E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(12): 957-961
Received: 03-09-2025
Accepted: 09-10-2025

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Effect of millet intercropping systems and integrated nutrient management on growth, yield attributes and yield of pigeonpea (*Cajanus cajan* L.)

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DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i12m.4518

Abstract
A field experiment was conducted during the rainy (kharif) seasons of 2023-24 and 2024-25 at experiment farm of Regional Agricultural Research Station, Warangal, Telangana on sandy loam soils, to study the effect of integrated nutrient management practices on pigeonpea [*Cajanus cajan* (L.)] based millet intercropping systems. The treatments comprised four intercropping systems of pigeonpea sole, pigeonpea + finger millet, pigeonpea + foxtail millet and pigeonpea + browntop millet with different integrated nutrient management levels. On the basis of 2 year results, it is found that pigeonpea sole recorded significantly higher plant height, number of branches plant^{-1}, drymatter accumulation ha^{-1}, number of pods plant^{-1}, number of seeds pod^{-1} and seed yield of pigeonpea over the other intercropping systems. Higher pigeonpea equivalent yield was recorded from pigeonpea + finger millet intercropping system over the other cropping systems at harvest. Among the INM practices, application of 125% RDN (recommended dose of nitrogen) through inorganic fertilizers recorded significantly higher growth, yield attributes, pigeonpea yield and pigeonpea equivalent yield over 100% RDN through inorganic fertilizers, 75% RDN through inorganic fertilizers + 25% RDN through poultry manure and 75% RDN through inorganic fertilizers + 25% RDN through urban compost which were on par with each other.

Keywords: Intercropping system, nutrient management, pigeonpea, millets

Introduction
Net sown area of India is 141.43 million hectares (M ha), which is 45.95% of total geographical area of the country. From the last 50 years, there is no increase in the net sown area of the country and on the other hand, population of India, in 1971 was only 54.82 crores and it is estimated as 141 crores and still it is increasing (India Stat, 2021). Increasing food production by increasing the area under cultivation is no longer possible. To achieve the projected food production, the yields must be increased per unit area by adopting the appropriate cropping systems. In this context intercropping systems gains the popularity especially in rainfed areas. Intercropping is growing of two or more crops simultaneously in the same piece of land and popular in rainfed agriculture with limited resources, because both the crops complement each other in exploiting resources. The main advantage of intercropping is yield stability over mono cropping which is most reliable. The important reason for intercropping non-legumes with legumes is that legumes can fix atmospheric nitrogen which may be available to the associated non-legumes and it is a common practice during rainy season in semi-arid tropics of India.

Pigeonpea is a widely grown pulse crop in India next to chickpea in an area of 50.02 lakh ha with the average productivity of 877 kg ha^{-1} (https://eands.dacnet.nic.in). It is an important constituent of the Indian diet and it contains 20-21% of protein. It is a widely spaced crop with initial slow growth. This can be taken as an advantage to introduce millets as intercrops in between the rows of Redgram.

In recent years, energy crisis led to hike in the prices of the inorganic fertilizers and declining soil health and productivity necessitated the use of organic manures compulsorily in agricultural crop production. The continuous use of inorganic fertilizers under intensive cropping system has

caused widespread deficiency of secondary and micronutrients in soil. As the nitrogen requirement of redgram and millets is very less compared to exhaustive crops like rice, wheat and maize, it is easier to opt for manures like poultry manure and urban compost, as they are readily available in the market, to supplement nutrients in integrated nutrient management. Usage of organic manures not only provide plant nutrients but also improve physical, chemical and biological properties of soil and crop yield. Keping these in view, current investigation was taken up.

Materials and Methods

A field experiment was conducted during rainy (kharif)seasons of 2023-24 and 2024-25 at research Farm, Regional Agricultural Research Station, Warangal (15^0 05' N, 79^0 28' E and 268.5 m above mean sea level), under Central Agro-Climatic Zone of Telangana. The soil of the experimental field was sandy loam having slightly alkaline soil reaction (7.12), electrical conductivity 1.1 dS/m, medium in organic carbon (0.6%), low in available nitrogen (202.0 kg ha^{-1}), high in available phosphorus (43.5 kg) and potassium (434.5 kg ha^{-1}).

