Indian Journal of Agronomy **51** (1) : 27–30 (March 2006)

Enhancing productivity and profitability of chickpea *(Cicer arietinum)* + Indian mustard *(Brassica juncea)* intercropping system

RAVI KUMAR, MASOOD ALI, R.L. ARYA[1] AND J.P. MISHIRA

Indian Institute of Pulses Research, Kanpur, Uttar Pradesh 208 024

Received : October 2004

ABSTRACT

A field experiment was carried out during 1998–99 to 2000–01 at the Indian Institute of Pulses Research, Kanpur, to study the genotypic compatibility in *kabuli* chickpea *(Cicer arietinum* L.) and Indian mustard *[Brassica juncea* (L.) Czernj. & Cosson] in chickpea + Indian mustard intercropping system. Sole crop of chickpea cv. 'BG 1003' recorded significantly highest growth and yield attributes than the other genotypes of chickpea. Among the various intercropping systems, 'BG 1003' chickpea + 'Vardan' Indian mustard recorded significantly highest growth and yield attributes of chickpea and Indian mustard than the other intercropping systems. However, highest 100-seed weight of chickpea was recorded in chickpea 'KAK 2' in chickpea + 'Vardan' Indian mustard intercropping system at 6:2 row ratio. Yield reduction of chickpea was recorded higher in Indian mustard genotypes of 'Varuna' than 'Vardan'. Significantly higher chickpea-equivalent yield, land-equivalent ratio (LER), net returns and benefit : cost ratio (B:C ratio) were recorded in 'BG 1003' + 'Vardan' intercropping system than the other intercropping system. Higher seed yield of component crops in intercropping system showed complimentary relationship which resulted in higher chickpea-equivalent yield.

Key words : Genotypic compatibility, Competition, Chickpea + Indian mustard intercropping

Kabuli chickpea is grown under irrigated conditions of alluvium plains of North India, which is very much risk-prone crop on account of its susceptibility to pests and diseases and its price flexibility due to uncertain market demand. Intercropping of Indian mustard and *kabuli* chickpea is a new proposition, which would ensure stability and higher profit per unit area of land than sole crop of *kabuli* chickpea. Intercropping has been in vogue for centuries, to sustain yield, minimize risk, utilize the lag phase and improve productivity. Selection of an appropriate and compatible genotype of component crop in a system helps in reducing the inter- and intra-plant competition for resources, thereby enhancing the productivity with optimal use of available and applied resources. The present study aims at exploring the possibilities of best compatible genotypes of *kabuli* chickpea and Indian mustard for enhancing the productivity, profitability and sustaining the productivity of *kabuli* chickpea + Indian mustard intercropping system.

MATERIALS AND METHODS

A field experiment was conducted during 1998–99 to 2000–01 at the research farm of Indian Institute of Pulses Research, Kanpur. The treatment combinations comprising 3 genotypes of *kabuli* chickpea, viz. 'L 550', 'BG 1003' and 'KAK 2', and 2 genotypes of Indian mustard, viz. 'Varuna' and 'Vardan', were intercropped with all the genotypes of chickpea and Indian mustard at 6 : 2 row ratio (*kabuli* chickpea + mustard) in replacement series. The sole stand of all the genotypes of chickpea and mustard were also maintained. Altogether 11 treatment combinations were evaluated in randomized block design with 3 replications. The sowing of *kabuli* chickpea and Indian mustard were done at 30 and 40 cm rows apart with plant to plant distance of 10 and 20 cm respectively. The chickpea and Indian mustard were sown on 2, 8 and 16 November during 1998, 1999 and 2000 respectively. Chickpea and Indian mustard were harvested 145 and 135 days after sowing in the respective years of study. Recommended dose of fertilizers for sole crop of chickpea and Indian mustard was 20 : 40 : 20 : 20 kg N:P:K: S/ha and 60 : 40 : 20 : 20 kg N:P:K: S/ha respectively. In intercropping both the crops were fertilized on the basis of proportionate area under each component crop in intercropping system at the time of sowing. The soil of the experimental field was sandy loam, neutral (pH

Present address : [1]RS, CTRI, Dinhata, Cooch Behar, West Bengal 736 135

7.1), low in organic carbon (0.34%) and medium in available phosphorus (15.8) kg/ha) and available potassium (138 kg/ha). The rainfall received during the cropping season were 3.3, 45.7 and 4.5 mm in 1998–99, 1999–2000 and 2000–01 respectively.

RESULTS AND DISCUSSION

Growth and growth attributes

Significantly highest plant height of chickpea and Indian mustard was obtained in chickpea cv 'BG 1003' + Indian mustard cv. 'Vardan' intercropped at 6 : 2 row ratio compared to the other intercropping system (Table 1). Sole crop of chickpea cv. 'BG 1003' recorded significantly highest dry weight of root nodules (205.0 mg)/plant than the other genotypes of chickpea. Similarly, sole crop of Indian mustard var. 'Varuna' recorded significantly highest plant height (198.2 cm), number of branches (6.9) and dry-matter accumulation (43.2 g)/plant than 'Vardan' Indian mustard. Chickpea var. 'BG 1003' + mustard var. 'Vardan' recorded significantly highest number of branches, dry-matter accumulation and dry weight of root nodules (184.5 mg) of chickpea than the other intercropping system. The increase in growth and growth attributes in different chickpea genotypes might be due to the least competition of Indian mustard. Arya and Jain (2003) also reported similar results in chickpea + Indian mustard intercropping system.

