

## Influence of crop geometry, cultivar and weed-management practice on crop-weed competition in chickpea (*Cicer arietinum*)

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### ABSTRACT

A field experiment was conducted to study the influence of 2 crop geometries (30 and 45 cm), 3 cultivars ('Avarodhi', 'Radhey' and 'Pant G 114') and 2 weed-management practices (weed-free and weedy) on crop-weed competition in chickpea (*Cicer arietinum* L.) during the winter seasons of 1996–97 and 1997–98 at Agricultural Research Farm, Varanasi, Uttar Pradesh. Chickpea cultivar 'Avarodhi' proved better competitor for space, soil moisture and nutrient compared to 'Radhey' and 'Pant G 114'. Row spacing of 45 cm accumulated more nutrient and utilized soil moisture efficiently in comparison to 30 cm row spacing. Full-season weed competition reduced grain yield, nutrient accumulation and utilization of soil moisture in chickpea cultivars in comparison to full-season weed free. Variety 'Avarodhi' and 45 cm row spacing recorded the highest grain yield, net return and benefit : cost ratio compared to 'Radhey' and 'Pant G 114' and 30 cm row spacing respectively.

**Key words:** Weed competition, Row spacing, Cultivars, Soil moisture, Nutrient, Space

Eastern part of Uttar Pradesh is dominated by rice crop in rainy *kharif* season followed by cultivation of wheat, oilseeds and pulses in winter (*rabi*) season. Chickpea is an important pulse crop of this region predominantly grown as rainfed crop. Among the factors responsible for low productivity of chickpea, the infestation of weeds and their competitive effects at all the stages of crop are important. Appropriate planting arrangement would provide more efficient use of available resources, viz. soil moisture, nutrients, and will allow a crop to exert greater inter-specific competition and reduce losses due to weeds (Zimdahl, 1980). Differences in weed suppression among crops or cultivars has long been established. According to Blackshaw (1994) cultivars for sustainable systems should be both high-yielding and competitive against weeds. Keeping these facts in view, the present investigation was carried out to find out the effect of row spacing, cultivars and weed-management practices on crop-weed competition in chickpea.

### MATERIALS AND METHODS

A field experiment was conducted during the winter seasons of 1996–97 and 1997–98 at Institute of Agricultural Sciences, BHU, Varanasi. The soil was clay loam, low in available nitrogen (196.0 and 198 kg/ha), medium in available phosphorus (20.2 and 20.2 kg/ha) and available potassium (224.3 and 226.2 kg/ha), with pH 7.4. The

treatment combinations comprising 3 genotypes of chickpea ('Avarodhi', 'Radhey' and 'Pant G 114' (and 2 row spacing (30 cm and 45 cm) in main plot and 2 weed-management treatments (weed-free and weedy) in subplot, were replicated 4 times in split-plot design. The growth habit of 'Avarodhi', 'Radhey' and 'Pant G 114' was semi-erect, spreading and semi-spreading. The crop was sown in the first week of November. Uniform dose of nitrogen, phosphorus and potassium @ 20, 40 and 20 kg/ha were placed through urea, single superphosphate and muriate of potash as basal dose before sowing of seeds. The plant population was maintained up to 330,000 ha after the germination. Lateral canopy spread of 5 randomly selected plants were measured using hand-made mobile metal scale. Moisture percentage of soil was worked out by thermogravimetric method as outlined by Dastane (1967) and expressed in mm water. The nitrogen, phosphorus and potassium in plant samples were estimated by standard analytical methods.

### RESULTS AND DISCUSSION

The weed flora observed in the experimental field were *Avena ludoviciana* Durie., *Cynodon dactylon* (L.) Pers., *Phalaris minor* Retz., *Cyperus rotundus* L. and *Anagallis arvensis* L.; *Argemone mexicana* L., *Chenopodium album* L., *Melilotus alba* Desr., *Melilotus indica* (L.) All., *Solanum nigrum* L., *Vicia hirsuta* L. and *Vicia sativa* L.

