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Efficacy of Pre Emergence Herbicides on Weed Dynamics and Yield of Maize (*Zea mays* L.)

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ABSTRACT

A field experiment was conducted during kharif 2015 at College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga. The treatments consist of herbicide saflufenacil + dimethenamid-P (Integrity 66.8 EC) @ 501, 668 and 835 g a.i. ha^{-1}, sole application of saflufenacil 70 WG @ 51, 68 and 85 g a.i. ha^{-1} , sole application of dimethenamid-P 72 EC @ 450, 600 and 750 g a.i. ha^{-1} and Atrazine 50 WP @ 1.25 kg a.i. ha^{-1}. In addition package of practices, weed free check and untreated control were also included for comparison. Pre - emergence application of saflufenacil was found more effective against broad leaved weeds while, dimethenamid-P against the grass and sedges. The combi- product of saflufenacil 68 g l^{-1} + dimethenamid-P 600 g l^{-1} EC (Integrity 66.8 EC) @ 668 g a. i. ha^{-1} acting as broad spectrum herbicide was found more efficient in controlling all types of weeds by recording highest weed control efficiency (72.63%). From the results, pre tank mixture of saflufenacil 68 g l^{-1} + dimethenamid-P 600 g l^{-1} EC (Integrity 66.8 EC) @ 668 g a. i. ha^{-1} can be used as pre - emergence safely in maize for better productivity (7420 kg ha^{-1})and effective weed management.

Key words: *Herbicide, Integrity, Broad Leaved weeds, Grass, Sedges*

INTRODUCTION

Maize is a high yielding crop, easy to process, readily digestible and cheaper than other cereals. In recent years, maize has replaced many traditional crops and its area is increasing very fast in Northern and Southern Transitional Zones of Karnataka due to its known advantages such as easy to cultivate, less pest and diseases and high yield and support price policy. As a result of these maize attained a commercial crop status. Still there is lot of scope to unlock the productivity potential of maize productivity. Among the major production constraints weed infestation is one of the major biotic constraint in maize production. It is more pertinent during incessant rains in early stages of maize growth which can't be controlled by traditional cultural practices alone due to much drudgery and labour scarcity.

Weed control during early stage of the crop is at most important. Though several pre emergence herbicides are available, they have to be applied at higher levels.

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Excessive herbicide dosage can cause serious ecological and environmental problems such as development of herbicide resistances and weed shift which posse's grater environmental health hazards. Further due to complexity of weed flora, a single herbicide cannot control diversified group of weeds in the crop ecology due to their selective nature and also narrow spectrum mode of action. Under such situations, herbicide combi- product can be of more useful for wide spectrum weed control.

The Saflufenacil is a uracil-based and Dimethenamid-p belongs to the chloroacetamide group of herbicide shows extremely high potency at very low dosage, thereby reducing the chemical requirement of the field, makes the amount of herbicide application needed much lower than that of conventional herbicides *viz.*, pendimethalin, alachlor, atrazine etc. Integrity (Saflufenacil + Dimethenamid-p) herbicides are desirable compliments to the current weed management programs in maize, because of its low dosage; broad-spectrum weed control, environmental safety and new mode of action that will help to reduce selection for herbicide on weed population. Keeping the above information in view an investigation was carried out to test the efficacy of pre emergence herbicides on weed dynamics and yield of maize in combinations with each other at varied concentration against weeds in maize ecosystem.

