 % SC @ 105 g a.i ha^{-1} +Atrazine 50% WP @ 250 g a.i. ha^{-1} (PoE 15DAS), T_8 –One hand weeding at 30 DAS, T_9 : Weedy check and T_{10}-Weed free. Among treatments, weed free treatment attributed more number of leaves, maximum plant height, dry matter production and leaf area plant^{-1} followed by treatment T_6 *i.e* topramezone 33.6 % SC @ 25.2 g a.i.ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1}. Significantly maximum values of yield attributes were recorded in treatment of topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 (g) a.i. ha^{-1}followed by treatment of tembotrione 42 % SC @ 105 g a. i. ha^{-1}+ atrazine 50% WP @ 250 g a. i. ha^{-1}. Minimum values of yield attributes were recorded in weedy check. Treatment of topramezone + atrazine @ 25.2 + 250 g a.i. ha^{-1} as PoE (T_6) found effective in limiting weed growth and recorded lower weed index, weed dry matter with higher weed control efficiency followed by tembotrione +atrazine @105 + 250 (g) a.i.ha^{-1}as PoE at all growth stages of crop. The benefit cost ratio was highest (2.94) with the application of topramezone + atrazine @ 25.2 + 250 g a.i ha^{-1} followed by tembotrione + atrazine @ 105 + 250 g a.i. ha^{-1} as PoE (2.81), whereas weedy check recorded significantly lower B:C ratio (1.50) over other treatments.

(Key words: Weed management, *kharif* maize, growth, weed studies, yield attributes and yield)

INTRODUCTION

An average productivity of maize in world is 3543 kg ha^{-1}. The average productivity of maize in India is 3195 kg ha^{-1}. Maharashtra ranks third at national level with average productivity of 3000 kg ha^{-1} (Anonymous, 2020).

The yield of maize under Indian condition may be attributed to number of factors among them weeds causes harmful effect on the growing plants and interfere with land use pattern (Raut *et al.,* 2017). Maize crop gets infested with different monocot as well as dicot weeds and is subjected to heavy weed competition, which often inflicts huge losses. Rajeshkumar *et al.* (2017) reported 63.75% yield reduction in maize due to control of weeds and they further concluded that weed management strategies attempt to limit the deleterious effects of weeds growing with crop plants.

Weed infestation is one of the major constraints of low productivity of maize. The average yield loss due to weeds in maize in India is 29.5-74.0 %. (Chopra and Augiras, 2007). The quantities of growth factors used by weeds are thus unavailable to the crop. Chemical weed control is a better supplement to conventional methods and forms an integral part of the modern crop production. Similar observation was recorded by Yenpreddiwar *et al.*, (2017). They noted that herbicides provide quick and effective control of weeds. Continuous usage of same herbicide or similar herbicides year after year over several years do certainly lead to elimination of sensitive weed species but leave out the tolerant weed species resulting in a gradual built up of their population. Hence, use of two different chemicals with different mode of action may enhance the efficacy of weed control.

Manual weeding in maize based intercropping systems is difficult due to closely spaced crop rows of component crops. Therefore, pre-emergence and post-emergence herbicides hold a key for early season weed

1. Professor (CAS), Dept. of Agronomy, College of Agriculture, Badnapur, Dist. Jalna,VNMKV, Parbhani.
2. Professor (CAS), Dept. of Soil Science and Agricultural Chemistry, College of Agriculture, Badnapur, Dist. Jalna, VNMKV, Parbhani
3. Teaching Associate, Dept. of Agronomy, College of Agriculture, Badnapur, Dist. Jalna, VNMKV, Parbhani.
4. P.G. Student, Dept. of Agronomy, College of Agriculture, Badnapur, Dist. Jalna, VNMKV, Parbhani

control in such system. Recently introduced herbicide *viz.,* Topramezone and tembotrione are selective, post-emergence herbicides. Tank mix application of these post emergence herbicides with lower dose of atrazine was reported to be more effective providing broad spectrum weed control than alone application of individual chemicals. So there is need to evaluate alternate post emergence herbicides in combination with conventional herbicides like atrazine/ 2,4-D which can provide broad spectrum weed control in maize crop in different weed seed bank regions.

