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Nitrogen and phosphorus management in Hybrid Pigeonpea (*Cajanus cajan* (L.) Millsp.) for improvement of yield and quality

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Abstract

A field experiment was conducted at Regional Agricultural Research Station, ANGRAU, Lam, Guntur, A P during *kharif* season of 2018 which is situated at an altitude of 35.1 m above mean sea level, 16°2' N latitude, 80°3' E longitude to study the Impact of nutrient management in hybrid pigeonpea (*Cajanus cajan* (L.) Millsp.) for improvement of yield and quality. The experiment was laid out in factorial randomized block design (FRBD) comprised of four nitrogen levels (N₁: 20 kg ha⁻¹, N₂: 40 kg ha⁻¹, N₃: 60 kg ha⁻¹ & N₄: 80 kg ha⁻¹) and three phosphorus (P₂O₅) levels (P₁: 50 kg ha⁻¹, P₂: 75 kg ha⁻¹ and P₃: 100 kg ha⁻¹). The results highlighted that the maximum grain yield, nutrient uptake and the quality (protein) of the hybrid pigeonpea (ICPH 2740) were realised with application of higher levels of nitrogen (80 kg N ha⁻¹) and phosphorus (100 kg P₂O₅ ha⁻¹). And these were statistically on par with their subsequent lower level of nitrogen (60 kg N ha⁻¹) and phosphorus (75 kg P₂O₅ ha⁻¹) and superior over the lowest levels. Protein content was also influenced by the levels of N and P₂O₅ and higher values noticed at higher levels of N and P₂O₅. From the above study, it was concluded that the application of 60 kg N ha⁻¹ and 75 kg P₂O₅ ha⁻¹ would give better yield and quality in hybrid Pigeonpea for commercial cultivation in Krishna Agro-climatic zone of Andhra Pradesh.

Keywords: Yield, nitrogen, phosphorus, potassium, uptake, protein content

Introduction

Pulses play a crucial role in agriculture, contributing to a larger portion of exports and offering considerable economic benefits to the country. Globally, pulses are cultivated around 93.18 MT ha⁻¹ with a production of 89.82 MT ha⁻¹. India ranks first in area (31%), production (28%) and import (14%) of the world pulse consumption (Annual report, DPD, 2021-22). Among the pulses, pigeonpea ranks as the sixth most significant grain legume crop and cultivated across the semi-arid tropics of Asia, Africa, and the Caribbean countries. Due to the availability of extra short, short, medium and perennial long duration varieties of redgram, it can be successfully accommodated in a diversified range of cropping systems (Sarkar *et al.*, 2020) [20]. In India, redgram is popularly known as pigeonpea, Congopea, gungpea, no-eye pea, toor dal and arhar dal *etc.* The natural distribution of pigeon peas is within the latitude range of 14° to 28° N, which represents the primary geographic region for the world's pigeonpea production (Jeyajothi and Pazhanivelan, 2017) [9]. Pigeonpea has the unique ability to combine optimal nutritional profiles which have a high protein content compared to cereals (average 25 g/100 g) (Wu *et al.*, 2024) [25] and it is considered a cost-effective source of protein, carbohydrates, minerals, and vitamins, including b-complex, especially in vegetarian diets.

Globally, redgram cultivation spreads in an area of 63.57 million ha, yielding a total production of 54.75 million tonnes and productivity of 861 kg ha⁻¹. India stands at the forefront of redgram production worldwide, with 42.2 lakh tonnes, cultivated across 49.0 million ha, achieving productivity of 861 kg ha⁻¹ (Sowmyasri *et al.*, 2023) [22]. The major cultivating regions of pigeonpeas in India are Maharashtra, Uttar Pradesh, Karnataka, Madhya Pradesh, Gujarat, Andhra Pradesh, and Haryana. Andhra Pradesh leads in pigeonpea production, accounting for 5% of the total yield with a production of 0.87 lakh tonnes from an area of 2.51 lakh ha, with a productivity rate of 347 kg ha⁻¹ (Kumari *et al.*, 2023) [14]. The low yield of the pigeonpea is mainly attributed

to inadequate and imbalanced nutrient management particularly with respect to nitrogen and phosphorus. Choice of adequate and optimum fertilization is one of the most important factors that enhance the productivity of pigeonpea.