The treatment combinations comprised 4 intercropping systems (pigeonpea sole, pigeonpea + finger millet, pigeonpea + foxtail millet and pigeonpea + browntop millet) and 4 nutrient management levels 100% RDN through inorganic fertilizers, 125% RDN through inorganic fertilizers, 75% RDN through inorganic fertilizers + 25% RDN through poultry manure and 75% RDN through inorganic fertilizers + 25% RDN through urban compost. For pigeonpea and intercrops, INM treatments (S_1, S_2, S_3 and S4) were applied based on plant population. Irrespective of treatments, P and K were applied based on recommended dose on population basis.

The experiment was laid out in split plot design with four main plots and four subplot treatments so the total number of treatments were sixteen treatments replicated thrice. Sole cropping of finger millet, foxtail millet and browntop millet with four INM treatments were taken separately and they were replicated thrice. Nitrogen content (%) in poultry manure and urban compost were analyzed chemically in both the years of experimentation and the Quantities of poultry manure and urban compost to be applied to S_3 and S_4 INM treatments were decided by the content of N in poultry manure and urban compost. 25% of RDN was met with poultry manure and urban compost in S_3 and S_4 INM treatments respectively in all the main plots. These manures were applied 10 days before sowing after making layout in the field to overcome the immobilization of nutrients in the field.

The pigeonpea and the intercrops were sown manually in both the years. Pigeonpea was sown with 150 cm of row spacing and in between two pigeonpea rows, four rows of intercrops were sown with the row spacing of 30 cm in all the millet intercrops. The recommended dose of fertilizers was given for (pigeonpea 20: 50: 00, finger millet 50: 30: 30, foxtail millet 40:20:00 and browntop millet 40:20:00 kg of N: P_2 O_5: K_2O ha^{-1}) in the form of urea, single super phosphate and muriate of potash. WRGE-97, PRS-38, SIA-3156 and GPUBT-6 varieties of pigeonpea, finger millet, foxtail millet and browntop millets were used respectively for the study. In case of intercropping treatments, fertilizers were applied in proportionate to the sole optimum population for main crop and intercrop, separately. The seed rate of the crops used were 8 kg ha^{-1} (pigeonpea), 8 kg ha^{-1} (finger millet), 5 kg ha^{-1} (foxtail millet) and 5 kg ha^{-1} (browntop millet). Weeding and plant-protection measures were undertaken as per their need and the required plant population was maintained. The crops were harvested at their physiological maturity. Standard procedures were used to measure the growth parameters and yield attributes. The seed yield from each net plot, treatment wise including the yield of five tagged plants was weighed and expressed in kg ha^{-1}

Pigeonpea equivalent yield was computed by converting the yield of intercrops into pigeonpea seed yield on the basis of prevailing market prices with the help of following formula.

$$\text{Pigeonpea equivalent yield (kg ha}^{-1}) = \frac{Y_i \times P_i}{P_c} + \text{Yield of pigeonpea (kg ha}^{-1})$$

Where,

Yi = Yield of intercrop (kg ha^{-1}),

Pi = Price of intercrop (₹ kg^{-1})

Pc = Price of pigeonpea (₹ kg^{-1})

Results and Discussion

Growth, yield attributes, seed yield and pigeonpea equivalent yield (PEY) of pigeonpea were significantly influenced by intercropping systems and integrated nutrient management practices during both years of experimentation.

Growth parameters

Sole pigeonpea recorded significantly greater plant height, dry matter production and number of branches per plant compared to all intercropping systems. The pooled mean plant height (185.69 cm), dry matter production (5166.08 kg ha^{-1}) and branches per plant (23.48) under sole cropping may be attributed to the absence of interspecific competition for growth resources. Among intercropping systems, pigeonpea + finger millet (1:4) performed relatively better than foxtail and browntop millet intercropping systems.

