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Short communication

Weed management with herbicdes in chickpea

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India is a premier chickpea growing country accounting 76% of total area and production of the world. Yield losses due to weed competition depending on the level of weed infestation and weed species. Yield reduction in chickpea due to presence of weeds to the extent of 75% was noticed by Chaudhary *et al*. (2005). Considerable variations were observed in the application of herbicides by farmers for the control of weeds in chickpea. In view of the above points, the present experiment was planned to evaluate the efficacy of herbicides for weed management in chickpea under middle Gujarat conditions.

The present experiment was conducted in *Rabi* season of the year 2012 at the farm of B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat). The soil was sandy loam in texture having low in available nitrogen and medium in available phosphorus and high in potassium with pH 7.91. Twelve weed management treatments, *viz*. pendimethalin 750 g/ha pre-emergence (PE), pendimethalin 750 g/ha PE *fb* HW at 30 DAS, oxadiargyl 75 g/ha PE, oxadiargyl 75 g/ha PE *fb* HW at 30 DAS, imazethapyr 50 g/ha PE, imazethapyr 50 g/ha PE *fb* HW at 30 DAS, oxyfluorfen 80 g/ha PE, oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS, pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE, pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE *fb* HW at 30 DAS, interculturing (IC) *fb* hand weeding (HW) at 20 and 40 DAS and weedy check were studied in randomized block design with four replications. The chickpea cv. "*Gujarat Gram-1'* was sown manually keeping the row distance of 30 cm at 60 kg seed/ha during 1st week of November 2012. Entire quantity of nitrogen (20 kg/ha) and phosphorous (40 kg/ha) in the form of urea and single super phosphate, respectively were applied at the time of field preparation. The herbicides were applied using knapsack sprayer fitted with flat fan nozzle as per treatment. The other package of practices was adopted to raise the crop as per the recommendations. Immediately after sowing, a light irrigation was given to the crop for uniform germination and next day the pre-emergence herbicides were applied. The crop was harvested on third week of March 2013. The observations on number of weeds and dry matter of weeds were taken from randomly selected four spots by using 0.25 m^2 quadrate from net plot area. Weed control efficiency (WCE) was calculated on the basis of standard formula as suggested by Maity and Mukherjee (2011). The seed and haulm yield was harvested from the net plot area and converted into hectare for comparison. Data on various observations during the experiment period was statistically analysed as per the standard procedure developed by Cochran and Cox (1957).

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Effect on weeds

At 25 DAS, the lowest suppression of monocot weeds (2.09/m^2) was recorded under oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS (Table 1). Similar results were also observed under weed management practices at 50 DAS with lowest value (3.06/m^2) in oxadiargyl 75 g/ha PE *fb* HW at 30 DAS and IC *fb* HW at 20 and 40 DAS. Dicot weed population (2.87 and 3.23/m^2) was recorded significantly lower under oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS as compared to other treatments at 25 and 30 DAS, respectively. Further, it was observed that oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS recorded significantly lowest dry weight of total weeds (1.35 g/m^2) at 25 DAS. At 50 DAS and at harvest, same trend was noticed except oxadiargyl 75 g/ha PE *fb* HW at 30 DAS, IC *fb* HW at 20 and 40 DAS and imazethapyr 50 g/ha PE *fb* HW at 30 DAS. Oxyfluorfen, oxadiargyl and imazethapyr may persist longer in soil, which restricts the germination of weeds and later germinated weeds can be removed manually at 30 DAS with hand weeding leading to minimum weed population and their dry weight. The result was in close conformity with findings of Poonia and Pithia (2013). Maximum weed control efficiency (83.7%) was achieved under oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS closely followed by

oxadiargyl 75 g/ha PE *fb* HW at 30 DAS (83.3%). There was reduction in the yield to the tune of 42.0% under weedy check.

Effect on crop

Plant height at harvest was recorded significantly higher (78.95 cm) under the treatment of oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS as compared to weedy check (63.80 cm). The values of number of yield attributing traits and yields, *viz*. no. of branches/plant, dry weight of *Rhizobium* nodule/ plant and no. of pods/plant, seed and haulm yields were registered significantly higher under oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS than

Table 1. Weed density, dry weight, weed control efficiency and weed index as influenced by different weed management practices