MATERIALS AND METHODS

The experiment on weed management in *kharif* maize (*Zea mays* L.) was carried out during *kharif* 2019 at experimental farm of agronomy, college of agriculture Badnapur, VNMKV, Parbhani, Maharashtra (India). Soil of the experimental field was clayey in texture, moderate in available (nitrogen) and low in available (phosphorus) with high in available (potassium) and moderately alkaline in reaction. The experimental site is situated at 19.8682 ^{0}N latitude and 75.7256 ^{0}E longitude and an altitude of 523 m above mean sea level. The randomized block design consisted of ten treatments and three replications. Net and gross plot size was 3.5 x 4.5 m^2 and 4.8 x 5.1 m^2, respectively. Maize crop variety DKC-9133 was dibbled at 60 cm row to row and 30 cm plant to plant distance. The doses of herbicides were calculated as per the treatments simultaneously with required calibration of knapsack sprayer. The powder or liquid formulation was diluted in the water according to the different doses and 1.2l of spray solution plot^{-1} was applied for each treatment with the help of knapsack sprayer. Treatments consisted of T_1-Atrazine 50 %WP @ 1 kg a.i. ha^{-1} (PE), T_2- 2,4 –D Dimethyl Amine salt 58 % SL @ 1 kg a.i. ha^{-1} (PoE), T_3-Topramezone 33.6 % SC @ 67.2 g a.i. ha^{-1} (PoE at 15 DAS), T_4- Topramezone 33.6% SC @ 25.2 g a.i. ha^{-1} (PoE at 15 DAS), T_5-Tembotrione 42% SC@ 105 g a.i. ha^{-1} (PoE 15 DAS), T_6- Topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} +Atrazine 50%WP @ 250 g a.i. ha^{-1} (PoE at 15 DAS), T_7-Tembotrione 42 % SC @ 105 g a.i. ha^{-1} +Atrazine 50% WP @ 250 g a.i. ha^{-1} (PoE 15 DAS), T_8 –One hand weeding at 30 DAS, T_9 : Weedy check, T_{10}- Weed free. Five plants were randomly selected within the net plot area and tagged for recording the periodic biometric observations at various stages of crop growth. Growth attributes *viz.,* Plant height, number of leaves plant^{-1}, dry matter accumulation plant^{-1}, leaf area plant^{-1} recorded at 30, 60, 90 and at harvest in that five plants were randomly selected within the net plot area and tagged for recording the periodic biometric observations at various stages of crop growth. Yield attributes recorded with sample plant at harvest *viz.,* number of cobs, length of cob, girth of cob, weight of cob, test weight, grain yield, stover yield, biological yield plot wise and converted into hectare basis and harvest index calculated in per cent. Weed dry weight also measure and record in g plot^{-1}. Fertilizer dose of 75:50:50 NPK kg ha^{-1} was applied as common to all treatments. Entire dose of P_2O_5 and K_2O and $^1/_3$ of N was applied as basal dose. Remaining nitrogen was applied in two more splits at knee height stage and at tasseling stage. Irrigation was given two times during two dry spells.

RESULTS AND DISCUSSION

Growth attributes

Data presented in Table 1 indicated that**,** significantly highest plant height (148.56 cm) was recorded with weed free treatment (T_{10}) which was found superior than the other treatments except topramezone 33.6% SC@ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) (148 cm) and topramezone 33.6% SC@ 67.2 g a.i. ha^{-1} as PoE (T_3) (147.8 cm), respectively, however, significantly lowest plant height was recorded due to Weedy check (T_9) (135.13 cm) at harvest.

Treatment of weed free (T_{10}) condition recorded higher plant dry matter (186.88 g) plant^{-1}, however, it was on par with topramezone 33.6% SC @ 25.2g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) (182.91g) at harvest. Significantly lowest plant dry matter (165.88 g) was recorded with weedy check (T_9), however, it was on par with 2,4-D Dimethyl amine salt 58 % SL@ 1 kg a.i. ha^{-1} (T_2) (168.8 g) and T_8 – one hand weeding at 30 DAS at harvest.

Weed free treatment (T_{10}) recorded significantly higher leaf area which was at par with topramezone 33.6% SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) at harvest. Weedy check (T_9) recorded significantly lowest leaf area than rest of the treatments.

Superior performance of topramezone + atrazine @ 25.2 + 250 g a.i. ha^{-1} + MSO (adjuvant) as PoE and tembotrione + atrazine @ 105 + 250 g a.i. ha^{-1} + stefes mero (adjuvant) as PoE was reported by Swetha *et al.*(2015). They noted better performance of growth attributes under application of topramezone and tembotrione with atrazine was due to timely weed control as a post emergence application of herbicide. Weed crop competition also decrease and provide the all resources such as a moisture, nutrients, light and space to crop instead of weed.