Application of 125% RDN through inorganic fertilizers significantly enhanced growth parameters over other nutrient treatments. Improved availability of nitrogen likely promoted vegetative growth, biomass accumulation and branching. Integrated nutrient management treatments recorded comparable performance with 100% RDN, indicating the beneficial role of organic nutrient sources in sustaining crop growth. Interaction effects were non-significant. The results are in line with Patil *et al* (2010) [9] and Jagadeesha *et al* (2019) [6].

Yield attributes

Number of pods per plant was significantly higher in sole pigeonpea, followed by pigeonpea + finger millet intercropping. Increased pod production under sole cropping may be due to greater assimilate availability per plant. Application of 125% RDN also significantly increased pods per plant, reflecting improved reproductive growth under higher nitrogen availability. However, number of seeds per pod and seed index were not significantly influenced by intercropping systems or nutrient management, suggesting these traits are largely genetically governed. The results are in line with the findings of Manjunath *et. al* (2018) [8] and Jagadeesha *et al* (2019) [6].

Seed yield and pigeonpea equivalent yield

Sole pigeonpea recorded the highest seed yield (1610.84 kg ha^{-1} pooled mean), which was significantly superior to intercropping systems. Among nutrient management practices, 125% RDN produced the highest seed yield (1536.82 kg ha^{-1}), followed by integrated nutrient management treatments.

In contrast, pigeonpea equivalent yield was significantly higher under intercropping systems. Pigeonpea + finger millet (1:4)

recorded the highest PEY (3091.11 kg ha^{-1} pooled mean), followed by pigeonpea + foxtail millet intercropping, due to the additional yield advantage of the intercrop. Application of 125% RDN also resulted in higher PEY, while interaction effects were largely non-significant. The results are in line with the findings of Manjunath *et. al* (2018) [8] and Jagadeesha *et al* (2019) [6].

Table 1: Plant height (cm), Drymatter production (kg ha^{-1}), Number of branches plant^{-1} of pigeonpea as influenced by pigeonpea based millet intercropping systems and integrated nutrient management during 2023-24 and 2024-25

Treatments	Plant height (cm)			Drymatter production (kg ha^{-1})			Number of branches plant^{-1}		
	2023-24	2024-25	Mean	2023-24	2024-25	Mean	2023-24	2024-25	Mean
Intercropping system (M)									
M_1- Pigeonpea sole	175.81	195.57	185.69	4870.25	5461.91	5166.08	22.22	24.74	23.48
M_2- Pigeonpea + Finger millet (1:4)	152.70	170.71	161.71	4259.26	4770.33	4514.79	19.35	21.65	20.50
M_3- Pigeonpea + Foxtail millet (1:4)	150.42	167.57	159.00	4197.27	4672.75	4435.01	19.04	21.25	20.15
M_4- Pigeonpea + Browntop millet (1:4)	148.01	165.34	156.67	4126.43	4587.89	4357.16	18.74	20.91	19.83
S.Em±	4.18	5.05	-	115.87	108.12	-	0.53	0.64	-
CD (p=0.05)	14.46	17.48	-	400.97	374.16	-	1.82	2.22	-
Integrated nutrient management (S)									
S_1- 100% RDN through inorganic fertilizers	155.56	168.33	161.95	4336.42	4712.35	4524.38	19.68	21.36	20.52
S_2- 125% RDN through inorganic fertilizers	167.49	187.25	177.37	4670.38	5201.69	4936.03	21.20	23.65	22.42
S_3- 75% RDN through inorganic fertilizers + 25% RDN through poultry manure	153.06	173.15	163.11	4250.40	4831.15	4540.77	19.34	21.97	20.65
S_4- 75% RDN through inorganic fertilizers + 25% RDN through urban compost	150.83	170.46	160.65	4196.01	4747.70	4471.85	19.13	21.59	20.36
S.Em±	2.46	3.00	-	68.64	67.59	-	0.31	0.38	-
CD (p=0.05)	7.19	8.75	-	200.34	197.27	-	0.91	1.11	-
Interactions									
MxS									
S.Em±	4.93	5.99	-	137.28	135.18	-	0.62	0.76	-
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-
SxM									
S.Em±	5.97	7.24	-	166.01	159.36	-	0.75	0.92	-
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-