Treatment	Monocot weed count (no./m^2)		Dicot weed count (no./m^2)		Dry weight of total weed (g/m^2)			WCE (%) at harvest	Weed index (%)
	25 DAS	50 DAS	25 DAS	50 DAS	25 DAS	50 DAS	At harvest		
Pendimethalin 750 g/ha PE	3.91^{b} (15.3)	4.90^{b} (24.0)	4.56^{b} (20.8)	7.16^{ab} (51.3)	2.14^{b} (4.6)	10.00^{b} (100.0)	13.46^{b} (181.2)	61.04	35.3
Pendimethalin 750 g/ha PE *fb* HW at 30 DAS	3.80^{b} (14.4)	4.28^{bcd} (18.3)	4.17^{bc} (17.4)	4.64^{cd} (21.5)	2.09^{b} (4.4)	6.87^{c} (47.2)	9.29^{d} (86.3)	67.23	13.5
Oxadiargyl 75 g/ha PE	3.80^{b} (14.4)	4.51^{bcd} (20.3)	4.27^{bc} (18.2)	4.97^{c} (24.7)	2.09^{b} (4.4)	7.50^{c} (56.2)	12.35^{b} (152.5)	68.28	14.7
Oxadiargyl 75 g/ha PE *fb* HW at 30 DAS	2.70^{d} (7.3)	3.66^{de} (13.4)	3.20^{de} (10.2)	3.51^{de} (12.3)	1.58^{e} (2.5)	5.38^{de} (28.9)	6.66^{e} (44.4)	83.31	5.1
Imazethapyr 50 g/ha PE	3.92^{b} (15.4)	4.78^{bc} (22.8)	4.40^{b} (19.4)	6.88^{b} (47.3)	2.11^{b} (4.4)	9.68^{b} (93.7)	12.18^{bc} (148.3)	43.83	23.0
Imazethapyr 50 g/ha PE *fb* HW at 30 DAS	3.06^{cd} (9.4)	3.92^{cd} (15.4)	3.92^{bcd} (15.4)	4.15^{cde} (17.2)	1.80^{cd} (1.2)	6.28^{cd} (39.4)	8.27^{de} (68.4)	74.66	6.7
Oxyfluorfen 80 g/ha PE	3.73^{b} (13.9)	4.39^{bcd} (19.3)	4.14^{bcd} (17.1)	4.68^{c} (21.9)	2.09^{b} (4.4)	7.02^{c} (49.3)	10.13^{cd} (102.6)	40.59	13.8
Oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS	2.09^{e} (4.4)	3.06^{e} (9.4)	2.87^{e} (8.2)	3.23^{e} (10.4)	1.35^{f} (1.8)	4.81^{e} (23.1)	6.66^{e} (44.4)	83.73	0
Pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE	3.66^{bc} (13.4)	4.17^{bcd} (17.4)	4.02^{bcd} (16.2)	4.68^{c} (21.9)	2.01^{bc} (4.0)	6.86^{c} (47.1)	9.34^{d} (87.2)	32.49	13.2
Pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE *fb* HW at 30 DAS	3.52^{bc} (12.4)	4.00^{bcd} (16.0)	4.02^{bcd} (16.2)	4.29^{cde} (18.4)	1.98^{bc} (3.9)	6.79^{cd} (46.1)	8.86^{d} (78.5)	71.21	12.7
IC *fb* HW at 20 and 40 DAS	3.06^{cd} (9.4)	3.78^{de} (14.3)	3.35^{cde} (11.2)	4.11^{cde} (16.9)	1.71^{de} (2.9)	6.17^{cd} (38.1)	8.05^{de} (64.8)	75.54	5.9
Weedy check	5.41^{a} (29.3)	6.80^{a} (46.2)	6.65^{a} (46.2)	8.20^{a} (67.2)	3.00^{a} (9.0)	12.02^{a} (144.5)	16.50^{a} (272.2)	-	42.0
LSD(P=0.05)	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	-	-
C.V.%	11.1	12.3	14.0	13.7	11.9	7.4	12.7	-	-

Original values are in parentheses and before statistical analysis were subjected to square root transformation $(\sqrt{x+1})$

Table 2. Yield attributes of chickpea as influenced by different weed management practices

