J. Soils and Crops 27 (2) 77-81, Dec. 2017

ISSN 0971-2836
NAAS Rating - 4.46
Scientific Journal Impact Factor - 4.338

INFLUENCE OF DIFFERENT HERBICIDES ON GROWTH, YIELD AND ECONOMICS OF MAIZE

Vijay G. Raut[1], V. S. Khawale[2], Aparna. M. Yadav [3], Damyanti Meshram[4] and Akshay Izalkar[5]

ABSTRACT

An investigation was conducted to study the influence of different herbicides on growth, yield and economics of maize at the farm of Agronomy Section, College of Agriculture, Nagpur during *kharif* season of 2015-16 in randomized block design with three replications. The treatments included pre emergence application of Oxydiargyl (@ 60, 75, 90 g ha^{-1}), Metsulfuron- methyl (@ 4, 5, 6 g ha^{-1}) and Halosulfuron methyl (@ 100, 125, 150 g ha^{-1}) compared with Weed free and Weedy check. The results of the study indicated that post emergence application of Metsulfuron- methyl @ 4 g ha^{-1} recorded higher growth, yield attributing characters and economics viz., Plant height, leaf area plant^{-1}, dry matter plant^{-1} , grain weight cob^{-1}, test weight, seed and straw yield (kg ha^{-1}). GMR, NMR and B:C ratio were significantly more by the application of Metsulfuron-methyl @ 4 g ha^{-1}.

(Key words: Maize, Oxydiargyl, Metsulfuron-methyl, Halosulfuron-methyl)

INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal crop of the world, known as "Queen of cereals" due to its great importance in human and animal diet, very efficient utilizer of solar energy and has immense potential for higher yield.

Maize is known for its wider adaptability and multipurpose uses as food, feed, fodder and industrial products. More than 35 products of daily use are derived from maize viz., starch, lactic acid, glucose, acetic acid, dextrose, sorbitol, dextrine, high fructose syrup, maltodextrine, germ oil, germ application in industries such as alcohol, textile, paper, pharmaceuticals, organic chemicals, cosmetics and edible oils. Green maize plants are used as succulent fodder, rosted green cobs are liked by people. It is also good feed for piggery, poultry and other animals. It content about 12 per cent protein, 8 per cent oil, 70 per cent CHO, 2.3 per cent crude fibre, 10.4 per cent albumins and 1.4 per cent ash (Omprakash *et al.,* 2006). Considering the above facts present investigation was undertaken to study the influence of different herbicides on growth, yield and economics of maize.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy farm, College of Agriculture, Nagpur during *kharif* season of 2015-16. The experiment was laid out in randomized block design with three replications. The treatments consisted of (T_1) weedy check, (T_2) weed free, (T_3) PE-Oxydiargyl 80% WP 60 g a.i ha^{-1} (T_4) PE-Oxydiargyl 80% WP 75 ga.i. ha^{-1}, (T_5) PE-Oxydiargyl 80% WP 90 g a.i. ha^{-1}, (T_6) POE-Metsulfuron methyl 20% WP 4 g a.i. ha^{-1} 15 DAS,(T_7) POE-Metsulfuron methyl 20% WP 5 g a.i. ha^{-1} 15 DAS, (T_8) POE-Metsulfuron methyl 20% WP 6 g a.i. ha^{-1} 15 DAS, (T_9) POE-Halosulfuron methyl 75% WG @ 100 g. a.i. ha^{-1} 15 DAS, (T_{10}) POE- Halosulfuron methyl 75% WG @ 125 g.a.i ha^{-1} 15 DAS, (T_{11}) POE- Halosulfuron methyl 75% WG @ 150 g a.i. ha^{-1} 15 DAS. The soil of experimental plot was clayey in texture, low in available nitrogen (187.60 kg ha^{-1}), medium in phosphorus (20.32 kg ha^{-1}) and organic carbon (0.52 %) and very high in available potash (333.67 kg ha^{-1}) and slightly alkaline in reaction (pH 7.87).