Table 2: Number of pods plant^{-1}, Number of seeds pod^{-1}, Seed index (100 seed weight) (gm) of pigeonpea as influenced by pigeonpea based millet intercropping systems and integrated nutrient management during 2023-24 and 2024-25

Treatments	Number of pods plant^{-1}			Number of seeds pod^{-1}			Seed index (100 seed weight) (gm)		
	2023-24	2024-25	Mean	2023-24	2024-25	Mean	2023-24	2024-25	Mean
Intercropping system (M)									
M_1- Pigeonpea sole	226.42	249.84	238.13	3.94	3.95	3.95	8.71	8.81	8.76
M_2- Pigeonpea + Finger millet (1:4)	197.11	218.96	208.03	3.83	3.83	3.83	8.57	8.65	8.61
M_3- Pigeonpea + Foxtail millet (1:4)	194.35	214.82	204.58	3.71	3.72	3.71	8.27	8.30	8.28
M_4- Pigeonpea + Browntop millet (1:4)	191.17	211.58	201.38	3.61	3.61	3.61	8.02	8.05	8.04
S.Em±	4.90	6.46	-	0.09	0.11	-	0.20	0.18	-
CD (p=0.05)	16.97	22.36	-	NS	NS	-	NS	NS	-
Integrated nutrient management (S)									
S_1- 100% RDN through inorganic fertilizers	200.81	216.63	208.72	3.78	3.73	3.76	8.44	8.44	8.44
S_2- 125% RDN through inorganic fertilizers	215.73	239.29	227.51	3.82	3.81	3.81	8.50	8.49	8.49
S_3- 75% RDN through inorganic fertilizers + 25% RDN through poultry manure	197.34	222.07	209.70	3.77	3.78	3.77	8.39	8.46	8.42
S_4- 75% RDN through inorganic fertilizers + 25% RDN through urban compost	195.17	217.21	206.19	3.73	3.76	3.75	8.35	8.42	8.38
S.Em±	2.95	3.85	-	0.06	0.07	-	0.13	0.12	-
CD (p=0.05)	8.60	11.22	-	NS	NS	-	NS	NS	-
Interactions									
MxS									
S.Em±	5.90	7.69	-	0.12	0.13	-	0.26	0.25	-
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-
SxM									
S.Em±	7.08	9.28	-	0.13	0.16	-	0.30	0.28	-
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-

Table 3: Seed yield (kg ha^{-1}), Pigeonpea equivalent yield (PEY) (kg ha^{-1}) of pigeonpea as influenced by pigeonpea based millet intercropping systems and integrated nutrient management during 2023-24 and 2024-25

