

Intercropping of pigeonpea (*Cajanus cajan*) with greengram (*Phaseolus radiatus*) under varying levels of fertility and plant population and its residual effect on succeeding wheat (*Triticum aestivum*)

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ABSTRACT

An experiment was conducted during 1988–89 and 1989–90 at Bichpuri, to assess the feasibility of uniform planting of pigeonpea [*Cajanus cajan* (L.) Millsp.] intercropped with greengram (*Phaseolus vulgaris* L.) under varying levels of fertility and plant population. Uniform planting of pigeonpea at 60 cm apart rows intercropped with greengram at optimum plant population and recommended fertilization (30 kg N/ha + 60 kg P₂O₅/ha for pigeonpea and 20 kg N/ha + 40 kg P₂O₅/ha for greengram) separately drilled gave higher grain yield (15.44 q/ha pigeonpea + 8.30 q/ha greengram) than either sole pigeonpea (16.84 q/ha) or greengram (8.92 q/ha) or rest of the intercropping systems followed. Application of fertilizer drilled separately, by and large, proved advantageous over the fertilizer mixed together for both crops in intercropping system. Higher land-equivalent ratio (1.85) also further established the superiority of former intercropping system. Intercropping of pigeonpea with greengram appreciably increased the wheat yield (*Triticum aestivum* L. emend. Fiori & Paol.) over the yield obtained after pigeonpea sole.

In Agra region of Uttar Pradesh, the traditional (old) longer-duration varieties of pigeonpea [*Cajanus cajan* (L.) millsp.] have been replaced by the short-duration and photo-insensitive cultivars, viz. 'UPAS 120', 'T 21', 'ICPL 87'. The cultivation of these varieties becomes popular because they provide opportunity for late-sown wheat (*Triticum aestivum* L. emend. Fiori & Paol.). There is possibility of growing short-duration intercrops like greengram (*Phaseolus radiatus* L.), blackgram and cowpea with pigeonpea, as the growth of the latter crop plants remain quite slow with little canopy during early stage. Fertilizers are costly and

scarce inputs and their judicious application coupled with plant population is essential to achieve higher benefits, especially under intercropping system like pigeonpea with greengram. Grain legumes also enrich the soil fertility that is too utilized by the succeeding crop. Hence the present experiment was conducted to study the optimum level of fertility and plant population in pigeonpea with greengram intercropping followed by wheat as a succeeding crop in winter season.

MATERIALS AND METHODS

The field experiment was conducted with 16 treatments (Table 1) using randomized

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Table 1. Grain yield, pigeonpea-equivalent yield (PEY), land-equivalent ratio (LER) in intercropping systems (pigeonpea + greengram) and grain yield of succeeding wheat under different fertility (NPK) levels (pooled data of 1988–89 and 1989–90)

Treatment	Grain yield (q/ha)			LER	Wheat yield (q/ha) at NPK recommended		
	Pigeonpea	Greengram	PEY		0	50%	100%
Pigeonpea ($N_{30}P_{60}K_0$, i.e. 100% NPK + 100% plant population (PP))	16.84		16.84		19.84	29.14	34.41
Greengram ($N_{20}P_{40}K_0$, i.e. 100% NPK + 100% PP)		8.92	9.25		27.58	32.86	38.13
Greengram ($N_{15}P_{30}K_0$, i.e. 75% NPK + 100% PP)		7.86	8.14		26.14	32.70	38.61
Greengram ($N_{15}P_{30}K_0$ + 75% PP)		7.30	7.58		26.88	31.82	38.37
Greengram ($N_{10}P_{20}K_0$, i.e. 50% NPK + 75% PP)		7.17	7.41		23.58	33.72	37.27
Greengram ($N_{10}P_{20}K_0$ + 50% PP)		6.61	6.84		22.78	32.20	37.83
Pigeonpea ($N_{30}P_{60}K_0$ + 100% PP) + greengram ($N_{20}P_{40}K_0$) + 100% PP†	15.44	8.30	24.02	1.85	24.72	32.26	38.20
Pigeonpea ($N_{30}P_{60}K_0$ + 100% PP) + greengram ($N_{15}P_{30}K_0$) + 100% PP†	14.83	7.47	22.53	1.83	25.75	33.27	38.78
Pigeonpea ($N_{30}P_{60}K_0$ + 100% PP) + greengram ($N_{15}P_{30}K_0$) + 75% PP†	14.01	7.05	21.29	1.80	23.82	34.52	39.09
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{10}P_{20}K_0$) + 75% PP†	13.66	6.97	20.85	1.78	22.24	33.65	38.35
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{10}P_{20}K_0$) + PP†	13.04	6.24	19.48	1.72	24.37	35.01	38.12
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{20}P_{40}K_0$) + 100% PP††	14.23	6.78	21.28	1.60	25.52	34.33	36.59
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{15}P_{30}K_0$) + 100% PP††	13.65	6.14	19.99	1.60	23.01	32.31	38.04