MATERIAL AND METHODS

Field experiment was conducted during *kharif 2015* at College of Agriculture, the University of Agricultural and Horticultural Sciences, Shivamogga. The treatments consist of herbicides saflufenacil + dimethenamid-P (Integrity 66.8 EC) @ 501, 668 and 835 g a.i. ha^{-1}, sole application of saflufenacil 70 WG @ 51, 68 and 85 g a.i. ha^{-1} , sole application of dimethenamid-P 72 EC @ 450, 600 and 750 g a.i. ha^{-1} and Atrazine 50 WP @ 1.25 kg a.i. ha^{-1}. In addition to package of practices, weed free check and untreated control were also included for comparison. The main field ploughed and leveled and seeds of hybrid CP 818 were sown. A common dose of fertilizer @ 150:75:40 kg NPK ha^{-1} was applied to maize in the form of urea, single super phosphate and murate of potash. Out of which 50 per cent nitrogen and entire phosphate and potassium were applied as basal dose at the time of sowing where the remaining 50 per cent nutrient was applied at 30DAS as top dress. The data on sedges, grass and broad leaved weed and total weed population and dry matter were recorded at 60 DAS with quadrate measuring one m^{-2} and expressed as No. m^{-2} and g m^{-2}, respectively and from that Weed control efficiency was calculated the formula given by Mani *et al*[5]. The yield observation was recorded by adopting standard procedure. Finally, the data was subjected to square root transformation using the formula X + 1 and statistical analysis was done as suggested by Gomez and Gomez[1].

Weed control efficiency:

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

Where,

WCE = Weed control efficiency (%)

DMC = Dry matter of weeds in Untreated control plot

DMT = Dry matter of weed in treated plots

RESULTS AND DISCUSSION

The untreated control recorded significantly higher weed population, weed biomass and lower weed control efficiency (Table 1-3), at all crop growth stages in contrast to weed free check which is obvious. Generally concentration of active ingredient and the weed dry weight has inverse relation. The total weeds dry weight and weed population decreases with increase in active ingredient of both integrity treatments (T_1-T_3) as well as the sole application of either saflufenacil (T_4-T_6) or dimethenamid-P (T_7-T_9). The total weed dry weight recorded by POP was statistically

lower among all the different herbicide treatments except weed free check at all the stages. The effectivity of the integrity saflufenacil +dimethenamid-P was more than their individual applications.

The weed free check recorded significantly lower weed biomass with respect sedges, grasses, broad leaved weeds and finally the total dry weight (Table 1-3) throughout the crop period as against the least with untreated control. The lower weed population and weed bio mass in weed free check as well as in POP is attributed to frequent removal of weeds and food reserve for sprouting tissue through physical methods namely hand weeding as and when weeds appear and intercultivation the results are in the line with their obtained by Shantveerayya and Agasimani[7]. Among the herbicides, lesser weed biomass and density of grasses and sedges was recorded with dimethenamid-P compared to saflufenacil and integrity of saflufenacil +dimethenamid-P. The effectivity of the chemicals on sedges and grass is also found in the order of dimethenamid-P > integrity > saflufenacil. dimethenamid-P is a seedling growth inhibiting herbicide. Growth of seedling is inhibited due to inhibiting the fatty acid and lipid biosynthesis by reduced cuticular wax deposition and also inhibited protein, isoprenoid (including gibberellin), and flavenoid (including anthocyanins) bio synthesis. However, the germination is not inhibited but seedling fails to emerge from soil. If weeds emerge they can have malformed leaves and grass may be "buggy whipped" (caused by newest leaf not emerging from the whorl). Similar findings were reported by Moran *et al*[6].

The effectivity of the chemicals on dry weight and density of both grasses and sedges is in the order of merit dimethenamid-P > integrity of saflufenacil + dimethenamid-P > saflufenacil. Similar trend was also observed at all the stages. Dimethenamid-P being a member of chloroacetamide group of herbicide, it controls majority of grass and sedges and few dicot weeds. Next to weed free check the POP treatment was found superior over other chemical methods at later stages, except with dimethenamid-P at higher doses at 60 DAS and at harvest which was next in the order to POP. Whereas, saflufenacil was found more effective on broad leaved weeds than dimethenamid-P and their integrity. The dry weight of broad leaved weeds and their density recorded with herbicide treatments is in the order of merit atrazine > saflufenacil > integrity of saflufenacil + dimethenamid-P > dimethenamid-P. The POP treatment was found superior over other chemical methods at later stages.