Yield attributes

Weed free treatment (T_{10}) recorded higher girth of cob (14.54 cm) which was at par with rest of the treatments, however, it was significantly superior over weedy check (T_9) (13.63 cm) and tembotrione 42% SC @ 105 g a.i. ha^{-1} (T_5) (13.70 cm), respectively.

Weed free treatment (T_{10}) recorded higher weight of cob (214.52 g) which was at par with topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) (208.33 g) and topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) (208.33 g) was at par with tembotrione 42 % SC @ 105 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_7) (202 g) and topramezone 33.6 % SC @ 67.2 g a.i. ha^{-1} (201.32 g) (T_3), respectively. Significantly lowest weight of cob^{-1} was recorded in weedy check (T_9) (153.50 g).

Weed free treatment (T_{10}) recorded higher test weight (40.5g) which was at par with topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a,i. ha^{-1} (T_6) (39.5 g), this treatment was found superior over other treatments. Significantly lowest test weight recorded in (T_9) weedy check (33.10 g).

Data presented in Table 1 revealed that, application of herbicide with combination of pre-emergence and post emergence herbicides resulted in better growth of the crop ultimately proved beneficial for better values of yield attributes *viz*., girth of cob, weight of cob, and test weight, which can be attributed to better control of weeds by the combination of herbicides. Similar findings were observed by Swetha *et al.* (2015). They observed minimum values of yield attributes in weedy check. These findings were in conformity with Sharma *et al*. (2014). They concluded that timely weed control enhance the yield attributes and yield with minimize the crop weed competition such as nutrient, light, moisture and space.

Weed studies

At harvest treatment of topramezone + atrazine @ 25.2 + 250 g *a.i.* ha^{-1} as PoE (T_6) recorded significantly lower dry matter (18.66 g m^{-2} and 22.43 g m^{-2}) which was at par with tembotrione + atrazine @ 105 +250 g *a.i.* ha^{-1} as PoE (T_7) (21.20 g m^{-2} and 25.28 g m^{-2}) and topramezone 33.6 % SC @ 67.2 g a.i. ha^{-1} (T_3) (21.75 g m^{-2} and 26.54 m^{-2}) respectively. Significantly highest weed dry matter was recorded in weedy check (T_9) (85.01 g m^{-2} and 102.2g m^{-2}), respectively.

Yield

Data presented in Table 1 reported that, efficient utilization of soil and climatic resources by maize plant in the presence of relatively low weed density and dry weight led to maximum grain yield (58.90 q ha^{-1}) in weed free treatment (T_{10}) which was at par with topramezone 33.6% SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) (56.69 q ha^{-1}) and tembotrione 42 % SC @ 105g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_7) (54.50 kg ha^{-1}), respectively. Significantly lowest grain yield was recorded in weedy check (T_9) (27.34 q ha^{-1}). Rana *et al.* (2017) also reported reduced maize grain yield to the tune of 63.5% under uninterupted growth of the weeds in experiment carried out during 2014 and 2015 on silty clay loam soil at Palampur. Madhavi *et al.* (2014) reported that efficiency of maize crop to partition the dry matter into its economic yield was highest in tank mix application of HPPD (4- hydroxyl-phenyl pyruvate dioxygenase) with atrazine.

Data presented in Table 1 regarding stover yield was significantly influenced by different weed management treatments. Highest stover yield was recorded in weed free treatment (74.67 q ha^{-1}) which was significantly superior to all other treatments; this might be due to the continuous removal of weeds. Similar findings were reported by Malviya *et al.* (2012). They recorded higher stover yield by chemical weed management as compared to mechanical weed management when applied at 30 and 45 DAS as a hoeing in rainfed maize. However, treatment (T_{10}) was found at par with topramezone 33.6 % SC @ 25.2 g a.i ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_6) (73.00 q ha^{-1}) as post emergence and it was at par with tembotrione 42 % SC @ 105 g a.i ha^{-1} + atrazine 50 % WP@ 250 g a.i. ha^{-1} (T_7) (72.62 q ha^{-1}) and topramezone 33.6 % SC @ 67.2 g a.i. ha^{-1} (T_3) (72.34 q ha^{-1}), respectively. Higher stover yield in weed control treatments could be due to better growth and development of maize, crop which produced more biomass. Significantly lower stover yield was recorded in weedy check. This is might be due to higher crop weed competition in weedy check treatment.