The crop variety PKVM- Shatak was used with gross plot size of 4.8 m × 5.4 m and net plot size of 3.6 m × 4.6 m. Full dose of phosphorus, potassium and half dose of nitrogen were applied at sowing and remaining half dose of N was applied at 30 DAS. In order to represent the plot, five plants of maize from each net plot were selected randomly, labeled properly. The growth attributing characters *viz.,* plant height, leaf area plant^{-1} and dry matter accumulation plant^{-1} were recorded at 30,60,90 DAS and at harvest and yield attributing characters and yield *viz.,* number of grains cob^{-1}, grain weight cob^{-1}, test weight, seed and straw yield (kg ha^{-1}) were also recorded at harvest. The gross monetary and net monetary returns along with B:C ratio were calculated.

RESULTS AND DISCUSSION

Effect of herbicides on crop growth

The data pertaining to various crop growth studied viz., plant height, leaf area and dry matter accumulation plant^{-1} as influenced by different herbicidal treatments are presented in table 1. Plant height, leaf area and dry matter accumulation plant^{-1} were significantly more in post-

1, 3, 4 and 5. P.G. Students, Agronomy section, College of Agriculture, Nagpur (M.S.)
2. Assoc. Professor, College of Agriculture, Nagpur (M.S.)

emergence application of Metsulfuron methyl 20% WG @ 4 g a.i. ha^{-1} 15 DAS (T_6) followed by post-emergence application of Metsulfuron- methyl 20% WG @ 5 g a.i. ha^{-1} 15 DAS (T_7) and Metsulfuron-methyl 20% WG @ 6 g a.i. ha^{-1} 15 DAS (T_8). Treatment T_1 (Weedy check) recorded least plant height, while treatment T_2 (Weed free) recorded maximum plant height. Same trend was found at 60, 90, DAS and at harvest stage .

Shekhawt *et al.* (2002) reported that weed free treatment resulted in maximum plant height (203 cm) yield attributes and grain and straw yields (56.40, 117 q ha^{-1}) of maize crop.Hussain *et al.* (2003) evaluated the comparative efficacy of different herbicides in controlling weeds and improving growth and yield of wheat crop. Alkanak 75.3 wp (Metsulfuron methyl + Issoproturon @ 1.5 a.i.; kg ha^{-1}), were used in wheat. Results showed that all the herbicide treatments decreased the weeds population,weed index and increased the plant height, spike length, dry matter, wheat grain yield by increasing number of tillers unit^{-1} area, number of grains spike^{-1}, thousand grains weight and harvest index. Alkanak gave maximum grain yield of 4067 kg ha^{-1}. Kathiresan *et al.* (2004) found that oxydiargyl @ 90 g a.i. ha^{-1} applied three days after planting recorded the least weed count, weed dry weight, lower weed index, higher plant height, bulb yield and no phytotoxic effect in respect of wilting, vein clearing, necrosis, epinesty and hyponasty. Yadav *et al.* (2004) observed that oxydiargyl @ 50 g a.i. ha^{-1} provided most effective in minimizing the monocot weed growth and dry weight of weeds, plant height and enhancing the seed yield of cumin. Davi and Nawamaki (2006) tried post emergence application of halosulfuron- methyl with rates between 22.5 and 37.5 g ha^{-1} a. i. and found most effective treatment againsts weeds viz., *Cyperus* spp, *Abutilontheophrasti*, *Xanthium* spp, *Bidens* spp, *Polygonum* spp, and *Amaraanthus* spp. They also reported increase in the plant height, leaf area, dry matter of plant and yield of maize and also showed excellent selectivity in maize.

Effect on yield attributes

Data pertaining to various yield attributes viz., number of cob plant^{-1}, number of grains cob^{-1}, grain weight cob^{-1} and test weight as influenced by different treatments are presented in table 2, indicated that cob bearing plant^{-1} were not influenced significantly by different treatments. Among herbicidal treatments application of metsulfuron-methyl 20% WG @ 4 g a.i. ha^{-1} 15 DAS recorded maximum number of grains cob^{-1}, grain weight cob^{-1} and test weight over rest of the herbicidal treatments followed by application of metsulfuron- methyl 20% WG @ 5 g a.i. ha^{-1} 15 DAS and application of Metsulfuron- methyl 20% WG @ 6 g a.i. ha^{-1} 15 DAS. Weed free was found significantly superior over all other treatments.

