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Short communication

Weed management in maize

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Maize (*Zea mays* L.) is the most versatile food crop of global importance. It ranks third most important food grain crop after rice and wheat in India providing food, feed, fodder and also serves as a source of basic raw material for number of industrial products for food (25%), animal feed (12%), poultry feed (49%), starch (12%), brewery (1%) and seed (1%) (Dass *et al*. 2008). It is one of the most efficient crops which gives high biological yield as well as grain yield in a short period of time due to its unique photosynthetic mechanism owing to C_4 mechanism. The average maize yield in the developed countries is more than 7 t/ha while in the developing countries it is only around 3 t/ ha (Dass *et al*. 2008). Amongst various production factors, weed management plays major role in increasing productivity of maize. Unchecked weed growth in crop may results in grain yield losses to the extent of 100% (Sharma 2005). The experiment was designed with the view to find out the effect of herbicides and their combination on productivity of maize.

A field experiment was conducted during rainy seasons of 2014 at research farm of Birsa Agricultural University situated at 23º17' N latitude and longitude of 85º10' E with an altitude of 625 m above mean sea level, to find out the effect of weed control methods on productivity and economics of maize. The experimental soil was poor in nitrogen (210 kg/ha), medium in phosphorus (14.7 kg/ha), potash (123 kg/ ha) and organic carbon (5.2 g/ka soil). The pH of soil was 5.4. The experiment was laid out in a randomized block design with 12 treatments in three replications. The crop variety "*Suwan*" was sown on 26.06.14 at spacing of 60 x 20 cm with fertilizer dose 120:60:40 kg N:P_2O_5:K_2O/ha. Half dose of N and full of P and K were applied as basal. Remaining 50% N was split into two doses, first 25% was applied at knee height stage and second 25% was applied at tasselling stage through top dressing of urea. Crop was harvested on 06.10.14**.** The herbicides as per treatment were applied by knapsack sprayer using 500 liter/ha water. The data on weed species were recorded at 30 and 60 days after sowing. Weed count was expressed as number/m^2. The mean data were subjected to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution. These samples were dried at 70 ºC till a constant weight was obtained. The dry matter was then computed in terms of g/m^2. Economics was calculated on the basis of prevailing market prices of inputs and produce.

The experimental field was infested with broad-leaved weeds like *Alternenthara sessils*, *Commelina benghalensis*, *Commelina nudifolia*, *Ageratum conyzoides*, *Phyllanthus niruri;* among grassy weeds *Echinochloa colona*, *Echinochloa crusgalli*, *Digitaria sanguinalis*, *Paspalam distichum*, *Dactyloctenium aegyptium* and among sedges *Cyperus rotundus*, *Cyperus iria* and *Fimbristylis milliaceae*.

Application of atrazine + pendimethalin 0.50 + 0.50 kg/ha as PE similar to hand weeding at 20 and 40 DAS as well as atrazin 1.0 kg/ha as PE recorded significantly reduced weed density of narrow-leaf, broad-leaf and sedges at 30 and 60 days after sowing. The extent of reduction was to the tune of 69.8, 96.9 and 85.1% at 30 days and 73.7, 85.7 and 88.2%, respectively at 60 days after sowing as compared to weedy check. In case of dry matter accumulation, application of atrazine + pendimethalin 0.50 + 0.50 kg/ha as pre-emergence (PE) similar to hand weeding at 20 and 40 DAS recorded significantly reduced weed dry matter of all category of weeds at both the growth stages of maize except broad-leaf and sedges at 30 DAS. The extent of reduction was to the tune of 71.4% in case of narrow-leaf at 30 days after sowing and 65.71, 71.74 and 63.64% in case of narrow, broad-leaf and sedges, respectively at 60 days after sowing compared to weedy check (Geetha *et al*. 2013).

Pre-emergence application of atrazine + pendimethalin 0.50+0.50 kg/ha similar to application

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Table 1. Weed density as influenced by weed management methods