**Table 1.** Effect of row spacing, genotype and weed management on weed dry weight, plant height, lateral canopy spread, grain yield, moisture use, moisture-use efficiency and economics of chickpea (average data of 2 years)

Treatment	Weed dry weight (g/m <sup>2</sup> )	Plant height (cm)		Lateral canopy spread (cm)		Grain yield (q/ha)	Total moisture use (mm)	Moisture-use efficiency (kg/mm/ha)	Net return (Rs/ha)	Benefit: cost ratio
		Days after sowing		Days after sowing						
		At 60 days	At 90 days	At 60 days	At 120 days					
<i>Row spacing (cm)</i>										
30	5.0 (26.7)	27.4	59.2	17.0	43.3	19.46	212.7	9.09	18,444	4.23
45	5.2 (29.8)	26.5	56.9	17.8	44.4	20.60	218.2	9.43	20,008	4.57
CD (P=0.05)	NS	NS	1.4	NS	NS	0.85				
<i>Genotype</i>										
'Avarodhi'	4.8 (26.2)	24.3	64.2	17.7	47.9	21.14	213.5	9.84	20,564	4.61
'Radhey'	5.2 (29.2)	25.7	53.7	17.5	43.1	19.83	217.2	9.08	18,964	4.34
'Pant G 114'	5.3 (29.6)	25.7	56.4	16.9	40.6	19.17	215.3	8.85	18,134	4.23
CD (P=0.05)	0.3	1.7	2.5	NS	2.9	0.97				
<i>Weed management</i>										
Weed-free	0.7 (0.0)	26.4	57.1	18.8	47.2	23.39	206.6	11.27	22,578	4.57
Weedy	9.5	27.5	59.1	16.0	40.4	16.71	224.0	7.41	15,868	4.17
CD (P=0.05)	0.3	1.1	2.0	0.7	1.2	0.80				

Data in parentheses indicate original values

Average common cost of cultivation, Rs 3,000/ha; cost of grain, Rs 1,160/q; cost of stalk Rs 52/q

### Performance of variety

Genotype had significant influence on weed dry weight. 'Avarodhi' significantly reduced weed dry weight in comparison to 'Radhey' and 'Plant G 114'. However, variations in weed dry weight due to 'Radhey' and 'Pant G 114' were statistically at par (Table 1).

The plant height and lateral canopy spread was significantly higher in 'Avarodhi' compared to 'Radhey' and 'Pant G 114' at 120 days stage. This may be attributed to the fact that 'Avarodhi' being semi-erect had faster growth in upward direction and resulted in more plant height and faced minimum weed competition by providing shading effect on weeds and consequently had more lateral canopy spread and in development of broad dense foliage. Weed-suppressing abilities of Indian mustard cultivars were also attributed to early growth of broad dense foliage by Yadav and Narwal (1997).

'Avarodhi' recorded maximum uptake (N, P and K) in both grain and stalk than 'Radhey' and 'Pant G 114.' 'Pant G 114' had the minimum uptake of N, P and K among all the cultivars. The higher nutrient uptake by cultivar 'Avarodhi' may be due to more grain yield and lower depletion of nutrients by weeds, than 'Radhey' and 'Pant G 114' (Table 2). The total moisture use was less in 'Avarodhi, which may be due to less weed dry-matter ac-

cumulation resulting in less transpirational loss of water. However, the moisture-use efficiency was higher in genotype 'Avarodhi' in comparison to 'Radhey' and 'Pant G 114' due to less total moisture use and more grain yield in respective varieties. Davis *et al.* (1965) also reported the differential ability of species to extract soil moisture from various locations in the soil.

'Avarodhi' proved to be a better competitor for growth resources and recorded significantly more grain yield (21.13 q/ha) in comparison to 'Radhey' (19.83 q/ha) and 'Pant G 114' (19.179 q/ha). The net return and benefit: cost ratio were also highest in 'Avarodhi' (Rs 20,564/ha and 4.61), followed by 'Radhey' (Rs 18,964/ha and 4.34) and 'Pant G 114' (Rs 18,134/ha and 4.23). Niemann (1992) in winter barley cultivars and Mishra and Bhan (1997) in pea cultivars, also reported differential response of cultivars due to weed pressure.