(Table 1. contd)

Treatment	Grain yield (q/ha)			LER	Wheat yield (q/ha) at NPK recommended		
	Pigeonpea	Greengram	PEY		0	50%	100%
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{15}P_{30}K_0$) + 75% PP††	12.96	6.52	19.50	1.64	23.92	31.79	36.91
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{10}P_{20}K_0$) + 75% PP††	11.94	5.42	17.53	1.48	23.11	34.14	38.24
Pigeonpea ($N_{30}P_{60}K_0$) + 100% PP + greengram ($N_{10}P_{20}K_0$) + 50% PP††	11.58	5.45	17.22	1.51	22.12	33.39	38.47
CD (P = 0.05)	1.30	1.06	1.60		3.02	0.88	3.51
					Treatment (T)	Fertility (F)	T x F interaction

Fertilizer drilled separately (1 : 2 ratio, pigeonpea 60 cm + greengram 30 cm between rows); †Fertilizer mixed together for both crops (1 : 2 row ratio of pigeonpea and greengram)

block design with 4 replications during 1988–89 and 1989–90 at Raja Balwant Singh College, Bichpuri, Agra. The soil of the experimental plot was sandy loam (Vertisols) with pH 7.8. The available N, P and K_2O were 140, 12 and 290 kg/ha respectively. Pigeonpea ('UPAS 120') as base crop (60 cm apart row) and greengram ('Pant 2') as an intercrop (30 cm spacing) were sown in 1 : 2 row ratio on 28 June and 24 June in rainy season of 1988 and 1989 respectively. The fertilizers in intercropping system were drilled separately and mixed together for both crops as per treatment. Pigeonpea was harvested on 18 November and 14 November and greengram on 27 September and 23 September in the respective year. In the winter season wheat ('HD 1553') was sown with 3 fertility levels (0, 50 and 100% of recommended dose of NPK, i.e. 120, 60 and 40 kg/ha), on 24 November in both the years and harvested on 8 and 4 April in the winter season of 1988 and 1989 respectively.

RESULTS AND DISCUSSION

Grain yield

The grain yield of pigeonpea as sole crop under uniform planting [100% plant population (60 cm x 15 cm) and 100% fertility, $N_{30}P_{60}K_0$] was higher than the yield obtained in pigeonpea under different intercropping systems. Greengram yield under sole cropping with 100% plant population and 100% fertility was also higher (8.29 q/ha) than the yields obtained in the intercropping systems.

The total yield of both the crops (pigeonpea with $N_{30}P_{60}K_0$ + 100% plant population + greengram with $N_{20}P_{40}K_0$ + 100% plant population fertilizer drilled separately in both the crops) was found maximum (15.44 q/ha pigeonpea + 8.30 q/

ha greengram), followed by pigeonpea with $N_{30}P_{60}K_0$ + 100% plant population + greengram with 75% NPK ($N_{15}P_{30}K_0$) + 100% plant population, which were statistically at par. Reduction in plant population and fertilizer dose of both the crops reduced the yield in intercropping system.

Pigeonpea-equivalent yield

The highest grain yield in pigeonpea equivalent was recorded in pigeonpea + greengram intercropping with 100% fertilizer drilled separately and 100% plant population in both crops. This may be due to higher yield of both base and intercrops in intercropping system.

Land-equivalent ratio

Intercropping of pigeonpea with greengram under 100% fertilizer drilled separate-

ly and 100% plant population recorded higher land-equivalent ratio (1.85), which further witnessed the profitability of intercrop system by exceeding the limit of standard value of land-equivalent ratio (1.40).

Wheat yield

Intercropping of pigeonpea by greengram appreciably increased the wheat yield in winter season than the yield obtained after sole pigeonpea. Increasing level of fertility increased the grain yield significantly, accruing highest productivity with 100% fertility (39.09 q/ha). On an average, the extent of increase due to 50 and 100% fertility over the control was 42.2 and 71.0% respectively. Association of pigeonpea with greengram might have fixed more nitrogen than pigeonpea alone which augment the wheat yield comparatively