



Evaluation of Sequential Application of Herbicides in Chickpea (*Cicer arietinum* L.)

D Kalyani, K Srinivasulu, K Chandrasekhar and P Ravindrababu

Department of Agronomy, Agricultural College, Bapatla 522 101

ABSTRACT

A field experiment was conducted during the *rabi* season of 2010 at the Agricultural College Farm, Bapatla, on clay loam soils to evaluate the sequential application of herbicides in chickpea. All herbicidal treatments reduced the total density and dry weight of weeds significantly over the weedy check. Pre-emergence application of pendimethalin @ 1.0 kg a.i ha⁻¹ followed by propaquizafop @ 75 g a.i ha⁻¹ as post-emergence application at 20 days after sowing and pre-emergence application of pendimethalin @ 1.0 kg a.i ha⁻¹ followed by imazethapyr @ 75 g a.i ha⁻¹ as post-emergence application at 20 days after sowing were found to be equally effective as handweeding twice treatment in reducing density and dry weight of weeds resulting in to increased plant height, number of branches per plant, dry weight, yield attributes and grain yield of chickpea.

Key words : Handweeding, weed density, PRE and POST herbicides, Returns per rupee of investment, Weed control efficiency.

Chickpea (*Cicer arietinum* L.) is one of the most important *rabi* pulse crop of India. Chickpea being slow in its early stages of growth and short stature plant is highly susceptible to weed competition and causing considerable yield loss ranging from 60 to 70 per cent depending upon nature and intensity of weed flora (Chaudhary *et al.*, 2005).

Crop weed competition is critical during first 40 days after sowing. Pre-emergence herbicides offer weed control initially for 25 to 30 days after sowing. To control the weed flushes emerging later in the season, application of post-emergence herbicides is necessary as hand weeding became difficult due to non-availability of labour during peak periods despite of its higher cost. Hence, present study was under taken to evaluate the sequential application of herbicides in chickpea.

MATERIAL AND METHODS

The experiment was conducted at the Agricultural College Farm, Bapatla during *rabi* 2010. The soil was clay loam in texture having pH of 7.6, organic carbon 0.5 %, available nitrogen 392.5 kg ha⁻¹, phosphorus 25.0 kg ha⁻¹ and potassium 184 kg ha⁻¹. The experiment was laid

out in randomized block design with 8 treatments replicated thrice. The treatments consists of T₁- Handweeding twice at 20 and 40 DAS, T₂- pendimethalin @ 1.0 kg a.i ha⁻¹ as pre-emergence, T₃- propaquizafop @ 75 g a.i. ha⁻¹ as post-emergence at 20 DAS, T₄- imazethapyr @ 75 g a.i. ha⁻¹ as post-emergence at 20 DAS, T₅- pendimethalin @ 1.0 kg a.i ha⁻¹ as pre-emergence followed by hand weeding at 40 DAS, T₆ - pendimethalin @ 1.0 kg a.i ha⁻¹ as pre-emergence followed by propaquizafop @ 75 g a.i. ha⁻¹ as post-emergence at 20 DAS, T₇- pendimethalin @ 1.0 kg a.i ha⁻¹ as pre-emergence followed by imazethapyr @ 75 g a.i. ha⁻¹ as post-emergence at 20 DAS and T₈- Weedy check. After thorough land preparation a basal dose of 20-50-40 kg N, P₂O₅ and K₂O, respectively was applied uniformly over the experimental area. Chickpea variety JG 11 was sown on 31st December 2010 and harvested on 28th March 2011 by adopting 30 x 10 cm spacing. Pendimethalin was sprayed uniformly with knapsack sprayer with discharge rate of 500 l ha⁻¹ on the same day of sowing as per the treatments. After recording the observations both on weeds and crop at 20 DAS, remaining post-emergence herbicides and hand weeding were carried out as per the

Table1. Effect of different weed management practices on density, dry weight of weeds, WCE and WI at 60 DAS in chickpea.