Higher weed biomass may be attributed to higher weed population recorded in untreated control and vice-versa in treated plots. The varied weed population across weed control treatments was due to differential effectivity of weed control treatments. However, among the chemical treatments, the total density of weeds reduces with increase in concentration of active ingredient of chemical integrity (T_1-T_3) as well as with either of the component chemical saflufenacil (T_4-T_6), or dimethenamid-P (T_7-T_9). This is true for all types of weeds. Significantly lower (10.56, 9.00 and 9.40 total weeds m^{-2}) and higher (228.85, 279.68 and 292.47 total weeds m^{-2}) weed population was recorded with weed free check and untreated control at 30, 60 DAS and at harvest, respectively. This is holds with respect to sedges, grasses and broad leaved weeds too (Table 1 to 3).

Saflufenacil controlling broad leaved weeds[4] and Dimethenamid- P limiting the growth of grasses. Trolove *et al*[10]., have also concluded that sole application of saflufenacil @ 70 g a.i. ha^{-1} recorded 58 per cent of weed cover score compared to combined application of Saflufenacil 70 g a.i. ha^{-1} + dimethenamid-p 600 g a.i. ha^{-1} (35%) in maize. Moran *et al*[6]., also concluded that saflufenacil + dimethenamid-P is an effective pre emergence

herbicide combination for the control of common lambsquarters, pigweed, common ragweed, and wild mustard in field corn.

Weed free check recorded maximum weed control efficiency at all the growth stages. The lesser weed dry weight with increased yield indicates competent weed control efficiency. This may be due to good efficiency of all weed control treatments is providing good weeds control until canopy cover. Further, POP (89.63 & 90.16%, respectively, at 60 DAS and harvest, respectively) treated plot recorded higher weed control efficiency at all the growth stages except at 30 DAS where it was on par with weed free check (94.41 and 93.58 % at 60 DAS and at harvest, respectively) (Table 1 - 3). This was closely followed by integrity @ 835 g a.i. ha^{-1} (77.63 and 74.32 %, at 60 DAS and at harvest, respectively). At 30 DAS integrity @ 835 g a.i. ha^{-1} recorded higher weed control efficiency than the sole application of their components and POP. Efficiency of saflufenacil or dimethenamid-P considerably less as compared to their combined application. Sole application Saflufenacil and dimethenamid-P recorded lower yield due to more number of grassy and broad leaved weeds in respective chemicals.

The yield reduction due to presence of weeds is expressed in terms weed index. The highest weed index was recorded with untreated control (78.2%) this was significantly higher over other weed control treatments (Table 4). The integrity treatments (T_1-T_3) have recorded significantly lower yield reduction due to less weed competition compared to their sole applications including atrazine which are on par with each other. Application of integrity @ 668 g a.i. ha^{-1} resulted in least weed index (14.7%) next to weed free check (0) and POP (11.5%). This was mainly due to improved growth as a consequence of effective control of weeds and reduction in the crop weed competition. This might have enabled the weeds to take up more nutrients, moisture, sunlight, space, etc.

Maintenance of weed free situation throughout the crop period has resulted in significantly higher growth parameters, yield components and yield of maize in contrast to untreated control which recorded the least values for the above aspects.

Among herbicidal treatments, saflufenacil + dimethenamid-P integrity @ 668 g a.i. ha^{-1} registered significantly higher grain and stover yield over others. The weed free check (8126 kg ha^{-1} and 10,229 kg ha^{-1}) > POP (7,700 and 9,989 kg ha^{-1}) > integrity @ 668 g a.i. ha^{-1} (7420 kg ha^{-1}) and stover (9906 kg ha^{-1}) are in the order of merit with regarded to grain and stover yield, respectively and are at par with each other (Table 4). The treatment where saflufenacil and dimethenamid-P applied alone yields are low. This indicates that these chemicals control only one group of weeds was masked by competitive effect of other group of weeds. Saflufenacil being an uracil based herbicide is potent inhibiter of protoporphyrinogen –IX-oxidizes (POP)[2]. It is primarily translocated through the xylem and limited mobility in phloem. This indicate that weed control spectrum of saflufenacil expand by tank mixing with dimethenamid-P. while, increase in stover yield can be attributed to better weed control which might have promoted the plant growth in terms of plant height, higher leaf area and higher total dry matter production..

