



## Weed management in chickpea under irrigated conditions

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### ABSTRACT

In a study on chickpea at Uttar Pradesh, two hand weeding done in weedy check and weed free plot results indicated that weed control treatments significantly reduced the density of weeds. Maximum weed control efficiency (100%) was recorded with weed free plot. Among herbicides, maximum WCE (95.0%) was recorded in pre-emergence of pendimethalin 1000 g/ha followed by combined PoE application of imazethapyr 75 g + quizalofop-ethyl 60 g/ha at 35 DAS and lowest WCE was recorded in weedy check. Among herbicides, the lowest number of plants (20.7/m<sup>2</sup>), plant height (33.4 cm) and number of pods/plant (22.4) at harvest stage of chickpea were recorded in PE application of pendimethalin 750 g/ha followed by combined PoE application of quizalofop-ethyl 60 g + oxyfluorfen 200 g/ha at 30 DAS. Maximum net monetary returns ` 53588/ha was recorded with pre-emergence application of pendimethalin 1000 g and PoE application of clodinafop 60 g/ha at 35 DAS.

In Uttar Pradesh, chickpea is cultivated in an area of 0.62 million hectares with a production and productivity of 0.51 million tonnes and 824 kg/ha, respectively (DES 2011). Weed infestation in chickpea offer serious competition and cause yield reduction to the extent of 75% (Chaudhary *et al.* 2005). The initial 60 days period is considered to be the critical for weed crop competition in chickpea (Singh and Singh 1992). With the increase in labour cost and scarcity of labour, manual weed control has become a difficult task. Suitable herbicide for effective control of mixed weed flora is required for better adoption in this crop by farmers. Hence, present investigation was carried out to study the efficacy of different herbicides on mixed weed flora and their effect on growth and yield of chickpea.

The field experiment was conducted during winter season of 2011 at N.D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) India. The soil of the experimental field was clay-loam, low in organic carbon, available nitrogen and phosphorus, medium in available potassium and alkaline in reaction (pH 8.1). Chickpea variety “PG-186” was sown on 19 November, 2011 in rows, at 40 cm apart at 4-5 cm deep. The experiment was laid out in a randomized block design with fourteen treatments (Table 1). Pre-plant incorporation and pre-emergence herbicides were applied one day before and after sowing,

respectively using a knapsack sprayer fitted with flatfan nozzle with a spray volume of 600 litres of water per hectare. Hand weeding was done as and when required. Weed dry weight was recorded by placing a quadrat of 0.25 m at three random places in each plot and then weighed for all weeds separately after oven drying at 45 days after sowing and harvesting. Weed control efficiency was calculated on the basis of dry weight of weeds as per the formula of Patil and Patil (1983). The weed index was calculated as per formula suggested by Gill and Kumar (1969).

### Effect on weeds

Both monocot and dicot weeds were observed in the experimental fields. Among dicot weeds *Chenopodium album* (51.9%) and *Anagallis arvensis* (17.9%), while grassy weed *Phalaris minor* (11.2%) and *Cynodon dactylon* (1.7%) at harvest were predominant in the weedy check plot. All the treatments receiving weed control measures effectively controlled both grassy and dicot weeds over weedy check (Table 1). Among the herbicides, pre-emergence application of pendimethalin 1000 g/ha followed by combined post-emergence application of imazethapyr 75 g + quizalofop 60 g/ha at 35 days after sowing (DAS) recorded significantly lower weed density of both grassy and dicot weeds at each growth stages as compared to other treatments (Table 2).

