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Research Paper

Evaluation of new herbicides for weed management in chickpea (*Cicer arietinum* L.)

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ABSTRACT

A field experiment was conducted on medium black soil at Instructional Farm, Junagadh Agricultural University, Junagadh during the *Rabi* season. The experiment comprising of twelve weed management treatments was conducted in a randomized block design with four replications. The results revealed that the highest mean seed (2937 kg ha^{-1}) and stover (3215 kg ha^{-1}) yields were recorded under conventional methods involving manual weeding and interculturing as and when required. The herbicidal treatments involving fluchloralin (0.675 kg ha^{-1}) or oxyfluorfen (0.120 kg ha^{-1}) as pre-emergence supplemented by post-emergence application of imazethapyr (0.050 kg ha^{-1}) at 30-35 DAS were also found equally effective. Significantly higher values of growth characters and yield attributes *viz.*, plant height, plant spread, number of branches per plant, number of pods per plant, number of seeds per pod, number of root nodules per plant and seed weight per plant were recorded with these treatments. However, test weight was not significantly influenced by various weed control treatments. Hand weeding and interculturing as and when required (weed free treatment), oxyfluorfen (0.120 kg ha^{-1} pre-eme.) with 1 hand weeding and interculturing at 30-35 DAS, fluchloralin (0.675 kg ha^{-1}) or oxyfluorfen (0.120 kg ha^{-1}) as pre-emergence supplemented by post-emergence application of imazethapyr (0.050 kg ha^{-1}) at 30-35 DAS established their superiority over rest of the treatments in keeping down weed population (*viz.*, sedge, monocot and dicot), weed biomass with higher weed control efficiency. Application of fluchloralin (0.675 kg ha^{-1}) or oxyfluorfen (0.120 kg ha^{-1}) as pre-emergence supplemented by post-emergence application of imazethapyr (0.050 kg ha^{-1}) at 30-35 DAS recorded lower weed index and higher herbicide efficiency index. Among all treatments tried in this experiment manual weeding and interculturing as and when required was found to be best and profitable by recording maximum net realization of Rs. 45384 ha^{-1}. This was closely followed by oxyfluorfen at 0.120 kg ha^{-1} (Rs. 42517 ha^{-1}) or fluchloralin at 0.675 kg ha^{-1} (Rs. 40820 ha^{-1}) as pre-emergence supplemented by post-emergence application of imazethapyr at 0.050 kg ha^{-1}.

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Key words : Weed management, Herbicides, Oxyfluorfen, Fluchloralin

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is world's important pulse crop occupying third position among pulses. Among a dozen of different grain legumes under cultivation in India, chickpea is the leading crop and is grown in *Rabi* season. Indian subcontinent accounts for 67 per cent of production of chickpea in the world. Indian farmers pay reasonable attention to cultivation, especially in respect of seed bed preparation, manuring and irrigation. Crop yield losses due to weeds have been estimated to range from 30 to 50 per cent (*Singh et al.,* 1985; *Balayan*, 1987). However, sufficient attention has not been paid to weed control aspect which remains one of the constraints in boosting up the gram production.

In view of the paucity of adequate research on integrated weed management in the chickpea crop, the present investigation was undertaken.

MATERIALS AND METHODS

The experiment was laid out in Randomized Block Design with four replications. The treatments were assigned at random to each experimental plot in each replication at Instructional Farm, Department of Agronomy, College of Agriculture, Gujarat Agricultural

University, Junagadh during *Rabi* season 2004. The soil of experimental plot was clayey in texture having pH 7.9. From fertility point of view, the soil was low in available nitrogen, medium in available phosphorus and high in available potash.The experiment comprised of twelve weed management treatments *viz.*, oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. (T_1), oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + 1 HW + 1 IC at 30 – 35 DAS (T_2), fluchloralin @ 0.675 kg ha^{-1} pre-eme. + 1 HW + 1 IC at 30 – 35 DAS (T_3), imazethapyr @ 0.050 kg ha^{-1} post-eme. (T_4), imazethapyr @ 0.075 kg ha^{-1} post-eme. (T_5), quizalofop ethyl @ 0.025 kg ha^{-1} post-eme. (T_6), quizalofop ethyl @ 0.050 kg ha^{-1} post-eme. (T_7), fluchloralin @ 0.675 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. (T_8), oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. (T_9), 1 HW at 30 DAS (T_{10}), weed free (T_{11}) and unweeded control (T_{12}). Observations were recorded on different characters and mean values were subjected to statistical analysis

RESULTS AND DISCUSSION

The experimental findings as influenced by different parameters are discussed below :

Effect on growth parameters:

Plant population:

Initial and final plant populations were not affected significantly by the different weed control treatments. Fluchloralin, oxyfluorfen, imazethapyr and quizalofop ethyl were found safe for chickpea (Table 1).