The lowest grain yield (3160 kg ha^{-1}) was noticed in untreated control as a consequence of greatest removal of nutrients and moisture by weeds and severe crop weed competition resulting in poor source and sink development with poor yield components. The results are in conformity with the findings of Shinde *et al*[8]., Kolage *et al*[3]., and Sinha *et al*[9]. The weed dry weight and weed density have strong negative correlation with grain yield in maize the results are in conformity with findings of Trolove *et al*[10].

Table 1: Sedges, grass and broad leaved weed density, weed biomass and weed control effeciency as influenced by different pre – emergence herbicides in maize at 30 days after sowing

Treatment	SEDGES	GRASS	BLW	Total	SEDGES	GRASS	BLW	Total	WCE
	(No. m^{-2})				(g m^{-2})				%
T_1: Saflufenacil 51 g a.i. ha^{-1} + Dimethenamid-P 450 g a.i. ha^{-1} (Integrity 66.8 EC @ 501 g a.i.ha^{-1})	3.10* (8.64)	4.96* (23.75)	5.89* (33.68)	8.19* (66.06)	3.32* (10.12)	3.83* (13.85)	5.80* (33.02)	7.57* (56.98)	75.23
T_2: Saflufenacil 68 g a.i. ha^{-1} + Dimethenamid-P 600 g a.i. ha^{-1} (Integrity 66.8 EC @ 668 g a.i.ha^{-1})	2.93 (7.56)	4.63 (20.51)	5.42 (28.39)	7.58 (56.45)	2.98 (7.99)	3.76 (13.31)	5.37 (28.22)	7.07 (49.52)	78.47
T_3: Saflufenacil 85 g a.i. ha^{-1} + Dimethenamid-P 750 g a.i. ha^{-1} (Integrity 66.8 EC @ 835 g a.i.ha^{-1})	2.91 (7.45)	4.33 (17.81)	5.18 (25.80)	7.22 (51.06)	2.61 (5.86)	3.32 (10.12)	5.02 (24.5)	6.40 (40.47)	82.40
T_4: Saflufenacil 70 WG @ 51 g a.i. ha^{-1}	4.75 (21.59)	7.03 (48.57)	4.70 (21.05)	9.60 (91.21)	5.66 (31.42)	5.8 (33.02)	4.97 (23.96)	9.40 (88.4)	61.57