**Table 1. Effect of weed control treatments on density of different weed species at 30 and 60 DAS of chickpea**

Treatment	Weed density (no./m <sup>2</sup> ) at 30 DAS						Weed density (no./m <sup>2</sup> ) at 60 DAS					
	C. <i>album</i>	P. <i>minor</i>	A. <i>arvensis</i>	C. <i>dactylon</i>	Other weeds	Total	C. <i>album</i>	P. <i>minor</i>	A. <i>arvensis</i>	C. <i>dactylon</i>	Other weeds	Total
Pendimethalin 1000 g/ha PE	2.54 (6.00)	2.38 (5.15)	2.14 (4.10)	1.12 (1.15)	3.44 (11.37)	5.30 (27.77)	3.93 (15.00)	2.94 (8.15)	2.53 (5.90)	1.72 (2.46)	3.96 (15.17)	6.86 (46.68)
Pendimethalin 1000 g PE <i>fb</i> quizalofop 60 g/ha PoE	2.91 (8.00)	2.33 (4.95)	2.09 (3.90)	1.39 (1.45)	3.27 (10.26)	5.38 (28.56)	3.66 (13.00)	1.83 (2.85)	2.31 (4.85)	1.80 (2.75)	2.59 (6.24)	5.48 (29.69)
Pendimethalin 1000 g PE <i>fb</i> clodinafop 60 g/ha PoE	2.73 (7.00)	2.31 (4.85)	2.13 (4.08)	1.46 (1.65)	3.14 (9.45)	5.23 (27.03)	3.39 (11.00)	1.63 (2.15)	2.29 (4.75)	1.65 (2.22)	2.39 (5.24)	5.08 (25.36)
Pendimethalin 750 g PE <i>fb</i> quizalofop 60 g + oxyfluorfen 200 g/ha PoE	2.91 (8.00)	2.40 (5.25)	2.16 (4.15)	1.32 (1.25)	3.26 (10.16)	5.41 (28.81)	1.87 (3.00)	1.91 (3.15)	1.83 (2.85)	1.80 (2.76)	1.90 (3.12)	3.92 (14.88)
Oxyfluorfen 200 g/ha PE	3.07 (9.00)	2.78 (7.25)	2.69 (6.75)	1.46 (1.65)	3.80 (14.25)	6.26 (38.90)	4.18 (17.00)	3.32 (10.56)	2.79 (7.30)	1.83 (2.85)	3.95 (15.15)	7.30 (52.86)
Oxyfluorfen 200 g PE <i>fb</i> quizalofop 60 g/ha PoE	3.23 (10.00)	2.57 (6.15)	2.59 (6.25)	1.39 (1.45)	3.80 (14.00)	6.18 (37.85)	3.93 (15.00)	2.18 (4.28)	2.40 (5.30)	1.66 (2.25)	3.02 (8.65)	5.99 (35.48)