Highest biological yield (133.57 q ha^{-1}) was recorded in weed free treatment which was on par with topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} + atrazine 50 % WP @ 250 g a,i. ha^{-1} as post emergence and it was at par with tembotrione 42 % SC @ 105 g a.i. ha^{-1}+ atrazine 50 % WP @ 250 g a.i. ha^{-1}, topramezone 33.6%SC @ 67.2 g a.i. $ha^{-1}$and atrazine 50% WP @1kg a.i. ha^{-1}, respectively. Significantly lowest biological yield was recorded in weedy check. Similar findings were reported by Swetha *et al*. (2015). They found the better results in maize crop in weed free treatment which was followed by topramezone and further stated that timely weed control enhanced the yield attributes and provide the crop all resources as suitable matter *viz.,* light, space, moisture and nutrient.

Data on harvest index in Table 1 revealed significant increase in harvest index in weed control treatments. Highest harvest index (44.09%) was recorded in weed free treatment (T_{10}) which was at par with topramezone 33.6 % SC @ 25.2 g a.i ha^{-1} + atrazine 50 % WP @ 250 g a.i. ha^{-1} (T_7) (43.71%), atrazine 50 % WP @ 1 kg a.i. ha^{-1} (T_1) (42.99%), topramezone 33.6 % SC@ 67.2 g a.i. ha^{-1} (T_3) (42.93 %) and tembotrione 42 % SC @ 105 g a.i. ha^{-1} + atrazine 50 % WP@ 250 g a.i. ha^{-1} (T_7) (42.87%), respectively. While the lowest harvest index (32.07 %) was recorded in (T_9) weedy check. This might be due to higher harvest index that the crop had a higher capacity to translocate photosynthates towards economic sinks in presence of low weed competition. A similar report of increase in the harvest index with reduced weed competition was reported earlier by Sanodiya *et al.*(2013).

In the present investigation, an attempt was made to study the effect of combination of herbicides on growth and yield of *kharif* maize. Growth and yield of maize was significantly improved due to tank mix application of herbicide combinations *viz.,* topramezone + atrazine @ 25.2 + 250 g a.i. ha^{-1} as PoE (15 DAS) and tembotrione + atrazine @ 105 + 250 g a.i. ha^{-1} as PoE (15 DAS) application over alone application of atrazine @ 1 kg a.i. ha^{-1}(PE), 2,4-D @ 1 kg a.i. ha^{-1}(PoE at 15 DAS), Tembotrione @ 105 g a.i. ha^{-1} and Topramezone @ 25.2 and 67.5 g a.i. ha^{-1} (PoE at 15 DAS).

Table 1. Growth and yield attributes at harvest of maize (*Zea mays* L.) influenced by different weed management treatments

Treatments	Plant height (cm) plant^{-1}	Dry matter accumulation (g plant^{-1})	Mean leaf area (cm^2 plant^{-1})	Girth of cob (cm)	Weight of cob(g)	Test weight (g)	Weed dry weight (g m^2)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological Yield (q ha^{-1})	Harvest Index
T_1	144.70	176.30	81.35	14.40	196.30	34.96	32.60	53.60	71.07	124.67	42.99
T_2	141.56	168.60	75.90	14.02	180.54	34.16	46.00	51.37	70.62	121.99	42.11
T_3	147.80	179.54	78.22	14.43	201.32	38.23	26.54	54.43	72.34	126.77	42.93
T_4	142.03	172.38	76.54	14.31	192.03	36.37	47.75	48.28	71.17	119.45	40.41
T_5	142.03	173.76	79.50	13.70	190.92	35.93	51.71	45.96	70.34	116.30	39.51
T_6	148.00	182.91	89.80	14.50	208.33	39.50	22.43	56.69	73.00	129.69	43.71
T_7	144.86	177.76	82.60	14.45	202.00	37.50	25.28	54.50	72.62	127.12	42.87
T_8	140.53	169.58	77.97	14.23	171.43	34.33	57.35	47.00	67.10	114.10	41.19
T_9	135.13	165.84	69.00	13.63	153.50	33.10	102.20	27.34	57.89	85.23	32.07
T_{10}	148.56	186.88	92.26	14.54	214.50	40.50	00	58.90	74.67	133.57	44.09
SE(m)±	0.75	2.10	1.08	0.25	3.66	0.52	1.86	1.40	1.17	3.11	-
CD(5%)	2.25	6.30	3.24	0.75	10.98	1.56	5.58	4.20	3.51	9.33	-
GM	**143.52**	**170.17**	**80.40**	**14.22**	**191.09**	**36.47**	**41.20**	**49.81**	**70.08**	**119.99**	**-**