T_5: Saflufenacil 70 WG @ 68 g a.i. ha^{-1}	4.52 (19.43)	6.71 (44.26)	4.21 (16.73)	9.02 (80.42)	5.33 (27.69)	5.18 (26.09)	4.58 (20.24)	8.61 (74.02)	67.82
T_6: Saflufenacil 70 WG @ 85 g a.i. ha^{-1}	4.27 (17.27)	6.47 (41.02)	3.85 (13.82)	8.55 (72.11)	4.97 (23.96)	4.97 (23.96)	4.22 (17.04)	8.07 (64.97)	71.75
T_7: Dimethenamid-P 72 EC @ 450 g a.i. ha^{-1}	2.73 (6.48)	3.87 (14.03)	9.22 (84.05)	10.27 (104.56)	2.50 (5.33)	3.15 (9.05)	8.75 (75.59)	9.54 (89.97)	60.88
T_8: Dimethenamid-P 72 EC @ 600 g a.i. ha^{-1}	2.51 (5.29)	3.43 (10.79)	8.85 (77.38)	9.72 (93.47)	2.40 (4.79)	3.07 (8.52)	8.03 (63.53)	8.82 (76.84)	66.59
T_9: Dimethenamid-P 72 EC @ 750 g a.i. ha^{-1}	2.28 (4.21)	2.83 (7.02)	8.62 (73.38)	9.25 (84.61)	2.28 (4.26)	2.61 (5.86)	7.95 (62.25)	8.57 (72.37)	68.53
T_{10}: Weed free check	1.51 (1.30)	2.36 (4.60)	2.36 (4.60)	3.40 (10.56)	1.91 (2.66)	1.91 (2.66)	2.40 (4.79)	3.32 (10.12)	95.60
T_{11}: Untreated control	6.31 (38.86)	9.28 (85.28)	10.28 (104.71)	15.16 (228.85)	7.80 (69.97)	9.21 (83.96)	9.70 (93.24)	15.19 (230.0)	0.00
T_{12}: POP	4.01 (15.11)	6.63 (43.18)	3.70 (12.74)	8.38 (69.19)	4.64 (20.77)	4.81 (22.37)	4.03 (15.44)	7.67 (58.58)	74.53
T_{13}: Atrazine 50 WP @ 1.25 kg a.i. ha^{-1}	4.24 (17.00)	6.48 (41.23)	3.75 (13.06)	8.39 (69.41)	4.75 (21.83)	4.86 (22.9)	4.08 (15.87)	7.8 (60.6)	73.65
S.Em.±	**0.20**	**0.35**	**0.26**	**0.16**	**0.20**	**0.31**	**0.15**	**0.27**	**0.70**
CD(p=0.05%)	**0.59**	**1.02**	**0.76**	**0.48**	**0.59**	**0.92**	**0.44**	**0.78**	**2.05**