Oxyfluorfen 200 g PE <i>fb</i> clodinafop 60 g/ha PoE	3.07 (9.00)	2.96 (8.25)	2.70 (6.85)	1.35 (1.34)	3.89 (14.75)	6.36 (40.19)	3.67 (13.00)	2.06 (3.76)	2.37 (5.15)	1.72 (5.15)	2.82 (7.45)	5.68 (29.91)
Oxyfluorfen 200 g + quizalofop 60 g/ha PoE	8.84 (78.00)	5.16 (26.23)	4.46 (19.45)	1.40 (1.45)	4.60 (20.71)	12.08 (145.84)	2.82 (7.50)	3.12 (9.26)	1.98 (3.45)	1.77 (2.65)	2.42 (5.35)	5.35 (28.21)
Oxyfluorfen 200 g + <i>fb</i> clodinafop 60 g/ha PoE	8.79 (77.00)	5.06 (25.23)	4.37 (18.68)	1.35 (1.33)	4.52 (20.00)	11.93 (142.24)	3.13 (9.30)	3.30 (10.45)	2.27 (4.65)	1.81 (2.78)	2.63 (6.45)	5.83 (33.63)
Imazethapyr 75 g/ha PoE	9.08 (82.00)	5.27 (27.23)	4.55 (20.22)	1.47 (1.65)	4.86 (23.16)	12.44 (154.26)	4.30 (18.00)	5.29 (27.45)	2.95 (8.21)	1.74 (2.54)	2.63 (6.78)	7.97 (62.98)
Pendimethalin 1000 g PE <i>fb</i> imazethapyr 75 g/ha PoE	2.91 (8.00)	2.37 (5.11)	2.09 (3.89)	1.28 (1.14)	3.21 (9.87)	5.33 (28.01)	2.10 (3.90)	3.12 (9.26)	1.66 (2.26)	1.63 (2.15)	2.22 (4.42)	4.74 (21.99)
Pendimethalin 1000 g PE <i>fb</i> imazethapyr 75 g + quizalofop 60 g/ha PoE	2.72 (7.00)	2.15 (4.15)	2.16 (4.20)	1.49 (1.75)	3.26 (10.27)	5.25 (27.37)	1.44 (1.58)	1.41 (1.50)	1.28 (1.15)	1.82 (2.85)	2.08 (3.85)	3.36 (10.93)
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Weedy check	9.25 (86.00)	5.34 (28.37)	4.65 (21.34)	1.56 (1.95)	4.55 (20.45)	12.52 (158.11)	9.67 (94.00)	5.77 (33.15)	4.94 (24.19)	1.90 (3.15)	5.13 (26.15)	13.38 (180.64)
LSD (p=0.05)	0.78	0.45	0.44	NS	0.55	1.16	0.64	0.41	0.34	0.19	0.39	0.95