T_1-Atrazine 50 %WP @ 1 kg a.i. ha^{-1} (PE), T_2- 2,4 –D 58 % SL @ 1 kg a.i. ha^{-1} (PoE), T_3-Topramezone 33.6 % SC @ 67.2 g a.i. ha^{-1} (PoE at 15 DAS), T_4-Topramezone 33.6% SC @ 25.2 g a.i. ha^{-1} (PoE at 15 DAS), T_5-Tembotrione 42% SC@ 105 g a.i. ha^{-1} (PoE 15 DAS), T_6- Topramezone 33.6 % SC @ 25.2 g a.i. ha^{-1} +Atrazine 50%WP @ 250 g a.i. ha^{-1} (PoE at 15DAS), T_7-Tembotrione 42 % SC @ 105 g a.i. ha^{-1} +Atrazine 50% WP @ 250 g a.i. ha^{-1} (PoE 15DAS), T_8 –One hand weeding at 30 DAS, T_9 : Weedy check, T_{10}- weed free

REFERENCES

Anonymous, 2020. Directorate of Economics & Statistics, Department of Agriculture & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India pp.-265-266.

Chopra P. and N. N. Angiras, 2007. Influence of tillage and weed control methods on growth, productivity and quality of maize (*Zea mays* L.) J. Crop and Weed **3**(2) : 10-14.

Madhavi, M, T. Ramprakash, A. Srinivas andM. Yakodri, 2014. Topromezone (33.6% SC) + Altrazine (50%) WP tank mix efficiency on maize. Biennial conference on "Emerging challenge in weed management" organised by Indian Soc. weed Sci. 15-17 February, 2014.

Malviya, A., N. Malviya, , B. Singh and A.K. Singh, 2012. Integrated weed management in maize (*Zea mays* L.) under rainfed conditions. Indian J. Dryland Agric. Res. & Dev. **27**(1): 70-73.

Rajeshkumar,A., N.S. Venkataraman, S. Ramadass, N. Ashok kumar and S.Thirumeninathan, 2017. Effect of weed control and cropping system on weed population and productivity of maize grown sole or intercropped with pulses. J. Crop and Weed **13**(3): 150-155.

Rana S.S., D. Badiyala, N. Sharma, Rajendra Kumar and P.Pathaniya, 2017. Impact of tembotrione on weed growth, yield and economics of maize (*Zea mays* L.) under mid hill of Himachal Pradesh. Pesticide Res. J. **29** (1):27-34.

Raut V.G., V.S. Khawale, R. Moharkar, R.Bhadoriya and D.Meshram, 2017. Effect of different herbicides on weeds and grain yield of maize. J. Soils and Crops, **27** (1): 248-252.

Sanodiya, P., A. K. Jha, and A.Shrivastava, 2013. Effect of integrated weed management on seed yield of fodder maize. Indian J. Weed Sci. **45**(3): 214–216.

Sharma, P., B.Duary, and R.Singh, 2014. Tank mix application of tembotrione and atrazine to reduce weed growth and increase productivity of maize. Indian J. Weed Sci. **50**(3): 305–308.

Swetha, K., M. Madhavi, G .Pratibha and T. Ramprakash, 2015. Weed management with new generation herbicides in maize. Indian J. Weed Sci. **47**(4):432–433.

Swetha, K. 2015. Weed management with new generation herbicides in *kharif* maize. Unpublished M.Sc.(Agri.) thesis submitted to Professor Jayashankar, Telangana State Agricultural University, Hyderabad, India.

Yenpredditwar M.D., P.G. Ingole, A.N. Paslawar, V.M. Bhale and J. P. Deshmukh, 2017. Effect of integrated weed management practices on seed cotton yield and economics of high density planting system of cotton J. Soils and Crops, **27**(1): 55-59.

Rec. on 21.07.2022 & Acc. on 20.08.2022