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EFFECT OF DIFFERENT HERBICIDES ON WEEDS AND GRAIN YIELD OF MAIZE

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ABSTRACT

The present experiment entitled "Weed management in maize (*Zea mays* L.) using different pre and post-emergence herbicides" was conducted during *kharif* season of 2015-16 in Agronomy Section, College of Agriculture, Nagpur, with an aim to study the effect of different herbicides on weeds and grain yield of maize in randomized block design with three replications. The experimental field was infested with monocot weeds viz., *Commelina benghalensis, Cyanotis oxillaris, Cyperus rotundus, Denebra arabica, Cynodon dactylon,* and dicot weeds viz., *Digera arvensis, Celosia argentea, Tridex procumbense, Acalypha indica, Euphorbia geniculata, Euphorbia hirta, Phyllanthus niruri,* and *Physalis minima.* These weeds were found dominant in the experimental plot. 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}) with Weed free and Weedy check. The results of the study indicated that post emergence application of Metsulfuron- methyl @ 4 g ha^{-1} significantly reduced monocot, dicot and total weed population and total weed dry weight with higher weed control efficiency and lower weed index. Higher grain yield and straw yield were significantly more by the application of Metsulfuron-methyl @ 4 g ha^{-1} over other herbicidal treatments.

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

INTRODUCTION

Weeds are associated with crops since time and create acute problem in rainy season crop. The yield of maize under Indian condition may be attributed by number of factors among them weeds causes harmful effect on the growing plants and interference with land use, weed rank as prime enemies in crop production. Weed characterized by a fast growing rate in their seeding stage become a potential source of competition specially for soil nutrients. They interfere with efficiency of fertilizer utilization by crop plants because a sizeable portion of the fertilizer added to the soil is used by weed.Weeds in maize are very competitive for water, light and nutrients.It is important to reduce their occurrence already in early stage of development i.e. from emergence to 8–10 leaves stage especially in maize, which is characterized by a slower growth rate in this period (G¹siorowska and Makarewicz, 2008). Potential yield losses, resulting from competitive weeds, can be significant and therefore, effective chemical treatments are still the most reasonable and cost-effective tillage in corn (Weber and Go³êbiowska, 2009). The aim of this study was to evaluate the efficacy of selected herbicides applied pre-and post-emergence for weed control in maize grown for grain.

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 consists 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 g.a.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, and (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 each experimental plot, an area of a quadrate 0.50 m x 0.50 m was fixed and observations on monocot, dicot, and total weed population were recorded at 30,60,90 DAS and at harvest stage.Total dry matter of weeds was also recorded at the same stages. Weed control efficiency and weed index were calculated by the following formuls

1) Weed control efficiency (%) :

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$$\text{WCE (\%)} = \frac{\text{DMC} - \text{DMT}}{\text{DMC}} \times 100$$

Where, WCE= Weed control efficiency,
DMC= Dry matter of weeds in control plot,
DMT= Dry matter of weeds in treated plot.

2) Weed index (%) :

$$\text{WI} = \frac{X - Y}{X} \times 100$$

Where,

WI = Weed index in per cent,
X =Yield from maximum yielding plot
Y = Yield under the treatment for which weed index is to be calculated.

For grain and straw yield five plants of maize from each net plot were selected randomly, labeled properly and seed and straw yield (kg ha^{-1}) were calulated.

RESULTS AND DISCUSSION

Effect of herbicides on weed population

The data pertaining to number of monocot, dicot and total weeds population m^{-2} as influenced by various treatments are presented in table 1. Weed count was progressively increased from 30 DAS with a decline observed at harvest stage of the crop. At 30 days among different herbicidal treatments post-emergence application of Metsulfuron methyl 20% WG @ 4 g a.i ha^{1} 15 DAS,(T_6) significantly reduced number of monocot, dicot and total weed population followed by post-emergence application of Metsulfuron methyl 20% WG @ 5 g a.i ha^{1} 15 DAS,(T_7) and post-emergence application of metsulfuron methyl 20% WG @ 6 g a.i. ha^{1} 15 DAS,(T_8). Significantly lowest number of monocot, dicot and total weeds were recorded by treatment T_2 (weed free) and higher number of monocot, dicot and total weeds were recorded by treatment T_1 (weedy check) at all stages of observations. Similar trend was observed at 60, 90 DAS, and at harvest stage.

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 + Isoproturon @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 dry matter, and wheat grain yield. Alkanak gave maximum grain yield of 4067 kg ha^{-1}. Wang *et al.* (2007) observed Metsulfuron-methyl is widely used for pre and post-emergence control of many annual grasses and broadleaf weeds in cereal, pasture, and plantation crops because Metsulfuron-methyl is effective even at low application doses. 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} can be safely applied to the wheat crop as post-emergence herbicide, it 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}. Ahmed and Chauhan (2015) observed that application of oxydiargyl @ 80, 120, 160. g a.i. ha^{-1} effictively controled the total weed population (*Digitaria ciliaris, Echinochloa colona and Phyllanthus niruri*), reduced the weed biomass significantly and among the herbicide treatment highest yield was recorded in plots treated with oxadiargyl @ 160 g a. i. ha^{-1}.