Plant height (cm):

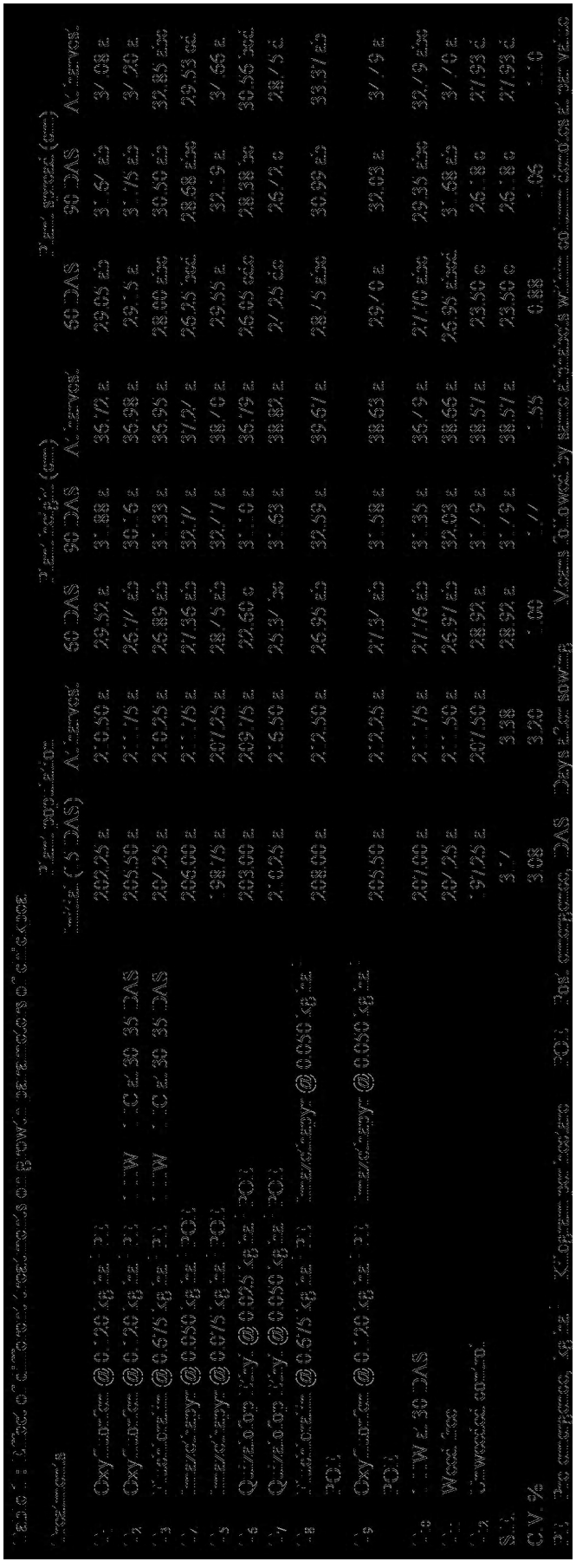
Plant height of chickpea at 60 DAS was affected significantly by the different weed control treatments (Table 1). The minimum values of plant height at 60 DAS were recorded only under post-emergence application of quizalofop ethyl at higher and lower doses. However, plant heights recorded at 90 DAS and at harvest were not differed significantly by different weed control treatments.