Table 2: Sedges, grass and broad leaved weed density, weed biomass and weed control effeciency as influenced by different pre – emergence herbicides in maize at 45 days after sowing

Treatment	SEDGES	GRASS	BLW	Total	SEDGES	GRASS	BLW	Total	WCE
	(No. m^{-2})				(g m^{-2})				%
T_1: Saflufenacil 51 g a.i. ha^{-1} + Dimethenamid-P 450 g a.i. ha^{-1} (Integrity 66.8 EC @ 501 g a.i.ha^{-1})	3.77 (13.19)	6.09 (36.28)	7.24 (51.45)	10.10 (100.92)	3.97 (14.87)	4.61 (20.35)	7.02 (48.54)	9.18 (83.77)	68.51
T_2: Saflufenacil 68 g a.i. ha^{-1} + Dimethenamid-P 600 g a.i. ha^{-1} (Integrity 66.8 EC @ 668 g a.i.ha^{-1})	3.54 (11.54)	5.67 (31.33)	6.66 (43.37)	9.34 (86.25)	3.56 (11.74)	4.52 (19.57)	6.50 (41.49)	8.57 (72.81)	72.63
T_3: Saflufenacil 85 g a.i. ha^{-1} + Dimethenamid-P 750 g a.i. ha^{-1} (Integrity 66.8 EC @ 835 g a.i.ha^{-1})	3.52 (11.38)	5.30 (27.21)	6.36 (39.41)	8.89 (78)	3.09 (8.61)	3.97 (14.87)	6.07 (36.01)	7.76 (59.5)	77.63
T_4: Saflufenacil 70 WG @ 51 g a.i. ha^{-1}	5.83 (32.98)	8.65 (74.21)	5.76 (32.16)	11.85 (139.35)	6.85 (46.19)	7.02 (48.54)	6.00 (35.23)	11.41 (129.96)	51.14
T_5: Saflufenacil 70 WG @ 68 g a.i. ha^{-1}	5.54 (29.68)	8.26 (67.61)	5.15 (25.56)	11.13 (122.85)	6.44 (40.71)	6.26 (38.36)	5.53 (29.75)	10.45 (108.82)	59.09
T_6: Saflufenacil 70 WG @ 85 g a.i. ha^{-1}	5.23 (26.38)	7.96 (62.66)	4.70 (21.11)	10.54 (110.16)	6.00 (35.23)	6.00 (35.23)	5.09 (25.05)	9.79 (95.51)	64.09
T_7: Dimethenamid-P 72 EC @ 450 g a.i. ha^{-1}	3.30 (9.89)	4.73 (21.44)	11.38 (128.41)	12.68 (159.74)	2.96 (7.83)	3.77 (13.31)	11.06 (121.3)	11.98 (142.44)	46.45
T_8: Dimethenamid-P 72 EC @ 600 g a.i. ha^{-1}	3.01 (8.08)	4.17 (16.49)	10.92 (118.22)	11.99 (142.79)	2.83 (7.05)	3.67 (12.53)	10.04 (99.89)	10.98 (119.46)	55.09
T_9: Dimethenamid-P 72 EC @ 750 g a.i. ha^{-1}	2.73 (6.43)	3.42 (10.72)	10.63 (112.1)	11.41 (129.25)	2.69 (6.26)	3.09 (8.61)	9.79 (94.81)	10.52 (109.68)	58.77
T_{10}: Weed free check	1.70 (1.90)	2.25 (4.10)	2.00 (3.00)	3.16 (9.00)	2.21 (3.91)	2.21 (3.99)	2.84 (7.05)	3.97 (14.87)	94.41
T_{11}: Untreated control	7.01 (48.15)	10.22 (103.64)	11.35 (127.89)	16.75 (279.68)	8.68 (80.44)	9.80 (96.48)	9.52 (127.87)	16.34 (266.1)	0.00
T_{12}: POP	2.68 (6.18)	3.20 (9.25)	3.31 (10.01)	5.70 (31.44)	2.52 (5.37)	2.77 (6.71)	3.80 (13.51)	5.33 (27.59)	89.63
T_{13}: Atrazine 50 WP @ 1.25 kg a.i. ha^{-1}	4.91 (23.09)	7.98 (62.99)	4.58 (19.95)	10.35 (106.03)	5.74 (32.1)	5.87 (33.66)	4.92 (23.33)	9.46 (89.09)	66.51
S.Em.±	**0.28**	**0.33**	**0.42**	**0.32**	**0.23**	**0.11**	**0.32**	**0.17**	**1.38**
CD(p=0.05%)	**0.81**	**0.96**	**1.23**	**0.92**	**0.68**	**0.34**	**0.94**	**0.51**	**4.02**

Table 3: Sedges, grass and broad leaved weed density, weed biomass and weed control effeciency as influenced by different pre – emergence herbicides in maize at 60 days after sowing