Treatments	Seed yield (kg ha^{-1})			Pigeonpea equivalent yield (PEY) (kg ha^{-1})		
	2023-24	2024-25	Mean	2023-24	2024-25	Mean
Intercropping system (M)						
M_1- Pigeonpea sole	1550.43	1671.24	1610.84	1550.43	1671.24	1610.84
M_2- Pigeonpea + Finger millet (1:4)	1347.40	1463.48	1405.44	2902.03	3280.18	3091.11
M_3- Pigeonpea + Foxtail millet (1:4)	1328.14	1435.28	1381.71	2712.69	3047.83	2880.26
M_4- Pigeonpea + Browntop millet (1:4)	1310.48	1420.10	1365.29	2154.11	2438.86	2296.48
S.Em±	30.60	36.57	-	23.86	32.89	-
CD (p=0.05)	105.87	126.54	-	NS	113.83	-
Integrated nutrient management (S)						
S_1- 100% RDN through inorganic fertilizers	1375.08	1445.26	1410.17	2321.31	2514.54	2417.92
S_2- 125% RDN through inorganic fertilizers	1477.00	1596.64	1536.82	2494.49	2800.74	2647.61
S_3- 75% RDN through inorganic fertilizers + 25% RDN through poultry manure	1352.21	1489.50	1420.86	2266.81	2582.63	2424.72
S_4- 75% RDN through inorganic fertilizers + 25% RDN through urban compost	1332.15	1458.71	1395.43	2236.65	2540.21	2388.43
S.Em±	19.02	22.01	-	42.13	50.45	-
CD (p=0.05)	55.53	64.25	-	NS	147.27	-
Interactions						
MxS						
S.Em±	38.05	44.02	-	84.25	100.91	-
CD (p=0.05)	NS	NS	-	NS	NS	-
SxM						
S.Em±	44.96	52.83		76.77	93.37	
CD (p=0.05)	NS	9.65	-	NS	NS	-

Conclusion

The study indicates that while sole pigeonpea is superior for individual crop growth and seed yield, pigeonpea-based millet intercropping systems—particularly with finger millet—offer higher system productivity on a pigeonpea equivalent yield basis. Application of 125% RDN consistently improved growth and yield, whereas integrated nutrient management showed promise for sustaining productivity under intercropping systems.

References

1. Directorate of Economics and Statistics. Department of Agriculture and Farmers Welfare, Government of India. New Delhi: Government of India. https://eands.dacnet.nic.in
2. Directorate of Economics and Statistics. Government of Telangana. Hyderabad: Government of Telangana. https://ecostat.telangana.gov.in
3. Amanullah, Khalid S, Khalil F, Soliman EM, Alshikh, Alwahibi MS, *et al*. Growth and dry matter partitioning response in cereal-legume intercropping under full and limited irrigation regimes. Sci Rep. 2021;11:1-15.
4. Himasree B, Chandrika V, Sarala NV, Prasanthi A. Evaluation of remunerative foxtail millet (*Setaria italica* L.) based intercropping systems under late sown conditions. Bull Environ Pharmacol Life Sci. 2017;6:306-308.
5. Jagadeesha N, Reddy VC, Krishnamurthy N, Sheshadri T. Effect of organic manures on productivity of finger millet and red gram intercropping system under protective irrigation. Int J Agric Sci. 2010;6(2):453-455.
6. Jagadeesha N, Srinivasulu GB, Ratnakar MS, Umesh MR, Gajanana K, Ravikumar B, *et al*. Effect of organic manures on physical, chemical and biological properties of soil and crop yield in finger millet-red gram intercropping system. Int J Curr Microbiol App Sci. 2019;8(5):1378-1386.
7. Mallikarjun, Koppalkar BG, Desai BK, Basavanneppa MA, Narayana Rao K, Swamy M. Performance of pigeonpea (*Cajanus cajan*) intercropping as influenced by row ratios and nutri-cereal crops. Int J Curr Microbiol App Sci. 2018;7(6):2653-2658.
8. Manjunath M, Vajjaramatti, Kalaghatagi SB. Performance of pigeonpea and millets in intercropping systems under rainfed conditions. J Farm Sci. 2018;31:199-201.
9. Patil NB, Halikatti SI, Sujay YH, Prasanna Kumar BH, Topagi SC, Pushpa V. Influence of intercropping on the growth and yield of little millet and pigeonpea. Int J Agric Sci. 2010;6:573-577.
10. Saharan K, Schütz L, Kahmen A, Wiemken A, Boller T, Mathimaran N. Finger millet growth and nutrient uptake is improved in intercropping with pigeon pea through biofertilization and bioirrigation mediated by arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria. Front Environ Sci. 2018;6(46):1-11.