All the weed management practices significantly improved the yield attributes over weedy check.This was because of improvement in growth characteristics as a consequence of weed control. Yield attributes viz., number of cobs plant^{-1}, number of grains cob^{-1} and grain weight cob^{-1}, test weight were more or less similar and significantly higher in treatment T_2 (weed free) and T_6 (Metsulfuron-methyl 20% WG @ 4 g a.i. ha^{-1} 15 DAS.) This could be because of elimination of crop weed competition during early growth as well as later part of the crop growth and development in this treatments and consequently greater dry matter accumulation by plants causing improvement in yield attributes.

Patel *et al.* (2006) observed that maximum girth and length of cob with weed free condition. Mathukia *et al.* (2014) noted significantly highest cob length, cob girth, number of cobs plant^{-1}, number of kernels cob^{-1}, fresh weight of cob, highest dry weight of cob, cob yield and fodder yield under weed free in sweet corn.

Effect on yield

Data in table 2 indicated that grain yield, and straw yield, significantly affected by different herbicidal treatments. All the weed management practices significantly improved grain yield and straw yield over weedy check. Treatment T_2 (weed free) registered significantly higher grain yield (5917.82 kg ha^{-1}) and straw yield (8995.10 ha^{-1}), which proved significantly superior to other treatments. Among herbicidal treatments application of Metsulfuron- methyl 20% WG @ 4 g a.i. ha^{-1} 15 DAS(T_6) recorded higher grain yield (5676.28 kg ha^{-1}) and straw yield (8514.42 kg ha^{-1}) as compared to all other herbicidal treatments followed by application of Metsulfuron- methyl 20% WG @ 5 g a.i ha^{-1} 15 DAS(T_7) and application of Metsulfuron- methyl 20% WG @ 6 g a.i ha^{-1} 15 DAS(T_8). Treatment Weedy check (T_1) recorded the lowest maize grain yield (3562.77 kg ha^{-1}). The increase in grain and straw yield was due to better leaf area, dry matter accumulation by plant, which is mainly because of availability of plant growth resources to the plant on account of reduced weed compitation.

Sondhia (2008) conducted research in wheat crop and reported that Metsulfuron-methyl a post-emergence herbicide was highly active to control broad-leaf weeds population in cereals, pasture and plantation crops. She stated that Metsulfuron-methyl application @ 3-4 g a.i. ha^{-1} to the wheat crop as post-emergence herbicide reduced weed dry weight by reducing monocot, dicot weed population, and weed index, while increased weed control efficiency, plant height and yield kg ha^{-1}. Singh *et al.* (2015) reported that post emergence application of metsulfuron-methyl 20% WG@ 4 g ha^{-1} + 0.2% surfactant significantly reduced broad leaf weed population and total weed dry weight with highest weed control efficiency, wheat yield, straw yield, biological yield and harvest index over other herbicidal treatments.

Economic studies

Data on gross monetary return, net monetary return and B:C ratio as affected by various herbicidal treatments are presented in table 2.

Perusal of the data indicated that GMR (Rs. 95277

Table 1. Effect of different herbicides on growth, yield, and economics of maize

Treatments	Doses g ha^{-1}	Plant height (cm)				Leaf area plant^{-1} (dm^2)				Dry matter accumulation plant^{-1} (g)			
		30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1- Weedy check		33.29	107.27	140.60	150.56	1.47	49.25	60.15	56.25	21.47	52.27	120.65	132.44
T_2- Weed free		44.19	135.30	167.33	179.33	25.91	66.23	79.66	75.14	33.66	70.04	156.57	165.34
T_3- Oxydiargyl	60	37.19	122.86	152.64	165.85	18.96	55.07	67.44	62.96	27.32	60.68	139.93	148.89
T_4- Oxydiargyl	75	39.33	120.72	158.44	169.67	2.04	59.00	68.46	67.79	29.38	64.09	142.16	152.12
T_5- Oxydiargyl	90	37.84	117.68	155.57	164.70	19.69	57.58	67.44	64.10	28.55	62.87	140.45	149.83
T_6- Metsulfuron methyl	04	42.19	131.64	165.60	176.72	24.14	64.19	75.60	73.27	33.67	66.11	153.33	162.86
T_7- Metsulfuron methyl	05	40.48	128.97	163.21	174.69	23.01	61.47	74.25	72.58	31.93	65.81	156.16	159.48
T_8- Metsulfuron methyl	06	40.69	124.92	162.62	170.53	22.98	60.11	72.96	70.96	29.72	65.61	149.74	158.26
T_9- Halosulfuron methyl	100	35.31	115.30	150.86	160.27	18.99	52.54	64.22	60.89	25.23	59.60	135.39	144.31
T_{10}- Halosulfuron methyl	125	34.77	112.36	147.62	154.35	17.87	51.48	63.25	58.95	22.69	58.42	131.34	141.49
T_{11}- Halosulfuron methyl	150	34.90	111.72	144.97	155.65	17.45	50.66	61.52	57.90	21.85	57.81	130.26	141.38
SE (m) ±		1.38	3.84	2.71	3.25	1.05	2.73	3.68	2.08	1.37	1.75	2.96	3.42
CD at 5%		4.06	11.27	7.96	9.55	3.08	7.02	10.81	6.10	4.10	5.22	8.71	10.36
GM		38.31	120.79	155.40	165.66	20.60	57.06	68.93	65.52	27.86	61.81	140.91	10.36