Yield attributes

Sole crop of chickpea var. 'BG 1003' recorded significantly higher pods/plant and grains/pod than rest of the genotypes of chickpea (Table 1). However, 100-seed weight of chickpea was recorded highest in 'KAK 2', followed 'L 550' and 'BG 1003'. Indian mustard 'Varuna' recorded highest mean yield attributes, viz. siliquae/plant, grains/siliqua and 100-seed weight than 'Vardan'. Among the various intercropping systems, significantly higher pods/plant and grains/pod of chickpea were recorded in chickpea var. 'BG 1003' + Indian mustard cv. 'Vardan' intercropping. Yield attributes of Indian mustard, viz. siliquae/plant, grains/siliqua and 100-seed weight were significantly higher in 'BG 1003' + 'Varuna' intercropping system than the other intercropping systems. Highest 100-seed weight of chickpea was recorded in 'KAK 2' + 'Vardan' intercropping system at 6 : 2 row ratio.

Productivity

Significantly highest grain yield of chickpea was recorded in sole crop of chickpea var. 'BG 1003' than 'KAK 2'. Seed yield of chickpea was significantly higher in chickpea var. 'BG 1003' + Indian mustard var. 'Vardan' than the other intercropping systems. The reduction in seed yield of chickpea to the tune of 13.6, 15.6 and 9.4% in intercropping of *kabuli* chickpea genotypes 'L 550', 'BG 1003' and 'KAK 2', respectively, with Indian mustard intercropping system might be due to loss in area and competition offered by intercrops for resources both above- and below- ground (Table 2). Seed yield of Indian mustard was significantly highest in chickpea var. 'KAK 2' + Indian mustard var. 'Varuna' compared to the other intercropping systems. The seed yield of Indian mustard 'Varuna' and 'Vardan' was reduced by 60.5 and 61.7%, respectively, in intercropping compared to their sole stands. Significantly highest chickpea-equivalent yield was recorded in 'BG 1003' + 'Vardan' intercropping system than the other intercropping systems. The increase in chickpea-equivalent yield with 'BG 1003' chickpea + 'Vardan' Indian mustard intercropping system to the tune of 2.2 and 6.9% than 'L 550' + 'Vardan' and 'KAK 2' + 'Vardan' intercropping systems respectively. The increase in seed yield of component crop in intercropping system have complimentary relationship which resulted in higher chickpea-equivalent yield. Prasad *et al.* (2000) reported that intercropping of Indian mustard with 'KWR 108' chickpea in 2 : 8 row ratio gave significantly higher grain yield of chickpea and Indian mustard, chickpea-equivalent yield and net return than the other chickpea varieties. The adverse effect of Indian mustard on grain yield of chickpea varieties varied from 0.57 to 4.09%. Indian mustard production enhanced from 8.93 to 13.08% in different chickpea varieties. Ali (1992), Sachan and Uttam (1992) and Kumar and Prasad (1998) also reported similar results in chickpea and Indian mustard varieties in chickpea + Indian mustard intercropping systems.

Economics

The highest net monetary advantage was obtained in 'BG 1003' + 'Vardan', followed by 'BG 1003' + 'Varuna' and 'L 550' + 'Varuna' intercropping systems (Table 2). However, minimum net return of was recorded in sole crop of 'Vardan' mustard. Highest benefit : cost ratio was fetched by 'BG 1003' + 'Vardan' intercropping system and minimum by sole crop of 'Vardan' mustard. Chickpea var. 'BG 1003' + Indian mustard var 'Vardan' proved to be the best intercropping system in 6 : 2 ratio, fetching highest net return owing to higher productivity. Mandal *et al.* (1996) reported that significantly higher chickpea yield and benefit: cost ratio was obtained in chickpea + yellow sarson intercropping system. It may be concluded that chickpea var. 'BG 1003' + Indian mustard var. 'Vardan' appeared promising and viable alternative intercropping system for the farming community of northern plain zones of India.