### Effect of crop geometry

Significant variations in weed dry weight at harvest were not observed due to row spacing (Table 1). At 120 days stage, wider row spacing (45 cm) recorded significantly smaller plant than narrow row spacing (30 cm). In case of lateral canopy spread, significant variations were not recorded at 60 and 120 days stages. These observa-

**Table 2.** Effect of row spacing, genotype and weed management on nitrogen, phosphorus and potassium uptake (kg/ha) in grain and stalk, and nutrient depletion (N, P and K) by weed (average data of 2 years)

Treatment	Nitrogen uptake (kg/ha)		Phosphorus uptake (kg/ha)		Potassium uptake (kg/ha)		Nutrient depletion by weed (kg/ha)		
	Grain	Stalk	Grain	Stalk	Grain	Stalk	Nitrogen	Phosphorus	Potassium
<i>Row spacing (cm)</i>									
30	67.1	19.3	11.3	9.8	28.3	27.5	3.2 (10.8)	1.8 (3.8)	3.3 (11.1)
45	70.3	20.1	11.8	10.0	29.4	28.4	3.3 (12.1)	1.9 (4.1)	3.3 (12.0)
CD (P=0.05)	2.8	NS	NS	NS	0.9	NS	NS	NS	NS
<i>Genotype</i>									
'Avarodhi'	72.8	21.4	12.2	10.8	30.0	30.4	3.2 (10.8)	1.8 (4.0)	3.2 (11.0)
'Radhey'	67.6	19.5	11.5	9.9	28.6	27.8	3.2 (11.4)	1.9 (4.3)	3.3 (12.3)
'Pant G 114'	65.7	18.2	11.1	9.1	28.0	25.8	3.3 (12.8)	1.9 (4.4)	3.5 (13.0)
CD (P=0.05)	3.4	NS	0.9	1.1	1.1	3.9	NS	NS	NS
<i>Weed management</i>									
Weed-free	81.4	22.2	13.7	11.1	34.5	31.4	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
Weedy	56.0	17.3	9.4	8.7	23.2	24.6	5.8 (37.5)	3.1 (11.6)	6.0 (38.3)
CD (P=0.05)	4.7	1.6	0.9	0.7	1.9	2.5	0.2	0.1	0.1

Data in parentheses indicate original values

tions corroborated more inter-row competition in narrow row spacing which might have reduced the lateral canopy spread and increased plant height.

Nitrogen, phosphorus and potassium uptake in grain and stalk of chickpea were higher in 45 cm row spacing in comparison to 30 cm row spacing. Significant variations in nutrient depletion by weeds were not recorded due to row spacing (Table 2). Wider row (45 cm)-spaced crop had more total moisture and moisture-use efficiency than narrow row-spaced crop (30 cm). Legere and Schneiber (1989) reported similar results in soybean that narrow row-spaced crop transpired less water in comparison to wider row-spaced crop.

Wider row spacing (45 cm) proved to be competitor for space, nutrients and soil moisture and recorded higher grain yield in comparison to narrow row spacing (30 cm). Row spacing of 45 cm (Rs 20,008/ha and 4.57) recorded more net return and benefit : cost ratio in comparison to 30 cm row spacing (Rs 18,444/ha and 4.23).

### Effect of weed management

Weed-free treatment had higher lateral canopy spread than weedy check (Table 1). However, plant height was higher in weedy check than weed free. This may be due to increased intra- and inter-specific competition in weedy check treatment, resulting in thinner and taller plant in an

attempt to capture sunlight. The weed-free treatment had more nutrient uptake (N, P and K) in grain and stalk than the weedy check during both the years. This was simply because of low shoot dry-matter production and low availability of these nutrients, as major amounts of nutrient were depleted by weeds (Table 2). In weedy treatments, 37.5 kg N, 11.6 kg P and 38.3 kg K/ha were depleted in comparison to full-season weed-free conditions. The results are in conformity with the findings of Vengris *et al.* (1953), who reported vigorous growth and higher biomass of weeds resulted in more nutrient depletion.

Weed-free treatment had low total moisture use and more moisture-use efficiency than weedy check. The moisture depletion was 7.76% more in weedy over weed-free which might be due to more plants/unit area in weedy treatment. Full-season weed-free condition recorded more grain yield, net return and benefit : cost ratio (23.39 q/ha, Rs 22,578/ha and 4.57) than full-season weedy condition (16.71 q/ha, Rs 15,868/ha and 4.17).

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