Table 2. Effect of different herbicides on growth, yield, and economics of maize

Treatments	Doses (g ha^{-1})	Cob bearing plant^{1}	No. of grains cob^{-1}	Grain weight cob^{-1} (g)	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	GMR	NMR	B:C ratio
T_1-Weedy check		1.05	331.78	55.79	21.81	3562.77	8995.10	57361	38421	3.02
T_2- Weed free		1.16	477.36	80.89	27.39	5917.82	7704.30	95277	74177	4.51
T_3- Oxydiargyl	60	1.08	410.25	72.76	22.66	5350.20	7843.40	86138	66738	4.44
T_4- Oxydiargyl	75	1.13	421.00	74.00	24.06	5446.81	7808.63	87694	68242	4.50
T_5- Oxydiargyl	90	1.12	416.28	73.14	23.79	5422.66	8514.42	87305	67800	4.47
T_6-Metsulfuron- methyl	04	1.14	472.50	75.99	26.28	5676.28	8228.73	91388	72123	4.74
T_7- Metsulfuron- methyl	0 5	1.12	450.80	75.25	25.13	5597.78	8119.15	90124	70841	4.67
T_8- Metsulfuron- methyl	0 6	1.11	442.44	74.77	24.55	5507.58	7069.50	89638	70336	4.64
T_9-Halosulfuron- methyl	100	1.11	375.00	72.05	22.51	4909.38	6852.11	79041	53740	3.12
T_{10}- Halosulfuron- methyl	125	1.09	368.57	71.47	21.81	4758.41	6599.93	76610	49782	2.85
T_{11}- Halosulfuron- methyl	150	1.03	364.36	69.48	20.27	4583.29	8995.10	73791	45435	2.60
SE(m)±		0.07	17.95	1.78	1.02	147.10	317.15	1985	1985	-
CD at 5%		0.20	52.65	5.23	3.01	431.46	930.23	5821	5821	-
GM		1.09	411.85	72.48	23.66	5163.05	7533.24	83124	61603	-

ha^{-1}), and NMR (Rs.74177 ha^{-1}) were significantly higher under weed free (T_2). Among different herbicidal treatments highest GMR (Rs. 91388 ha^{-1}), and NMR (Rs. 72123 ha^{-1}) were recorded by the application of Metsulfuron- methyl 20% WG 4 g a.i. ha^{-1} 15 DAS (T_6) followed by the application of metsulfuron- methyl 20% WG 5 g a.i. ha^{1} 15 DAS (T_7) and application of Metsulfuron- methyl 20% WG @ 6 g a.i. ha^{1} 15 DAS (T_8). Amongst herbicidal treatments highest benefit cost ratio (B:C) was obtained by the application of Metsulfuron- methyl 20% WG @ 4 g a.i ha^{1} 15 DAS (4.74), followed by the application of Metsulfuron- methyl 20% WG @ 5 g a.i ha^{1} 15 DAS (4.67) and application of Metsulfuron- methyl 20% WG @ 6 g a.i. ha^{1} 15 DAS (4.64) over rest of treatments. Treatment weedy check (T_1) recorded the lowest B:C ratio (3.02). Effective weed control with better grain yield resulted in higher gross monetary returns, net monetary returns and benefit : cost ratio, in treatments T_2 (weed free) and T_6 (Metsulfuron- methyl 20% WG @ 5 g a.i. ha^{1} 15 DAS) .