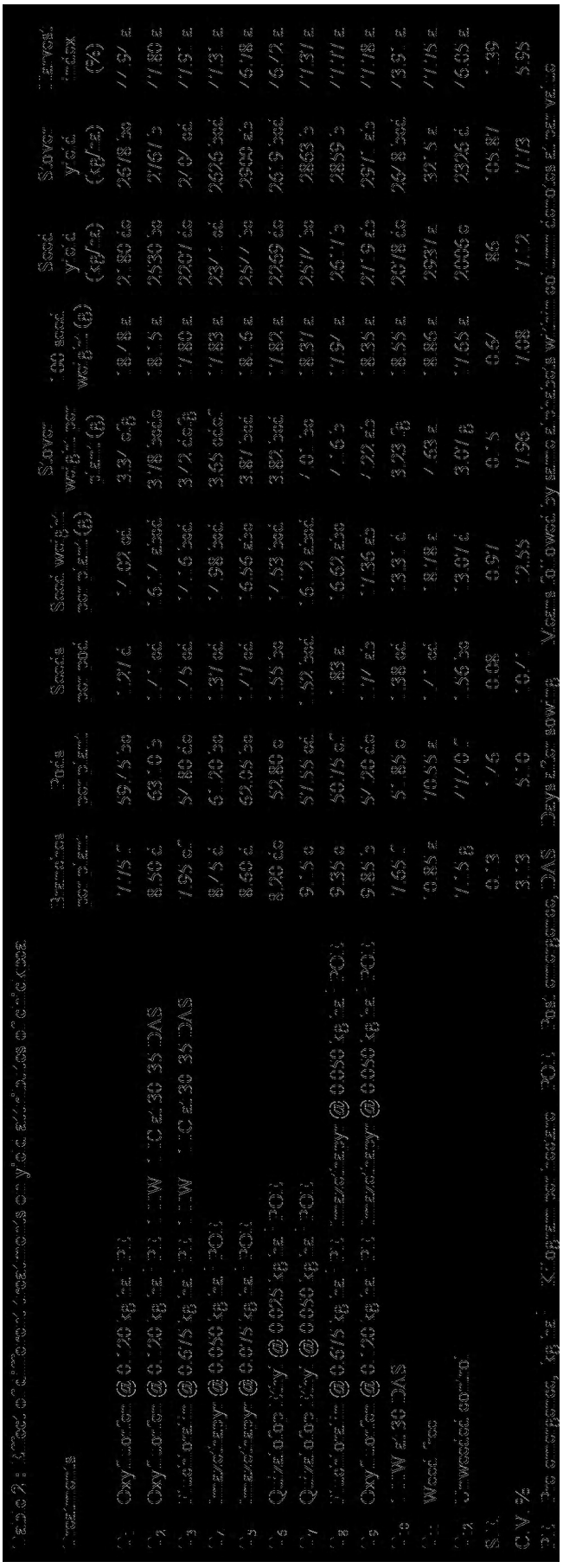
Plant spread (cm):

Higher values of plant spread were obtained under treatment imazethapyr @ 0.075 kg ha^{-1} post-eme. at 30-35 DAS (Table 1). It was comparable with pre-emergence application of oxyfluorfen @ 0.120 kg ha^{-1} with imazethapyr @ 0.050 kg ha^{-1} post-eme. at 30-35 DAS.

Effect of different treatments on yield attributes and yield :

Yield attributing characters were significantly





affected by different treatments. Maximum values of yield attributes *viz.*, number of branches per plant, number of pods per plant, number of seeds per pod, number of root nodules per plant and seed weight per plant were recorded under weed free condition. Among different treatments, pre-emergence application of fluchloralin at 0.675 kg ha^{-1} and oxyfluorfen at 0.120 kg ha^{-1} each with post-emergence application of imazethapyr at 0.050 kg ha^{-1} recorded higher values of these components. However, test weight was not affected by different treatments (Table 2).

Effect of different treatments on yield on chickpea:
Yield (kg ha^{-1}):

Significantly higher seed yield (2937 kg ha^{-1}) and stover yield(3215 kg ha^{-1}) of chickpea was recorded under weed free condition over rest of the treatments except oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme (Table 2).

Effect of different treatments on weed parameters:
Weed population:

Pre-emergence application of oxyfluorfen @ 0.120 kg ha^{-1} + 1 HW + 1 IC at 30 – 35 DAS and fluchloralin @ 0.675 kg ha^{-1} pre-eme. + 1 HW + 1 IC at 30 – 35 DAS were found effective against all types of weeds at 20 and 40 DAS. Oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. was found effective against all types of weeds at 60 DAS. Oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + 1 HW + 1 IC at 30 – 35 DAS and fluchloralin @ 0.675 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. were found effective against all types of weeds at harvest (Table 3).

Dry weight of weeds (kg ha^{-1}):

Significantly lower dry weight of weeds was recorded under weed free treatment. However, oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + 1 HW + 1 IC at 30 – 35 DAS and fluchloralin @ 0.675 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme were also found equally effective in this respect (Table 4).

Weed control efficiency:

Significantly higher weed control efficiency was obtained under weed free treatment (100 %). It was closely followed by oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + 1 HW + 1 IC at 30 – 35 DAS (99.01 %) and fluchloralin @ 0.675 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. (98.54 %) (Table 4).