Treatment	SEDGES	GRASS	BLW	Total	SEDGES	GRASS	BLW	Total	WCE
	(No. m^{-2})				(g m^{-2})				%
T_1: Saflufenacil 51 g a.i. ha^{-1} + Dimethenamid-P 450 g a.i. ha^{-1} (Integrity 66.8 EC @ 501 g a.i.ha^{-1})	4.04 (15.31)	6.76 (44.84)	8.04 (63.59)	11.21 (120.74)	4.39 (18.38)	5.1 (25.15)	7.79 (59.98)	10.20 (103.52)	63.85
T_2: Saflufenacil 68 g a.i. ha^{-1} + Dimethenamid-P 600 g a.i. ha^{-1} (Integrity 66.8 EC @ 668 g a.i.ha^{-1})	3.78 (13.27)	6.29 (38.73)	7.59 (56.61)	10.37 (106.6)	3.93 (14.51)	5.01 (24.19)	7.21 (51.27)	9.51 (89.97)	68.58
T_3: Saflufenacil 85 g a.i. ha^{-1} + Dimethenamid-P 750 g a.i. ha^{-1} (Integrity 66.8 EC @ 835 g a.i.ha^{-1})	3.75 (13.06)	5.87 (33.63)	7.36 (53.71)	9.87 (96.41)	3.4 (10.64)	4.39 (18.38)	6.73 (44.5)	8.61 (73.53)	74.32
T_4: Saflufenacil 70 WG @ 51 g a.i. ha^{-1}	6.38 (39.76)	9.61 (91.72)	7.19 (50.75)	13.16 (172.23)	7.60 (57.08)	7.79 (59.98)	6.66 (43.53)	12.68 (160.6)	43.92
T_5: Saflufenacil 70 WG @ 68 g a.i. ha^{-1}	6.06 (35.69)	9.18 (83.57)	7.04 (48.59)	12.36 (151.85)	7.15 (50.31)	6.94 (47.4)	6.13 (36.76)	11.61 (134.47)	53.04
T_6: Saflufenacil 70 WG @ 85 g a.i. ha^{-1}	5.71 (31.61)	8.84 (77.45)	6.81 (45.48)	11.71 (136.15)	6.66 (43.53)	6.66 (43.53)	5.64 (30.96)	10.88 (118.03)	58.78
T_7: Dimethenamid-P 72 EC @ 450 g a.i. ha^{-1}	3.50 (11.23)	5.23 (26.50)	11.90 (141.25)	13.45 (179.98)	3.26 (9.67)	4.17 (16.45)	12.25 (149)	13.27 (175.12)	38.85
T_8: Dimethenamid-P 72 EC @ 600 g a.i. ha^{-1}	3.16 (8.99)	4.61 (20.38)	11.45 (130.04)	12.70 (160.41)	3.11 (8.71)	4.05 (15.48)	11.45 (130)	12.46 (154.19)	46.16
T_9: Dimethenamid-P 72 EC @ 750 g a.i. ha^{-1}	2.82 (6.95)	3.77 (13.25)	11.15 (123.31)	12.06 (150.61)	2.95 (7.74)	3.40 (10.64)	10.95 (118.9)	11.76 (137.28)	52.06
T_{10}: Weed free check	1.48 (1.20)	2.46 (5.10)	2.02 (3.10)	3.22 (9.40)	2.41 (4.84)	2.41 (4.89)	3.12 (8.71)	4.39 (18.38)	93.58
T_{11}: Untreated control	6.77 (44.83)	9.98 (98.76)	12.2 (147.88)	17.13 (292.47)	8.87 (77.90)	9.70 (93.27)	10.87 (116.09)	16.95 (286.3)	0.00
T_{12}: POP	2.76 (6.64)	3.60 (12.00)	3.86 (13.09)	6.31 (38.86)	2.76 (6.63)	3.04 (8.29)	3.97 (14.27)	5.39 (28.19)	90.16
T_{13}: Atrazine 50 WP @ 1.25 kg a.i. ha^{-1}	6.55 (42.54)	8.86 (77.86)	6.61 (42.75)	11.83 (139.0)	6.36 (39.67)	6.51 (41.6)	5.45 (28.83)	10.51 (110.1)	61.55
S.Em.±	**0.31**	**0.62**	**0.82**	**0.54**	**0.11**	**0.10**	**0.16**	**0.16**	**1.50**
CD(p=0.05%)	**0.89**	**1.82**	**2.45**	**1.57**	**0.33**	**0.31**	**0.46**	**0.46**	**4.39**

Table 4: Grain yield influenced by different pre emergence herbicides application in maize