Jat *et al*. (2003) found that tank mix application of metsulfuron methyl + Isoproturon (4 g + 750 g a.i. ha^{-1}) recorded maximum net return of (Rs 31,713 ha^{-1}) and benefit:cost ratio (2:79) followed by 2-4-D + isoproturon (400 g + 750 g a.i. ha^{-1}) (Rs 30,941) and (2.72) respectively in wheat. Kamble *et al.* (2005) reported that treatment weed free check recorded higher net returns (Rs.73470 ha^{-1}) and B:C ratio (4.53) over other treatments and it was on par with the chemical treatment Atrazine (50%) 1.25 kg or lit + Pendimethalin (50%) 2.5 lit ha^{-1} in maize. Adpawar *et al.* (2011) reported that highest net monetary return (Rs 12,777 ha^{-1}), gross monetary return (Rs 20,782 ha^{-1}) and B: C ratio (2.60) were observed in treatment with weed free plot in soybean. Yadav *et al*. (2012) reported that highest net return (Rs.41081 ha^{-1}) and BCR (2.17) was recorded with the application of Oxadiargyl 50 g ha^{-1} at 20 DAS which were higher over rest of the treatments in cumim.

REFERENCES

Davi, R. and T. Nawamaki, 2006. Halosulfuron- methyl, new post-emergency herbicide for rice and maize. Giornate Fitopatologiche : 291-296.

Hussain, N., M. B. Khan, M. Tariq and S. Hanif, 2003. Spectrum of activity of different herbicides on growth and yield of wheat (*Triticum aestivum*). International J. Agric. And Bio. **5**(2) :166–168.

Jat, R. S., V. Nepadia and R.L. Jat, 2003. Effect of weed control and sowing method on production potential of wheat. (*Triticum aestivum*) Indian J. Agron. **48**(3): 192-195.

Kamble, T.C., S.U.Kakade, S.U.Nemade, R.V. Pawar and V. A. Apotikar, 2005. Integrated weed management in hybrid maize. Crop Res. **29**(3): 396-400.

Kathiresan, R. M., L. Gnanavel and U. V. Jayakanth, 2004. Bioefficiency and phytotoxicity of oxydiargyl in onion (*Allium cepa* Var. Aggregateum). Indian J. Weed Sci. **36**(3-4) : 236-238.

Mathukia, R. K., V. K. Dobariya, B.S. Goshi and S.K. Chhodavadia, 2014. Integrated weed management in *rabi* Sweet corn (*Zea mays* L. *var. Saccharata*). Adv. Crop Sci. Tech. **2**:4.

OmPrakash, P. Shanti, E.Satyanarayana and R.Saikumar, 2006. Exploitation of genetic variability for quality traits and Agronomic characters in quality protein maize (QPM) germplasm. Ann. Agric. Res. New Series. **27**(3) : 240-244.

Patel, V. N., P. N. Upadhyay, S. U. Zala and B. D. Patel, 2006. Residual effect of herbicide applied as alone and mixture to kharif maize on succeeding rabi oat and mustard. Indian J. Weed Sci**. 38**(3&4) : 258-262.

Shekhawt, S. M., L .S. Bhushan, K. D. Koranne and G. Friesen, 2002. Weed management in maize and blackgram intercropping in mid- hills sub- humid zone of Himachal Pradesh. Indian J. Weed Sci. **25** (1-2) : 43-46.

Singh, R. K., S. K. Verma, S. K. Prasad and S. B. Singh, 2015. Effect of Metsulfuron- methyl against broad leaf weeds in wheat (*Triticum aestivum* L.). J. Crop and Weed. **11**(Special Issue): 161-166.

Sondhia, S. 2008. Persistence of metsulfuron-methyl in wheat crop and soil. Environ Monit Assess .**147**:463-469.

Yadav, R. S., S. K. Sharma and B. L. Poonia, 2004. Selectivity and phytotoxicity of oxydiargyl on cumin and weeds and its residual effect on succeedings mothbean and pearl millet. Indian J. Weed Sci**. 36**(1-2) : 83-85.

Yadav, A., J. C. Patel, R.S. Mehta and T. Meena, 2012. Growth, yields and economics of cumin (*Cuminum cyminum L.*) production as affected by weed management practices. Inter. J. Seed Spices **2**(2): 27-29.

Rec. on 03.06.2016 & Acc. on 29.09.2016