Table 3 : Effect of different treatments on weed parameters

Treatments		No. of sedge weeds / m^2				No. of monocot weeds / m^2				No. of dicot weeds / m^2			
		20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest
T_1	Oxyfluorfen @ 0.120 kg ha^{-1} PE	2.090 c (4.39)	3.980 b (15.84)	4.830 b (23.32)	5.190 cd (26.99)	2.860 c (8.18)	3.950 b (15.59)	4.950 b (24.47)	5.760 b (33.19)	3.270 c (10.70)	4.060 b (16.48)	4.930 b (24.27)	5.840 b (34.08)
T_2	Oxyfluorfen @ 0.120 kg ha^{-1} PE + 1 HW + 1 IC at 30-35 DAS	2.360 c (5.57)	2.310 de (5.34)	2.980 e (8.86)	3.440 e (11.83)	2.940 c (8.64)	2.620 d (6.88)	3.660 c (13.36)	4.760 cd (21.83)	3.310 c (10.94)	2.720 e (7.37)	3.710 cde (13.73)	5.360 bc (28.72)
T_3	Fluchloralin @ 0.675 kg ha^{-1} PE + 1 HW + 1 IC at 30-35 DAS	1.780 c (3.16)	2.210 e (4.87)	3.610 de (13.04)	3.670 e (13.46)	3.030 bc (9.20)	2.670 d (7.14)	3.690 c (13.60)	5.020 c (25.18)	3.370 bc (11.36)	2.690 e (7.23)	3.950 cde (15.58)	5.540 bc (30.72)
T_4	Imazethapyr @ 0.050 kg ha^{-1} POE	3.510 b (12.35)	3.520 bc (12.41)	4.540 bc (20.64)	5.080 cd (25.85)	3.790 a (14.35)	4.500 ab (20.22)	4.090 c (16.72)	5.060 c (25.63)	4.080 a (16.65)	4.600 a (21.16)	3.950 cde (15.62)	5.390 bc (29.11)
T_5	Imazethapyr @ 0.075 kg ha^{-1} POE	4.000 ab (15.96)	3.960 b (15.65)	4.050 cd (16.42)	4.650 d (21.62)	3.810 a (14.48)	4.530 ab (20.53)	3.800 c (14.41)	4.810 c (23.13)	4.410 a (19.46)	4.630 a (21.46)	3.590 de (12.87)	5.160 c (26.61)
T_6	Quizalofop Ethyl @ 0.025 kg ha^{-1} POE	4.220 ab (17.77)	4.120 b (16.97)	5.060 b (25.57)	5.810 bc (33.78)	3.660 ab (13.38)	4.110 b (16.88)	3.870 c (14.99)	4.930 c (24.33)	3.930 ab (15.47)	3.440 cd (11.84)	4.110 cd (16.91)	5.270 bc (27.77)
T_7	Quizalofop Ethyl @ 0.050 kg ha^{-1} POE	4.340 a (18.85)	4.180 b (17.46)	5.080 b (25.78)	5.760 bc (33.20)	3.740 a (13.97)	4.150 b (17.22)	3.630 c (13.18)	4.650 cd (21.61)	4.260 a (18.16)	3.110 cde (9.70)	3.950 cde (15.64)	5.000 cd (24.96)
T_8	Fluchloralin @ 0.675 kg ha^{-1} PE + Imazethapyr @ 0.050 kg ha^{-1} POE	2.520 c (6.37)	2.630 de (6.94)	3.030 e (9.15)	3.550 e (12.63)	3.060 bc (9.39)	3.350 c (11.21)	3.020 d (9.12)	4.230 de (17.88)	3.420 bc (11.67)	3.560 bc (12.71)	3.590 de (12.87)	4.620 de (21.35)
T_9	Oxyfluorfen @ 0.120 kg ha^{-1} PE + Imazethapyr @ 0.050 kg ha^{-1} POE	2.470 c (6.12)	2.500 de (6.25)	2.870 e (8.22)	3.630 e (13.16)	2.910 c (8.46)	3.190 cd (10.19)	2.730 d (7.46)	3.890 e (15.17)	3.280 c (10.73)	3.350 cd (11.23)	3.460 e (11.95)	4.320 e (18.70)
T_{10}	1 HW at 30 DAS	3.830 ab (14.65)	2.940 cd (8.62)	5.230 b (27.40)	6.030 b (36.32)	4.110 a (16.86)	2.780 cd (7.73)	3.770 c (14.21)	5.190 c (26.89)	4.370 a (19.13)	2.940 de (8.62)	4.240 c (17.98)	5.510 bc (30.34)
T_{11}	Weed free	0.000 d (0.00)	0.000 f (0.00)	0.000 f (0.00)	0.000 f (0.00)	0.000 d (0.00)	0.000 e (0.00)	0.000 e (0.00)	0.000 f (0.00)	0.000 d (0.00)	0.000 f (0.00)	0.000 f (0.00)	0.000 f (0.00)
T_{12}	Unweeded control	3.970 ab (15.73)	6.270 a (39.35)	6.790 a (46.05)	8.590 a (73.83)	4.410 a (17.16)	4.990 a (24.89)	5.660 a (31.98)	6.420 a (41.19)	4.520 a (20.41)	5.080 a (25.80)	5.520 a (30.46)	7.170 a (51.45)
S.E. ±		0.2554	0.2162	0.2424	0.2535	0.2104	0.2037	0.1710	0.1651	0.1949	0.1768	0.1761	0.1761
C.V. %		17.46	13.42	12.12	10.98	13.26	11.96	9.57	7.25	11.08	10.56	9.40	6.88