Treatment	Weed density (no./m^2)							
	30 DAS				60 DAS			
	NL	BL	S	Total	NL	BL	S	Total
Pretilachlor 0.5 kg/ha PE	6.34 (40)	7.38 (56)	7.55 (57)	12.4 (153)	6.85 (47)	7.42 (55)	6.53 (43)	12.0 (144)
Atrazine 1.0 kg/ha PE	4.88(24)	3.21 (10)	5.35 (31)	7.99 (65)	5.75 (33)	5.83 (37)	4.76 (23)	9.48 (93)
Pendimethalin 1.0 kg /ha PE	5.58(31)	5.51 (32)	5.99 (39)	10.1 (101)	6.43 (43)	6.74 (46)	5.96 (35)	11.1 (124)
Metribuzin 0.35 kg/ha PE	6.91(47)	11.1 (123)	11.6 (135)	17.5 (305)	8.41 (70)	11.1 (122)	11.3 (128)	17.9 (320)
Pretilachlor + metribuzin 0.75 + 0.175 kg/ha PE	5.41 (29)	5.10 (28)	5.88 (36)	9.55 (93)	5.95 (36)	6.37 (41)	5.08 (27)	10.1 (103)
Atrazine + pendimethalin 0.50 + 0.50 kg/ha PE	4.04 (16)	2.39 (5)	4.73 (23)	6.68 (44)	4.47 (20)	4.87 (23)	4.07 (16)	7.73 (60)
Pretilachlor 1.0 kg/ha 15 DAS	5.59 (31)	6.61 (47)	6.66 (44)	11.0 (122)	6.69 (45)	7.20 (51)	6.42 (41)	11.7 (138)
Metribuzin 0.25 kg/ha 15 DAS	5.28 (29)	5.55 (32)	5.99 (39)	9.70 (100)	6.14 (37)	6.61 (43)	5.48 (31)	10.6 (111)
Atrazine + 2,4-D 0.50 + 0.50 kg/ha 30 DAS	6.47 (41)	10.2 (104)	8.77 (80)	15.0 (225)	7.26 (53)	10.7 (113)	9.82 (96)	16.2 (262)
Green manuring *fb* 2,4-D 0.625 kg/ha) 30 DA	6.70 (45)	10.3 (113)	10.2 (104)	16.1 (262)	7.45 (55)	10.8 (116)	10.0 (101)	16.5 (273)
Hand weeding	4.11 (17)	3.12 (9)	5.23 (27)	7.33 (53)	5.53 (31)	5.70 (33)	4.32 (18)	9.04 (82)
Weedy check	7.29 (53)	12.6 (159)	12.4 (154)	19.1 (366)	8.71 (76)	12.7 (161)	11.7 (136)	19.3 (373)
LSD (P=0.05)	1.41	2.79	2.56	2.48	1.58	1.44	1.37	1.67

Table 2. Weed dry matter as influenced by weed management methods

Treatment	Weed dry matter (g/m^2)							
	30 DAS				60 DAS			
	NL	BL	S	Total	NL	BL	S	Total
Pretilachlor 0.5 kg/ha PE	3.81(15)	3.96(18)	4.35(19)	7.04(52.1)	4.46(20)	5.99(36)	5.51(30)	9.28(86)
Atrazine 1.0 kg/ha PE	3.03(9)	3.44(11)	4.02(16)	6.05(36.2)	4.01(16)	4.40(19)	4.68(21)	7.51(56)
Pendimethalin 1.0 kg/ha PE	4.43(20)	4.05(16)	4.36(19)	7.39(54.5)	4.18(17)	4.96(24)	4.97(24)	8.11(65)
Metribuzin 0.35 kg/ha PE	3.34(11)	4.65(21)	4.55(20)	7.27(52.6)	5.12(26)	6.54(42)	6.35(40)	10.41(108)
Pretilachlor + metribuzin 0.75+0.175 kg/ha PE	3.06(9)	3.55(12)	4.12(17)	6.18(38.6)	4.07(16)	4.51(20)	4.69(22)	7.64(58)
Atrazine + pendimethalin 0.50 + 0.50 kg/ha PE	2.48(6)	3.07(9)	3.41(12)	5.19(26.5)	3.57(12)	3.60(13)	4.04(16)	6.44(41)
Pretilachlor 1.0 kg/ha 15 DAS	3.56(13)	4.14(17)	4.36(19)	6.94(47.8)	4.20(17)	5.11(26)	5.17(26)	8.35(69)
Metribuzin 0.25 kg/ha 15 DAS	3.21(10)	3.61(13)	4.29(18)	6.42(41.2)	4.15(17)	4.72(22)	4.76(22)	7.85(61)
Atrazine + 2,4-D 0.50 + 0.50 kg/ha 30 DAS	4.16(18)	4.53(20)	4.46(20)	7.57(57.5)	4.56(21)	6.14(38)	6.11(37)	9.79(96)
Green manuring *fb* 2,4-D 0.625 kg/ha) 30 DA	4.32(18)	4.51(21)	4.48(20)	7.69(58.9)	5.00(25)	6.49(42)	6.21(38)	10.27(105)
Hand weeding	2.87(8)	3.22(10)	3.60(14)	5.65(31.9)	3.87(15)	4.13(17)	4.24(18)	7.04(49)
Weedy check	4.63(21)	4.70(22)	4.73(22)	8.08(65.6)	5.94(35)	6.82(46)	6.66(44)	11.21(125)
LSD (P=0.05)	1.27	NS	NS	1.58	0.81	0.90	0.97	0.62

of atrazine 1.0 kg/ha as PE, pretilachlor + metribuzin 0.75 + 0.175 kg/ha as PE, two hand weeding at 20 and 40 days after sowing recorded 19.5% higher plant height than weedy check. Application of atrazine + pendimethalin 0.50+0.50 kg/ha as PE similar to all weed control treatments except application of pretilachlor 0.5 kg/ha as PE, metribuzin 0.35 kg/ha as PE, *Sesbania aculeata* broadcasted *fb* 2,4-D 0.625 kg/ha at 30 DAS and two hand weeding at 20 and 40 days after sowing recorded 16.8% more number of grains per cobas compared to weedy check. Application of atrazine + pendimethalin 0.50+0.50 kg/ha as PE similar to application of atrazine 1.0 kg/ha as PE and two hand weeding at 20 and 40 days after sowing recorded 31.4% more 100 seed weight as compared to weedy check. It also recorded 65.6% significantly higher grain yield as compared to weedy check while straw yield was similar to hand weeding performed at 20 and 40 DAS and produced 65.7% higher as compared to weedy check.