Table 1. Growth and yield attributes of chickpea and Indian mustard at harvest as affected by genotypic compatibility of chickpea and mustard in chickpea + Indian mustard intercropping system (average data of 3 years)

Treatment	Plant height (cm)		Branches/ plant		Dry-matter accumulation/ plant (g)		Dry weight of root nodules/ plant (mg)*	Pods/siliquae/ plant		Grains or seeds/ pod or siliqua		100-seed weight (g)	
	Chickpea	Indian mustard	Chickpea	Indian mustard	Chickpea	Indian mustard		Chickpea	Indian mustard	Chickpea	Indian mustard	Chickpea	Indian mustard
Sole cropping													
Chickpea													
'L 550'	48.3		7.8		17.6		181.4	20.3		1.1		34.7	
'BG 1003'	49.8		8.8		19.8		205.0	27.7		1.3		35.5	
'KAK 2'	48.9		7.9		18.3		197.1	17.0		1.1		36.0	
Indian mustard													
'Varuna'		198.2		6.9		43.2			251.7		5.6		0.6
'Vardan'		175.1		5.2		36.9			225.5		5.3		0.5
Intercropping system													
'L 550' +'Varuna'	49.7	204.9	6.1	10.7	14.2	48.6	151.2	16.5	272.3	1.1	5.9	30.7	0.7
'L 550' + 'Vardan'	50.1	197.8	6.8	8.9	14.9	42.8	158.3	17.9	244.8	1.1	5.6	31.9	0.5
'BG 1003' + 'Varuna'	51.4	209.7	7.5	8.7	16.4	47.0	180.3	18.8	284.6	1.1	6.0	28.7	0.7
'BG 1003' + 'Vardan'	52.0	183.1	8.0	7.0	17.3	40.6	184.5	21.1	264.3	1.2	5.8	29.1	0.6
'KAK 2' + 'Varuna'	50.1	206.3	6.2	9.7	15.0	47.8	175.1	13.8	278.9	1.0	5.9	33.7	0.7
'KAK 2' + 'Vardan'	51.2	192.4	6.7	7.5	15.7	41.3	182.1	15.7	255.8	1.0	5.7	35.0	0.6
CD (P=0.05)	1.4	4.0	0.4	0.7	0.9	1.8	6.2	1.0	5.7	0.003	0.02	1.8	0.06

*75 days after sowing

Table 2. Effect of different genotypes of *kabuli* chickpea and Indian mustard on seed and chickpea-equivalent yield, land-equivalent ratio and economics in chickpea + Indian mustard intercropping system (average data of 3 years)

Treatment	Seed yield (q/ha)		Chickpea-equivalent yield (q/ha)	Land-equivalent ratio	Net returns (Rs/ha)	Benefit : cost ratio
	Chickpea	Indian mustard				
Sole cropping						
Chickpea						
'L 550'	14.48		14.48	1.00	19,240	2.98
'BG 1003'	15.81		15.81	1.00	21,167	3.01
'KAK 2'	13.54		13.54	1.00	16,633	2.58
Indian mustard						
'Varuna'		18.98	11.55	1.00	11,017	2.43
'Vardan'		17.45	10.62	1.00	9,528	2.24
Intercropping system						
'L 550' +'Varuna'	12.43	7.12	16.76	1.22	23,280	3.27
'L 550' + 'Vardan'	12.80	6.28	16.62	1.20	22,993	3.25
'BG 1003' + 'Varuna'	12.88	6.67	16.94	1.16	23,640	3.31
'BG 1003' + 'Vardan'	13.78	6.36	17.65	1.22	25,047	3.45
'KAK 2' + 'Varuna'	11.29	8.03	16.18	1.28	22,113	3.16
'KAK 2' + 'Vardan'	11.90	7.57	16.39	1.30	22,540	3.20
CD (P=0.05)	1.20	0.78	1.35			

Selling price : *Kabuli* chickpea @ Rs 20/kg; Indian mustard @ Rs 12/kg

REFERENCES

Ali, M. 1992. Genotypic compatibility and spatial arrangement in chickpea (*Cicer arietinum)* and Indian mustard (*Brassica juncea)* intercropping in north east plain zones. *Indian Journal of Agricultural Sciences* **62** (4) : 249–253.

Arya, R.L. and Jain, Vinamrata. 2003. Identification of different ideotypes of *desi* and *kabuli* chickpea varieties in chickpea + mustard intercropping system. Paper presented in 'National Symposium on Resources Management for Eco-friendly Crop Production' held at CSAUA & T, Kanpur, during 26–28 February 2003, p. 8.

Kumar, A. and Prasad, K. 1998. Studies on screening of suitable chickpea varieties for chickpea + mustard intercropping M.Sc. (Agriculture) thesis, Department of Agronomy, Chandra Shekhar Azad University, Kanpur, Uttar Pradesh.

Mandal, B.K., Chaudhari, S.K. and Subuchi, S.K. 1996. Production potential and economic viability of intercropping system including oilseeds and pulses under rainfed conditions. *Indian Journal of Agricultural Sciences* **66** (1) : 11–15.

Prasad, Kedar, Rathi, K.S. and Ram, Hari. 2000. Studies on intercropping of mustard with chickpea varieties. *Crop Research* **19** (1) : 144–145.

Sachan, S.S. and Uttam, S.K. 1992. Intercropping of mustard *(Brassica juncea)* with gram *(Cicer arietinum)* under different planting system of eroded soils. *Indian Journal of Agronomy* **37** (1) : 68–70.

Willey, R.W. 1979a. Intercropping. Its importance and research needs. Part I. Competition and yield advantages. *Field Crop Abstracts* **32** : 1–10.