Treatment	Plant height (cm) at harvest	No. of branch/ plant	Dry weight of *Rhizobium* nodules/plant (g)	No of pods/ plant	Seed index (g)	Harvest index (%)
Pendimethalin 750 g/ha PE	69.6^{bc}	5.5^{d}	49.1^{d}	56.7^{e}	20.9^{abc}	33.2
Pendimethalin 750 g/ha PE *fb* HW at 30 DAS	74.2^{ab}	7.5^{b}	70.5^{b}	80.7^{bc}	21.5^{ab}	36.3
Oxadiargyl 75 g/ha PE	71.4^{abc}	7.2^{bc}	56.4^{cd}	77.0^{cd}	20.8^{abc}	36.8
Oxadiargyl 75 g/ha PE *fb* HW at 30 DAS	76.1^{ab}	8.7^{a}	81.0^{a}	90.0^{ab}	22.0^{ab}	34.0
Imazethapyr 50 g/ha PE	71.0^{abc}	6.2^{cd}	52.0^{cd}	68.2^{d}	20.7^{abc}	36.2
Imazethapyr 50 g/ha PE *fb* HW at 30 DAS	75.1^{ab}	8.0^{ab}	78.8^{ab}	86.2^{abc}	21.8^{ab}	35.0
Oxyfluorfen 80 g/ha PE	72.4^{ab}	7.5^{b}	59.9^{c}	80.0^{bc}	20.3^{bc}	36.2
Oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS	78.9^{a}	8.7^{a}	81.1^{a}	94.5^{a}	22.8^{a}	33.4
Pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE	74.5^{ab}	7.5^{b}	72.3^{ab}	81.2^{bc}	21.8^{ab}	35.4
Pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE *fb* HW at 30 DAS	74.5^{ab}	8.0^{ab}	74.3^{ab}	81.7^{bc}	20.8^{abc}	34.6
IC *fb* HW at 20 & 40 DAS	75.3^{ab}	8.2^{ab}	79.1^{ab}	88.2^{ab}	21.9^{ab}	34.2
Weedy check	63.8^{c}	5.2^{d}	38.3^{e}	56.5^{e}	19.0^{c}	33.6
LSD (P=0.05)	Sig.	Sig.	Sig.	Sig.	Sig.	NS
C.V.%	6.9	9.12	8.6	8.0	6.2	9.97

Table 3. Yields and economics of chickpea as influenced by different weed management practices

Treatment	Seed yield (t/ha)	Haulm yield (t/ha)	Gross returns (x10^3 `/ha)	Total cost of production (x10^3 `/ha)	Net returns (x10^3 `/ha)	BCR
Pendimethalin 750 g/ha PE	1.51	3.03	55.85	23.15	32.70	1.41
Pendimethalin 750 g/ha PE *fb* HW at 30 DAS	2.02	3.54	74.20	24.18	50.02	2.07
Oxadiargyl 75 g/ha PE	1.99	3.41	73.10	23.10	50.00	2.16
Oxadiargyl 75 g/ha PE *fb* HW at 30 DAS	2.21	4.29	81.75	24.13	57.62	2.39
Imazethapyr 50 g/ha PE	1.80	3.16	66.02	22.96	43.06	1.88
Imazethapyr 50 g/ha PE *fb* HW at 30 DAS	2.18	4.04	80.20	23.99	56.21	2.34
Oxyfluorfen 80 g/ha PE	2.01	3.54	73.89	22.64	51.25	2.26
Oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS	2.33	4.63	86.29	23.67	62.62	2.65
Pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE	2.03	3.69	74.60	23.70	50.90	2.15
Pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE *fb* HW at 30 DAS	2.04	3.85	75.15	24.73	50.41	2.04
IC *fb* HW at 20 & 40 DAS	2.19	4.21	81.04	24.01	57.02	2.37
Weedy check	1.35	2.66	49.98	21.18	28.80	1.36
S.Em. $\pm$	0.05	0.27	-	-	-	-
LSD(P=0.05)	Sig.	Sig.	-	-	-	-
C.V.%	0.01	0.015	-	-	-	-

recorded under other treatments except, imazethapyr 50 g/ha PE *fb* HW at 30 DAS, pendimethalin + imazethapyr (pre-mixed) 750 g/ha PE *fb* HW at 30 DAS and IC *fb* HW at 20 and 40 DAS (Table 2). The higher yield attributes and yield of chickpea under imazethapyr herbicide application was also noticed by Goud *et al*. (2013). Significantly, lower seed yield (1.35 t/ha) and haulm yield (2.66 t/ha) was recorded under weedy check but remained at par with pendimethalin 750 g/ha PE for seed and haulm yield and imazethapyr 50 g/ha PE for haulm yield (Table 3). These results were in accordance with the findings of Ratnam *et al*. (2011). The harvest index was unaffected due to various weed management practices in chickpea. Further, it was noticed that application of oxyfluorfen 80 g/ha PE *fb* HW at 30 DAS recorded higher net returns (₹ 63622) with higher benefit cost ratio (2.65) followed by oxadiargyl 75 g/ha PE *fb* HW at 30 DAS, IC *fb* HW at 20 and 40 DAS, imazethapyr 50 g/ha PE *fb* HW at 30 DAS and oxyfluorfen 80 g/ha PE. The lowest BCR ratio (1.36) was observed in weedy check followed by pendimethalin 750 g/ha PE (Table 3).

SUMMARY

Oxyfluorfen 80 g/ha, oxadiargyl 75 g/ha, imazethapyr 50 g/ha as PE *fb* hand weeding at 30 DAS and IC at 20 DAS *fb* hand weeding at 40 DAS were found effective in reducing population of both monocot and dicot weeds and their dry weight as compared to other weed management practices. Higher yield attributing characters and yields were achieved when herbicides, *viz*. oxyfluorfen, oxadiargyl and imazethapyr were applied as pre emergence *fb* hand weeding at 30 DAS.

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