Pre-emergence application of atrazine + pendimethalin 0.50 + 0.50 kg/ha recorded maximum B:C ratio (3.57) and ₹ 17,728/ha, significantly higher net return compared to hand weeding (₹35,764/ha) performed at 20 and 40 days after sowing and ₹43,274/ha higher compared to weedy check (₹10218/ha). Sidhu *et al.* (2014) also reported pre-emergence tank mix application of atrazine + pendimethalinis economically feasible and cost effective for controlling weeds.

It was concluded that for higher productivity, profitability and effective weed control in maize, atrazine + pendimethalin 0.50 + 0.50 kg/ha as pre-emergence can be applied.

Table 3. Yield attributes and yields of maize as influenced by weed management methods

Treatment	Plant height (cm)	No. of grains/cob	100-seeds weight (g)	Yield (t/ha)	
				Grain	Straw
Pretilachlor 0.5 kg/ha PE	213	371	20.8	2.12	3.17
Atrazine 1.0 kg/ha PE	241	470	23.1	2.94	4.39
Pendimethalin 1.0 kg/ha PE	230	450	21.1	2.32	3.50
Metribuzin 0.35 kg/ha PE	207	412	18.1	1.58	2.37
Pretilachlor + metribuzin 0.75+0.175 kg/ha PE	240	449	21.7	2.57	3.84
Atrazine + pendimethalin 0.50+0.50 kg/ha PE	255	495	24.0	3.80	5.73
Pretilachlor 1.0 kg/ha 15 DAS	214	429	20.2	2.30	3.43
Metribuzin 0.25 kg/ha 15 DAS	238	427	21.1	2.37	3.56
Atrazine + 2,4-D 0.50+0.50 kg/ha 30 DAS	210	444	19.3	1.75	2.65
Green manuring *fb* 2,4-D 0.625 kg/ha) 30 DAS	210	373	19.0	1.75	2.63
Hand weeding	246	415	23.3	3.06	4.59
Weedy check	204	412	16.4	1.31	1.96
LSD (P=0.05)	15	68	2.0	0.71	1.10

Table 4. Economics of maize as influenced by weed management methods

Treatment	Cost of cultivation (x10^3 ` /ha)	Gross returns (x10^3 ` /ha)	Net returns (x10^3 ` /ha)	B:C
Pretilachlor 0.5 kg/ha PE	14.24	38.2	23.95	1.68
Atrazine 1.0 kg/ha PE	14.56	52.86	38.31	2.63
Pendimethalin 1.0 kg/ha PE	15.44	41.82	26.38	1.71
Metribuzin 0.35 kg/ha PE	14.65	28.44	13.79	0.94
Pretilachlor + metribuzin 0.75 + 0.175 kg/ha PE	15.04	46.20	31.15	2.07
Atrazine + pendimethalin 0.50+0.50 kg/ha PE	15.00	68.50	53.49	3.57
Pretilachlor 1.0 kg/ha 15 DAS	14.84	41.30	26.46	1.78
Metribuzin 0.25 kg/ha 15 DAS	14.36	42.68	28.31	1.97
Atrazine + 2,4-D 0.50+0.50 kg/ha 30 DAS	14.60	31.59	17.00	1.16
Green manuring *fb* 2,4-D 0.625 kg/ha) 30 DAS	16.66	31.56	14.89	0.89
Hand weeding	19.34	55.10	35.76	1.85
Weedy check	13.34	23.56	10.22	0.77
LSD (P=0.05)		13.08	13.08	0.90

price of maize grain = ₹ 15/kg and straw= ₹ 2/kg

SUMMARY

A field experiment was conducted on sandy loam soil of Birsa Agricultural University, Ranchi during rainy season of 2014 to evaluate the performance of weed-control methods on weed dynamics and productivity of maize. The experiment was laid out in randomized block design with 12 treatment in three replication. Application of atrazine + pendimethalin 0.50 + 0.50 kg/ha as pre-emergence similar to two hand weeding at 20 and 40 DAS recorded reduced weed density dry matter accumulation compared to weedy check at 30 and 60 days after sowing. These resulted significantly increase in plant height, number of grains per cob, 100-seed weight as well as 65.6% significantly higher grain yield (3.80 t/ha) as compared to weedy check (1.309 t/ha), consequently maximum net return (₹ 53492/ha) and benefit: cost ratio (3.57) than rest of the treatments.

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