Treatment	Grain yield (kg ha^{-1})	Stover yield	Weed index
T_1: Saflufenacil 51 g a.i. ha^{-1} + Dimethenamid-P 450 g a.i. ha^{-1} (Integrity 66.8 EC @ 501 g a.i.ha^{-1})	6967	9396	22.2
T_2: Saflufenacil 68 g a.i. ha^{-1} + Dimethenamid-P 600 g a.i. ha^{-1} (Integrity 66.8 EC @ 668 g a.i.ha^{-1})	7420	9906	14.7
T_3: Saflufenacil 85 g a.i. ha^{-1} + Dimethenamid-P 750 g a.i. ha^{-1} (Integrity 66.8 EC @ 835 g a.i.ha^{-1})	7217	9717	17.0
T_4: Saflufenacil 70 WG @ 51 g a.i. ha^{-1}	5163	8510	40.6
T_5: Saflufenacil 70 WG @ 68 g a.i. ha^{-1}	5944	8689	31.7
T_6: Saflufenacil 70 WG @ 85 g a.i. ha^{-1}	5212	8667	40.1
T_7: Dimethenamid-P 72 EC @ 450 g a.i. ha^{-1}	4898	8463	43.7
T_8: Dimethenamid-P 72 EC @ 600 g a.i. ha^{-1}	6051	8764	30.4
T_9: Dimethenamid-P 72 EC @ 750 g a.i. ha^{-1}	4273	7652	50.9
T_{10}: Weed free check	8127	10229	0.0
T_{11}: Untreated control	3160	6172	78.2
T_{12}: POP	7700	9989	11.5
T_{13}: Atrazine 50 WP @ 1.25 kg a.i. ha^{-1}	6153	9016	22.4
S.Em.±	**257**	**809**	**3.9**
CD (p=0.05%)	**750**	**2360**	**11.3**

CONCLUSION

The total weed density and dry matter differed significantly due to weed control ability of different formulation of chemicals at all the growth stages of crop. Among the herbicide tested Saflufenacil 68 g a.i.ha^{-1} + Dimethenamid-P 600 g a.i. ha^{-1} (Integrity 66.8 EC @ 668 g a.i. ha^{-1}) recorded the lower weed density and weed dry weight resulted in higher weed control efficiency and grain yield. By this inferred that the integrity can be effectively used for broad spectrum weed control in maize.

REFERENCES

1. Gomez, K.A. and Gomez, A.K., *Statistical procedures for Agricultural Research. (2nd Ed.).* John Wiley and Sons, New York, pp: 105-114 (1984).
2. Grossmann, K., Niggweg, R., Christiansen, N., Looser, R. And Ehrhardt, T., The herbicide saflufenacil (Kixor®) is a new inhibitor of protoporphyrinogen IX oxidase activity. *Weed Sci*., **58:** 1-9 (2010).
3. Kolage, A.K., Shinde, S.H. and Bhilare, R.L., Weed management in *kharif maize*. *J. Maharashtra Agric. Univ.*, **29(1):** 110-111 (2004).
4. Lieble, R., Walter, H., Bowe, S.J., Holt, T.J. and Westberg, D.E., BAS 800H: a new herbicide for pre-plant burn down and pre-emergence dicot weed control. *Weed Sci. Soc. of Am. Conf*., Abstr. 120 (2008).
5. Mani, V.S., Chakraborty, T.K. and Gautam, K.C.. Double hedge weed killers in peas. Indian Fmg., **26(2):** 80-83 (1973).
6. Moran, M.E., Sikkema, P.H. and Swanton, C.J., Efficacy of saflufenacil plus dimethenamid-p for weed control in corn. *Weed Technol*., **25:** 330-334 (2011).
7. Shantveerayya, H. And Agasimani, C.A., Effect of herbicides on weed control and productivity of maize (*Zea mays* L.).*Karnataka J. Agric. Sci*., **25(1):** 137-139 (2011).
8. Shinde, S.H., Kolage, A.K. and Bhilare, R.L., Effect of weed control on growth and yield of maize. *J. Maharashtra Agric. Univ.*, **26(2):** 212-213 (2001).
9. Sinha, S.P., Prasad, S.M. and Singh, S.J., Nutrient utilization by winter maize (*Zea mays*) and weeds as influenced by integrated weed management. *Indian J. Agron*., **50(4):** 303-304 (2005).
10. Trolove, M.R., Rahman, A. Hagerty, G.C. and James, T.K., Efficacy and crop selectivity of salufenacil alone and with partner herbicides for weed control in maize, *New Zealand Plant Protec.,* **64:** 133-141 (2011).