Effect of herbicides on weed dry weight

Relevant data regarding dry matter production by weeds (gm^{-2}) as influenced periodically by different treatments are presented in table 2. At 30 DAS, application of Metsulfuron methyl 20% WG @ 4 g a.i ha^{-1} 15 DAS (T_6) alone recorded significantly lower weed dry weight than other herbicidal weed control treatments and at par with treatment T_7 (Metsulfuron methyl 20% WG @ 5 g a.i ha^{-1} 15 DAS) and T_8 (Metsulfuron methyl 20% WG @ 6 g a.i ha^{-1} 15 DAS) . Treatment T_1 (weedy check) showed significantly more weed dry weight while treatment T_2 (Weed free) recorded lowest weed dry weight over rest of the treatments. Same trend was found at 60, 90 DAS , and at harvest stage of observations.

Wang *et al.* (2007) observed that Metsulfuron-methyl application reduced the weeds and weed dry weight. It is widely used for pre and post-emergence control of many annual grasses and broadleaf weeds in cereal, pasture, and plantation crops because metsulfuron-methyl is effective even at low application doses. 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 + 0.2% surfactant significantly reduced broad leaf weed population and total weed dry weight with highest weed control efficiency, seed yield, straw yield, biological yield and harvest index over other herbicidal treatments in wheat.

Effect of herbicides on weed control efficiency and weed index

Data pertaining to weed control efficiency (%) and weed index (%) as influenced by different weed control treatments are presented in table 2.

At 30 DAS, among the chemical weed control treatment post- emergence application of Metsulfuron methyl 20% WG @ 4 g a.i. ha^{-1} 15 DAS (T_6) recorded higher weed control efficiency, it was followed by Metsulfuron

Table 1. Effect of different herbicides on weeds and grain yield of maize

	Treatments	Doses g ha^{-1}	Monocot weed population				Dicot weed population				Total weed population			
			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		6.76 (45.30)	8.17 (66.30)	9.10 (82.33)	8.80 (77.00)	5.72 (32.33)	7.49 (55.66)	8.17 (66.33)	7.82 (60.66)	8.83 (77.63)	11.06 (121.99)	12.21 (148.66)	11.75 (137.66)
T_2	Weed free		00	00	00	00	00	00	00	00	00	00	00	00
T_3	Oxydiargyl	60	5.08 (25.33)	5.36 (28.33)	5.70 (32.00)	5.58 (30.36)	4.56 (20.33)	5.08 (25.33)	5.27 (27.33)	5.14 (26.00)	6.79 (45.66)	7.35 (53.66)	7.73 (59.33)	7.54 (56.36)
T_4	Oxydiargyl	75	4.91 (23.66)	5.08 (25.33)	5.49 (29.66)	5.30 (27.66)	4.22 (17.33)	4.67 (21.33)	5.11 (25.66)	4.88 (23.33)	6.44 (40.99)	6.86 (46.66)	7.47 (55.32)	7.17 (50.99)
T_5	Oxydiargyl	90	5.01 (24.66)	5.40 (28.66)	5.64 (31.33)	5.49 (39.66)	4.48 (19.66)	4.91 (23.66)	5.21 (26.66)	5.11 (25.66)	6.69 (44.32)	7.26 (52.32)	7.64 (57.99)	8.11 (50.32)
T_6	Metsulfuron - methyl	04	4.10 (16.33)	4.48 (19.66)	4.88 (23.33)	4.56 (20.33)	3.48 (11.66)	3.97 (15.33)	4.33 (18.33)	4.14 (16.66)	5.33 (27.99)	5.95 (34.99)	6.49 (41.66)	6.12 (36.99)
T_7	Metsulfuron- methyl	05	4.33 (18.33)	4.81 (22.66)	5.08 (25.33)	4.91 (33.66)	3.85 (14.33)	4.14 (16.66)	4.70 (21.66)	4.33 (18.33)	5.75 (32.66)	6.31 (39.32)	6.89 (46.99)	6.46 (41.24)
T_8	Metsulfuron- methyl	06	4.41 (19.00)	4.88 (23.33)	5.11 (25.66)	4.98 (24.33)	3.90 (14.71)	4.33 (18.33)	4.77 (22.33)	4.60 (20.66)	5.84 (33.66)	6.49 (41.66)	6.96 (47.99)	6.60 (42.99)
T_9	Halosulfuron-methyl	100	5.11 (25.66)	5.46 (29.33)	5.75 (32.66)	5.40 (28.66)	4.81 (22.66)	5.17 (26.33)	5.40 (28.66)	5.27 (27.33)	6.98 (48.32)	7.49 (55.66)	7.86 (61.32)	7.51 (55.99)
T_{10}	Halosulfuron-methyl	125	5.27 (27.33)	5.67 (31.66)	6.04 (36.00)	5.72 (32.33)	4.88 (23.33)	5.30 (27.66)	5.55 (30.33)	5.33 (28.00)	7.15 (50.66)	7.73 (59.32)	8.17 (66.33)	7.79 (60.33)
T_{11}	Halosulfuron-methyl	150	5.30 (27.66)	5.72 (32.30)	6.09 (36.66)	5.87 (34.00)	5.04 (25.00)	5.49 (29.66)	5.67 (31.66)	5.58 (30.66)	7.29 (52.66)	7.90 (61.96)	8.29 (68.32)	8.00 (64.66)
	SE (m) ±		0.162	0.167	0.196	0.187	0.175	0.137	0.169	0.176	0.185	0.198	0.220	0.211
	CD at 5%		0.47	0.49	0.57	0.54	0.50	0.40	0.49	0.49	0.54	0.58	0.64	0.61
	GM		4.57	5.00	5.35	5.17	4.09	4.59	4.92	4.74	6.10	6.76	7.24	7.09