PE = Pre emergence DAS = Days after sowing POE = Post emergence kg ha^{-1} = Kilogram per hectare The data subjected to square root transformation ($\sqrt{x}$)
Figures in parenthesis are original value Means followed by same alphabets within column denotes at par value

Table 4 : Effect of different treatments on dry weight of weeds, weed index (WI), weed control efficiency (WCE) herbicide efficiency index (HEI), economics and net return after harvest in chickpea

Treatments		Dry weight of weeds (kg/ha)	WI (%)	WCE (%)	HEI (%)	Net realization Rs./ha	Net return increase over control Rs./ha
T_1	Oxyfluorfen @ 0.120 kg ha^{-1} PE	42.03 d	16.88 ab	93.22 d	1.23 c	34477	2457
T_2	Oxyfluorfen @ 0.120 kg ha^{-1} PE + 1 HW + 1 IC at 30–35 DAS	6.13 h	14.03 b	99.01 a	27.84 a	39402	7382
T_3	Fluchloralin @ 0.675 kg ha^{-1} PE + 1 HW + 1 IC at 30–35 DAS	22.98 efg	25.08 a	96.33 bc	5.87 bc	34187	2167
T_4	Imazethapyr @ 0.050 kg ha^{-1} POE	30.00 de	18.28 ab	95.18 cd	3.90 bc	36836	4816
T_5	Imazethapyr @ 0.075 kg ha^{-1} POE	25.90 ef	9.38 bc	95.82 c	6.69 bc	39990	7970
T_6	Quizalofop Ethyl @ 0.025 kg ha^{-1} POE	83.15 c	18.56 ab	86.70 f	1.60 c	35657	3637
T_7	Quizalofop Ethyl @ 0.050 kg ha^{-1} POE	70.00 c	10.93 b	88.76 e	2.79 c	40082	8062
T_8	Fluchloralin @ 0.675 kg ha^{-1} PE + Imazethapyr @ 0.050 kg ha^{-1} POE	9.08 gh	10.89 b	98.54 a	28.97 a	40820	8800
T_9	Oxyfluorfen @ 0.120 kg ha^{-1} PE + Imazethapyr @ 0.050 kg ha^{-1} POE	11.13 fgh	7.55 bc	98.21 ab	20.61 ab	42517	10497
T_{10}	1 HW at 30 DAS	117.05 b	17.46 ab	81.14 g		33135	1115
T_{11}	Weed free	0.00 h	0.00 c	100.00 a		45384	13364
T_{12}	Unweeded control	622.20 a	27.54 a	0.00 h		32020	0
S.E.±		5.04	3.31	0.69	5.29		
C.V. %		11.64	44.97	1.60	95.73		

PE = Pre-emergence DAS = Days after sowing POE = Post-emergence kg ha^{-1} = Kilogram per hectare
Figure in parenthesis are transformed value
Means followed by same alphabets within column denotes at par value

Weed index and herbicide efficiency index:

Significantly lower weed index and higher herbicide efficiency index was observed under treatment oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. However, it was comparable with fluchloralin @ 0.675 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme (Table 4).

Economics :

The most advantageous treatment was weed free treatment resulting in higher seed yield with maximum net realization of Rs. 45384 ha^{-1}. The other profitable treatments were oxyfluorfen @ 0.120 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme. (Rs. 42517 ha^{-1}) and fluchloralin @ 0.675 kg ha^{-1} pre-eme. + imazethapyr @ 0.050 kg ha^{-1} post-eme (Rs. 40820 ha^{-1}) (Table 4).

Based on the results of one year experimentation, it seems quite logical to conclude that potential production, profit and effective weed management in chickpea on medium black soil of South Saurashtra Agro-Climatic Region can be achieved by conventional methods *i.e.* weed free condition where labours are easily available. Alternatively combination of fluchloralin at 0.675 kg ha^{-1} or oxyfluorfen @ 0.120 kg ha^{-1} as pre-emergence supplemented by imazethapyr @ 0.050 kg ha^{-1} as post-emergence at 30-35 DAS should be adopted where farm labourers are scare.

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