Treatments	Density (m ²)				Dry weight (g m ⁻²)	WCE (%)	WI (%)
	Grasses	Sedges	BLWs	Total			
T ₁ - Hand weeding twice at 20 &40 DAS	1.33 (2.00)	2.76 (8.00)	1.67 (3.00)	3.49 (13.00)	8.33	69.4 (87.5)	0.0 (0.0)
T ₂ - Pendimethalin @1.0 kg a.i ha ⁻¹ as PRE	4.30 (18.66)	5.08 (26.66)	2.55 (6.66)	7.12 (51.98)	35.00	45.8 (51.4)	29.9 (25.4)
T ₃ -Propaquizafop @75 g a.i ha ⁻¹ as POST at 20 DAS	2.55 (6.66)	3.86 (16.0)	2.93 (9.00)	5.47 (31.66)	39.33	42.4 (45.5)	25.8 (19.4)
T ₄ -Imazethapyr @ 75 g a.i ha ⁻¹ as POST at 20 DAS	3.43 (12.66)	3.05 (10.66)	2.27 (5.33)	5.30 (28.65)	23.67	54.4 (66.1)	25.3 (19.4)
T ₅ - T ₂ fb Hand weeding at 40 DAS	1.67 (3.20)	3.55 (12.00)	1.67 (3.00)	4.20 (18.20)	19.00	65.7 (83.0)	21.3 (13.2)
T ₆ - T ₂ fb Propaquizafop @75 g a.i ha ⁻¹ as POST at 20 DAS	1.67 (3.0)	3.03 (10.00)	2.27 (5.33)	4.13 (18.33)	14.67	65.4 (82.7)	15.3 (7.1)
T ₇ - T ₂ fb Imazethapyr @ 75 g a.i ha ⁻¹ as POST at 20 DAS	3.13 (10.00)	2.92 (9.00)	1.67 (3.00)	4.59 (22.00)	16.00	60.6 (75.9)	15.8 (7.7)
T ₈ - Weedy check	5.02 (25.33)	5.51 (30.66)	5.41 (29.33)	9.22 (85.32)	71.00	0.0 (0.0)	37.3 (36.8)
SEm ±	0.31	0.37	0.26	0.29	1.29	1.3	2.8
CD (P=0.05)	0.95	1.12	0.81	0.90	3.91	4.1	8.5
CV%	18.87	17.26	18.22	9.41	7.87	5.6	22.8

Figures in the parentheses are original values; Square root and arc sine transformations used for statistical analysis of densities and WCE, WI respectively. BLWs = broad leaved weeds, WCE = Weed Control Efficiency, WI = Weed Index. PRE = Pre-emergence application, POST = Post emergence application and fb = followed by

treatments. Data on number of weeds were subjected to square root transformation before statistical analysis. Weed control efficiency and weed index were calculated as per the formulae given below.

$$\text{WCE (\%)} = \frac{\text{DWC} - \text{DWT}}{\text{DWC}} \times 100$$

Where,

WEC = Weed control efficiency
DWC = Dry weight of weeds in weedy check
DWT = Dry weight of weeds in treated plot.

$$\text{WI} = \frac{\text{X} - \text{Y}}{\text{X}} \times 100$$

Where,

WI = Weed index
X = Grain yield from weed free plot
(As weed free plot was not maintained, the yield of T₁ was taken)
Y = Grain yield from plots for which WI is to be calculated.

RESULTS AND DISCUSSION

Effect on weeds:

The weed flora identified in the experimental field was *Cynodon dactylon*,

Table 2. Effect of different weed management practices on growth parameters and seed yield of chickpea

Treatments	Plant height (cm)	Dry matter accumulation (g m ⁻²)	Yield attributing characters			Seedyield (kg ha ⁻¹)
			Pods plant ⁻¹	Seeds pod ⁻¹	100 seed weight (g)	
T ₁ - Hand weeding twice at 20 &40 DAS	40.0	297	43.6	1.4	21.8	1255
T ₂ - Pendimethalin @1.0 kg a.i ha ⁻¹ as PRE	35.0	221	31.3	1.2	20.5	934
T ₃ - Propaquizafop @75 g a.i ha ⁻¹ as POST at 20 DAS	35.0	233	30.6	1.2	20.6	1006
T ₄ -Imazethapyr @ 75 g a.i ha ⁻¹ as POST at 20 DAS	35.0	255	31.7	1.2	20.6	1009
T ₅ - T ₂ fb Hand weeding at 40 DAS	36.0	272	35.1	1.2	21.0	1088
T ₆ - T ₂ fb Propaquizafop @75 g a.i ha ⁻¹ as POST at 20 DAS	38.0	278	41.5	1.3	20.9	1165
T ₇ - T ₂ fb Imazethapyr @ 75 g a.i ha ⁻¹ as POST at 20 DAS	35.0	277	40.7	1.3	20.9	1159
T ₈ - Weedy check	34.0	199	22.7	1.2	19.7	790
SEm ±	1.0	7	2.5	0.03	4	45
CD (P=0.05)	3.0	21	7.6	0.1	NS	137
CV%	6.0	5	12.6	5.0	3	7

Cyperus rotundus, Linn., *Trianthema portulacastrum*, Linn., *Digera arvensis*, Forsk., *Euphorbia hirta*, Linn., *Euphorbia geniculata*, *Aristolochia bracteata*, Retz., *Chozophora rottleria*, *Cleome viscosa*, L., *Trichodesma indicum*, R.Br., *Amaranthus viridis*, Linn., *Physalis minima* and *Phyllanthus madraspatensis*. Among the weed flora identified in the experimental plot, *Cynodon dactylon* and *Cyperus rotundus* were the two predominant weed species.