Table 2. Effect of different herbicides on weeds and grain yield of maize

	Treatments	Doses g ha^{-1}	Total weed dry weight				Weed control efficiency %				Weed index %	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
			30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest			
T_1	Weedy check		10.00 (99.53)	12.04 (144.61)	12.93 (166.75)	10.54 (110.75)	-	-	-	-	39.80	3562.77	5130.40
T_2	Weed free		00	00	00	00	100	100	100	100	-	5917.82	8995.10
T_3	Oxydiargyl	60	7.30 (52.87)	7.87 (61.51)	8.25 (67.6)	8.08 (64.82)	46.88	57.46	59.46	41.47	9.59	5350.20	7704.30
T_4	Oxydiargyl	75	6.97 (48.22)	7.29 (52.72)	8.04 (64.3)	7.73 (59.39)	51.55	63.54	61.43	46.37	7.96	5446.81	7843.40
T_5	Oxydiargyl	90	7.19 (51.33)	7.79 (60.33)	8.32 (68.75)	7.91 (62.12)	48.42	58.28	58.77	43.9	8.37	5422.66	7808.63
T_6	Metsulfuron- methyl	04	5.92 (34.59)	6.48 (41.5)	7.07 (49.59)	6.85 (46.51)	65.24	71.3	70.26	59.81	4.08	5676.28	8514.42
T_7	Metsulfuron- methyl	05	6.26 (38.72)	6.94 (47.77)	7.46 (55.30)	7.20 (51.39)	61.09	66.96	66.83	46.37	5.41	5597.78	8228.73
T_8	Metsulfuron- methyl	06	6.41 (40.62)	6.96 (47.97)	7.59 (57.12)	7.35 (53.55)	58.18	65.23	65.74	45.32	6.93	5507.58	8119.15
T_9	Halosulfuron-methyl	100	7.52 (56.13)	7.85 (61.26)	8.47 (71.38)	7.93 (62.43)	43.6	57.63	57.19	43.62	17.04	4909.38	7069.50
T_{10}	Halosulfuron-methyl	125	7.67 (58.33)	8.20 (66.76)	8.65 (74.33)	8.27 (67.92)	41.39	53.83	55.42	38.67	19.59	4758.41	6852.11
T_{11}	Halosulfuron-methyl	150	7.85 (61.17)	8.40 (70.22)	8.76 (76.4)	8.47 (71.26)	38.54	51.44	54.18	35.65	22.55	4583.29	6599.93
	SE (m) ±		0.178	0.194	0.204	0.201	-	-	-	-	-	147.10	317.15
	CD at 5%		0.52	0.57	0.60	0.59	-	-	-	-	-	431.46	930.23
	GM		6.65	7.27	7.77	7.37	-	-	-	-	-	5163.05	7533.24

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), which also provided more or less good control of early-emerged weeds and later emerged weeds. The treatment T_2 (weed free) recorded highest weed control efficiency. This could be due to continuous weed free plot that caused better weed control through crop growth with significant reduction in weed dry matter accumulation. Same trend was found at 60, 90 DAS, and at harvest stage. Weed index (%) was computed as the yield reduction comparative to the highest yielding treatment T_2 (Weed free). Among the herbicidal treatment, application of Metsulfuron methyl 20% WG @ 4 g a.i. ha^{-1} 15 DAS (T_6) recorded minimum weed index. Better weed control in this treatment provided favourable condition for crop growth and less yield reduction than other treatments.

Singh *et al.* (2005) found that weed free check recorded minimum weed population per m^{-2} and maximum weed control efficiency (92.91%) and maximum grain yield (28.40 q ha^{-1}) in wheat. 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. It can be concluded 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}.

Effect of herbicides 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 treatment 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). Weedy check (T_1) recorded the lowest maize grain yield (3562.77 kg ha^{-1}).

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 + Isoproturon @1.5 a.i.; kg ha^{-1}), was 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} and thousand grains weight and harvest index. Alkanak gave maximum grain yield of 4067 kg ha^{-1}. Singh *et al.* (2005) found that weed free check recorded minimum weed population per m^{-2} and maximum weed control efficiency (92.91%) and maximum grain yield (28.40 q ha^{-1}) in wheat. Sibel *et al.* (2010) recorded that weed free plots gave the highest yield (16.2 kg/m^{-2}) of onion bulb.

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