**Table 2. Effect of weed control treatments on density of different weed species**

Treatment	Weed density (no./m <sup>2</sup> ) at 90 DAS						Weed density (no./m <sup>2</sup> ) at harvest					
	C. <i>album</i>	P. <i>minor</i>	A. <i>arvensis</i>	C. <i>dactylon</i>	Other weeds	Total	C. <i>album</i>	P. <i>minor</i>	A. <i>arvensis</i>	C. <i>dactylon</i>	Other weeds	Total
Pendimethalin 1000 g/ha PE	4.23 (17.4)	3.19 (9.76)	2.78 (7.26)	2.09 (3.87)	4.26 (17.77)	7.51 (56.11)	4.10 (16.40)	3.63 (6.45)	2.62 (6.35)	2.09 (3.87)	3.84 (14.25)	6.91 (47.32)
Pendimethalin 1000 g PE <i>fb</i> quizalofop 60 g/ha PoE	4.01 (15.6)	1.99 (3.46)	2.61 (6.35)	2.09 (3.90)	3.15 (9.46)	6.26 (38.82)	3.81 (14.10)	1.81 (2.80)	2.22 (4.45)	2.09 (3.90)	2.63 (6.44)	5.66 (31.69)
Pendimethalin 1000 g PE <i>fb</i> clodinafop 60 g/ha PoE	3.70 (13.2)	1.83 (2.85)	2.58 (6.15)	1.98 (3.44)	2.77 (7.24)	5.77 (32.93)	3.52 (11.95)	1.58 (2.00)	2.15 (4.15)	1.98 (3.44)	2.39 (5.24)	5.21 (26.78)
Pendimethalin 750 g PE <i>fb</i> quizalofop 60 g + oxyfluorfen 200 g/ha PoE	2.85 (7.6)	2.11 (3.95)	2.16 (4.15)	2.06 (3.15)	2.39 (5.22)	5.02 (24.72)	2.57 (6.10)	1.86 (2.95)	1.94 (3.25)	2.06 (3.75)	2.16 (4.15)	4.55 (20.20)
Oxyfluorfen 200 g/ha PE	4.49 (19.8)	3.55 (12.15)	3.08 (9.00)	2.06 (3.76)	4.29 (18.00)	7.93 (62.67)	4.14 (16.76)	3.15 (9.45)	2.78 (7.26)	2.06 (3.76)	3.97 (15.25)	7.27 (52.48)
Oxyfluorfen 200 g PE <i>fb</i> quizalofop 60 g/ha PoE	4.29 (18.0)	2.57 (6.15)	2.79 (7.30)	2.03 (3.65)	3.33 (10.65)	6.75 (45.75)	3.99 (15.45)	2.39 (5.21)	2.60 (6.30)	2.03 (3.65)	2.59 (6.25)	6.10 (36.86)
Oxyfluorfen 200 g PE <i>fb</i> clodinafop 60 g/ha PoE	3.95 (15.2)	2.31 (4.85)	2.60 (6.25)	2.10 (3.95)	3.14 (9.45)	6.32 (39.75)	3.74 (13.00)	1.91 (3.16)	2.38 (5.17)	2.11 (3.95)	2.37 (5.15)	5.60 (30.99)
Oxyfluorfen 200 g + quizalofop 60 g/ha PoE	3.08 (9.0)	3.29 (10.35)	2.34 (5.00)	2.12 (4.01)	2.96 (8.30)	6.09 (36.66)	2.76 (7.15)	2.95 (8.22)	2.08 (3.85)	2.12 (4.01)	2.36 (5.10)	5.36 (28.33)
Oxyfluorfen 200 g + <i>fb</i> clodinafop 60 g/ha PoE	3.36 (10.8)	3.51 (11.88)	2.38 (5.19)	1.94 (3.26)	3.13 (9.35)	6.39 (40.53)	3.05 (8.85)	3.05 (8.85)	2.14 (4.08)	1.94 (3.26)	2.41 (5.33)	5.55 (30.37)
Imazethapyr 75 g/ha PoE	4.79 (22.4)	5.45 (29.19)	2.95 (8.21)	2.17 (4.22)	3.06 (8.85)	8.57 (72.92)	4.58 (20.45)	4.96 (24.11)	2.64 (6.46)	2.17 (4.22)	2.35 (5.00)	7.79 (60.24)
Pendimethalin 1000 g PE <i>fb</i> imazethapyr 75 g/ha PoE	2.22 (4.4)	3.38 (10.98)	1.66 (2.26)	1.93 (3.26)	1.69 (6.76)	5.30 (27.71)	1.87 (3.00)	3.04 (8.78)	1.63 (2.15)	1.94 (3.26)	2.14 (4.10)	4.66 (21.29)
Pendimethalin 1000 g PE <i>fb</i> imazeth- apyr 75 g + quizalofop 60 g/ha PoE	1.62 (2.1)	1.65 (2.26)	1.28 (2.15)	2.01 (3.58)	2.46 (5.60)	3.88 (14.74)	1.56 (1.95)	1.53 (1.85)	1.22 (1.00)	2.01 (3.58)	2.09 (3.90)	3.55 (12.28)
Weed free	0.71 (0.0)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Weedy check	9.82 (97.0)	5.98 (35.70)	4.94 (24.19)	2.37 (5.15)	5.51 (30.20)	13.81 (192.24)	9.67 (94.00)	5.61 (31.76)	4.49 (19.87)	2.37 (5.15)	5.12 (26.00)	13.24 (176.78)
LSD (p=0.05)	0.72	0.49	0.36	0.28	0.52	1.12	0.24	0.42	0.32	0.24	0.38	0.98