All weed management practices significantly reduced the density and dry weight of weeds over weedy check. (Table1). Significant reduction in the density and dry weight of grasses and sedges was recorded with the treatments where propaquizafop and imazethapyr involved, respectively. Handweeding twice at 20 and 40 DAS recorded the lowest dry matter and it gave highest weed control efficiency than other weed management practices. Similar findings were reported by Dadhich and Malik (1991). Among herbicidal treatments, sequential application of

pendimethalin followed by propaquizafop at 20 days after sowing (T₆) and pre-emergence application of pendimethalin followed by imazethapyr at 20 days after sowing (T₇) was found to be equally effective as handweeding twice and superior to rest of the herbicidal treatments in reducing the density and dry weight of weeds and resulted into higher weed control efficiency. Results were in conformity with that obtained by Kacchadiya *et al.* (2009)

Effect on crop:

All weed management practices recorded significantly increased plant height, dry weight of plants, yield attributes and seed yield of chickpea over the weedy check. Higher number of pods per plant, seeds per pod was recorded with handweeding twice and was on par with sequential application of pendimethalin followed by propaquizafop at 20 DAS (T₆) and pendimethalin followed by imazethapyr at 20 DAS (T₇) treatments. However, test weight was non significant with various weed management practices. Similar findings were reported by Mukharjee and Singh (2005).

Table 3. Economics of different weed management practices in chickpea

Treatments	Grain yield (kg ha ⁻¹)	Cost of cultivation (Rs ha ⁻¹)	Gross returns (Rs ha ⁻¹)	Net returns (Rs ha ⁻¹)	Returns per rupee invested
T ₁ - Hand weeding twice at 20 & 40 DAS	1255	16496	37,650	21,154	1.28
T ₂ - Pendimethalin @ 1.0 kg a.i ha ⁻¹ as PRE	934	12,589	28,020	15,431	1.22
T ₃ - Propaquizafop @ 75 g a.i ha ⁻¹ as POST at 20 DAS	1006	12,802	30,180	17,378	1.35
T ₄ - Imazethapyr @ 75 g a.i ha ⁻¹ as POST at 20 DAS	1009	12,652	30,270	17,618	1.39
T ₅ - T ₂ fb Hand weeding at 40 DAS	1088	15,271	32,640	17,369	1.13
T ₆ - T ₂ fb Propaquizafop @ 75 g a.i ha ⁻¹ as POST at 20 DAS	1165	14,259	34,950	20,691	1.45
T ₇ - T ₂ fb Imazethapyr @ 75 g a.i ha ⁻¹ as POST at 20 DAS	1159	14,109	34,770	20,661	1.46
T ₈ - Weedy check	790	11,132	23,700	12,568	1.12

Input costs

Seed	:	Rs. 30.00 kg ⁻¹
Urea	:	Rs. 5.00 kg ⁻¹
SSP	:	Rs. 4.60 kg ⁻¹
MOP	:	Rs. 3.20 kg ⁻¹
Pendimethalin	:	Rs. 390 L ⁻¹
Propaquizafop	:	Rs. 2000 L ⁻¹
Imazethapyr	:	Rs. 1800 L ⁻¹

Output price

Seed : Rs.30.00 kg⁻¹

All weed management practices produced significantly higher seed yield compared to the weedy check. Highest seed yield was recorded with hand weeding twice treatment which was on par with sequential application of pendimethalin followed by propaquizafop (T₆) and pendimethalin followed by imazethapyr (T₇) treatments. Reduced seed yield in T₅ treatment compared to T₆ and T₇ treatments may be due to inferiority of pendimethalin to control grassy weeds and also due to late weeding (*i.e.* at 40 DAS) weeds were encouraged to grow more vigorously and they did enough damage at the early stage itself.

Economics:

The highest net profit of Rs. 21,154 was recorded with handweeding twice treatment which

was closely followed by pendimethalin @ 1.0 kg ha⁻¹ fb propaquizafop @ 75 g a.i ha⁻¹ (T₆) and pendimethalin @ 1.0 kg ha⁻¹ fb imazethapyr (T₇) treatments. However, the return per rupee of investment worked out with handweeding was only 1.28. This was mainly because of the higher cost involved in manual weeding resulting in lower returns per rupee of investment.

Over all study indicated that, application of pendimethalin @ 1.0 kg ha⁻¹ followed by propaquizafop @ 75 g a.i ha⁻¹ at 20 DAS (T₆) and pendimethalin @ 1.0 kg ha⁻¹ followed by imazethapyr at 20 DAS (T₇) treatments were found to be equally effective to handweeding twice in reducing density, dry weight of weeds resulted in to better growth and development of the crop which ultimately increased seed yield and net returns per rupee of investment in chickpea.

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(Received on 25.08.2011 and revised on 19.10.2011)