Fig. in parenthesis are the original value,  $x = \sqrt{x+0.5}$  transformation

**Table 3. Effect of weed control practices on yield attributes, yield, weed index and economics**

Treatment	Weed control efficiency (%)	Weed index (%)	No. of plants (m <sup>2</sup> ) at harvest	Plant height (cm) at harvest	No. of pods/plant	Grain yield (t/ha)	Net return (x10 <sup>3</sup> /ha)
Pendimethalin 1000 g/ha PE	75.6	18.3	22.5	41.0	34.5	1.40	42.31
Pendimethalin 1000 g PE <i>fb</i> quizalofop 60 g/ha PoE	83.1	5.5	23.2	46.9	39.8	1.62	50.45
Pendimethalin 1000 g PE <i>fb</i> clodinafop 60 g/ha PoE	86.8	3.0	24.0	47.3	40.3	1.67	53.59
Pendimethalin 750 g PE <i>fb</i> quizalofop 60 g + oxyfluorfen 200 g/ha PoE	92.2	72.2	6.5	29.7	24.9	0.48	-3.88
Oxyfluorfen 200 g/ha PE	73.5	23.0	24.2	36.3	29.6	1.32	37.99
Oxyfluorfen 200 g PE <i>fb</i> quizalofop 60 g/ha PoE	81.1	10.2	24.0	42.3	35.4	1.54	46.06
Oxyfluorfen 200 g PE <i>fb</i> clodinafop 60 g/ha PoE	84.8	7.8	24.4	44.3	36.2	1.58	48.38
Oxyfluorfen 200 g + quizalofop 60 g/ha PoE	89.7	71.8	6.6	30.2	27.0	0.48	-2.41
Oxyfluorfen 200 g + <i>fb</i> clodinafop 60 g/ha PoE	88.6	69.5	7.2	30.6	27.4	0.52	0.00
Imazethapyr 75 g/ha PoE	74.7	27.3	21.9	33.6	30.3	1.25	35.86
Pendimethalin 1000 g PE <i>fb</i> imazethapyr 75 g/ha PoE	90.5	14.2	22.0	34.1	34.9	1.47	44.83
Pendimethalin 1000 g PE <i>fb</i> imazethapyr 75 g + quizalofop 60 g/ha PoE	95.0	40.0	14.3	31.4	28.7	1.03	22.62
Weed free	100.0	0.0	24.0	48.8	41.5	1.72	48.99
Weedy check	0.0	46.4	20.7	33.4	22.4	0.92	22.05
LSD (p=0.05)	-	-	3.26	5.84	5.45	0.21	-

Maximum weed control efficiency (100%) was recorded with weed free plot. Among herbicides, maximum WCE (94.99%) was recorded in pre-emergence of pendimethalin 1000 g/ha followed by combined PoE application of imazethapyr 75 g + quizalofop-ethyl 60 g/ha at 35 DAS. The lowest WCE was recorded in weedy check. Among herbicides pre-emergence application of oxyfluorfen 200 g/ha recorded the lowest WCE (73.5%). Sharma (2009) and Ratnam *et al.* (2011) also reported the maximum WCE in pre-plant and incorporation of fluchloralin at 1.0 kg/ha and the lowest in oxyfluorfen at 0.15 kg/ha.

### Effect on crop

All the weed-control measures had significantly positive impact on yield attributes and seed yield of chickpea over weedy check (Table 3). Significantly the lowest values of number of plants (20.7/m<sup>2</sup>), plant height (33.4cm) and number of pods/plant (22.4) at harvest stage of chickpea were recorded under weedy check. Among herbicides, lowest number of plants (20.7/m<sup>2</sup>), plant height (33.4cm) and number of pods/plant (22.4) at harvest stage of chickpea were recorded in PE application of pendimethalin 750 g followed by combined PoE application of quizalofop-ethyl 60 g + oxyfluorfen 200 g/ha at 30 DAS. These results were in agreement with the findings of Dungerwal *et al.* (2002). Maximum reduction in seed yield was recorded in PE application of pendimethalin 750 g followed with tank mix PoE application of quizalofop-ethyl 60 g + oxyfluorfen 200 g/ha (0.47 t/ha) at 35 DAS over weedy check (0.92 t/ha)

Maximum net monetary returns ` 53588/ha was recorded with pre-emergence application of pendimethalin 1000 g and PoE application of clodinafop 60 g/ha at 35 DAS. By registering net

monetary returns of ` 50448/ha, pre-emergence application of pendimethalin 1000 g PE and PoE application of quizalofop-ethyl 60 g/ha at 35 DAS found to be the next best treatment. Pre-emergence application of pendimethalin 750 g followed by tank mix PoE application of quizalofop-ethyl 60 g + oxyfluorfen 200 g/ha at 35 DAS and PoE application of oxyfluorfen 200 g + quizalofop-ethyl 60 g/ha at 35 DAS gave negative returns because of high cost of cultivation (Pedde *et al.* 2013).

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