Farmers apply an enormous amount of synthetic fertilizers in the soil to meet the increasing demands of the growing population. The excessive utilization of chemical fertilizers will cause serious environmental impacts which will degrade the soil fertility to the maximum extent. The major utilization of chemicals in agricultural production systems can be decreased through the integrated use of fertilizers along with available manures and crop residues. Integrated nutrient management involves maintaining soil fertility and plant nutrient availability at optimal levels to sustain the desired productivity by maximizing the advantages of all available sources of organic, inorganic, and biological fertilizers. A nutrient balance sheet for agriculture is a tool used to track the inputs and outputs of nutrients within a farming system. It helps to understand the nutrient dynamics of their soil and crops and also helps to understand fertilization and soil management practices. This comprehensive approach ensures that farming not only becomes more productive and profitable but also engages in environmental sustainability and responsibility.

Materials and Methods

A field experiment was conducted during *khari*, 2018 on black cotton soils at Regional Agricultural Research Station, Acharya N G Ranga Agricultural University (ANGRAU), Lam Farm, Guntur, which is situated at an altitude of 35.1 m above mean sea level, 16°2'N latitude, 80°3'E longitude in Krishna Agro Climatic Zone of Andhra Pradesh, India. Based on soil analysis, the soil of the experimental site was classified as clayloam in texture, alkaline in reaction, low in organic carbon (0.43%), low in nitrogen (188 kg ha⁻¹), medium in phosphorus (43.5 kg ha⁻¹) and high in potassium (716 kg ha⁻¹). The experiment was laid out in factorial randomized block design (FRBD) with three replications, comprised of two factors in which the first factor had four nitrogen levels (N₁: 20 kg ha⁻¹, N₂: 40 kg ha⁻¹, N₃: 60 kg ha⁻¹ & N₄: 80 kg ha⁻¹) and second factor of three phosphorus (P₂O₅) levels (P₁: 50 kg ha⁻¹, P₂: 75 kg ha⁻¹ and P₃: 100 kg ha⁻¹) of hybrid pigeonpea ICPH-2740. The nitrogen in the form of urea and phosphorus in single super phosphate (SSP) form were applied as basal as per the treatments. The crop was sown on 17th July, 2018 used bold healthy seed treated with imidachloprid 600 FS @ 5 ml kg⁻¹ seed by adopting a plant spacing of 180 cm × 20 cm. The total rainfall received during the crop growth period was 391.1 mm well distributed in 21 rainy days. The crop was harvested on 12th January, 2019. Samples collected for recording drymatter accumulation at harvest were oven dried, then powdered and analysed using different methods for different nutrients. For analysis of nitrogen using Micro Kjeldahl's method, for phosphorus using Olsen's method and for potassium using Neutral Normal Ammonium extractant method. The effect of treatments was statistically analyzed using the F test. The experimental data were collected analysed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test as per the procedure given by Gomez and Gomez (1984) [17] and conclusions were drawn at 5% probability level.

Results and Discussion

Growth

Data presented in the Table 1 reveal that the plant height of 232.4 cm was obtained with the highest level of nitrogen (80 kg N ha⁻¹)

which was significantly on par with 60 kg N ha⁻¹ registering 227.5 cm at harvest. The increase in the plant height with increase in nitrogen level might have accelerated the synthesis of more chlorophyll and amino acids and stimulated the cellular activity, responsible for cell division and meristematic growth. These results were in close conformity with those of Goud *et al.* (2012) [8], Meena *et al.* (2013) [15] and Singh *et al.* (2016) [21]. Significant increase in plant height was observed with an increase in levels of phosphorus. The plant height of 230.6 cm was recorded highest with an application of 100 kg P₂O₅ ha⁻¹ and was on par with 75 kg P₂O₅ ha⁻¹ (223.4 cm) and superior over 50 kg P₂O₅ ha⁻¹. The increase in plant height due to higher levels of phosphorus might be resulted towards accelerating effect of P on the synthesis of protoplasm, and role of P in growth of new tissues and cell elongation which in turn increases the plant height. Similar results were reported by Goud *et al.* (2012) [8].

There was a significant improvement in the drymatter production at harvest with an increase in N levels. The highest drymatter accumulation of 7347 kg ha⁻¹ was recorded with an application of 80 kg N ha⁻¹ which was on par with 60 kg N ha⁻¹ (7052 kg ha⁻¹). However, the drymatter accumulation was significantly higher with 80 kg N ha⁻¹ than that of other two lower levels of nitrogen (20 kg ha⁻¹ and 40 kg ha⁻¹) at harvest. The probable reason for increase in the drymatter accumulation with increase in the nitrogen might be due to its role in plant metabolism by being an essential constituent of metabolically active compounds like amino acids, nucleic acids and enzymes. Thereby it results in an increase in the photosynthetic activity which finally results in vegetative growth. Increase in drymatter with increase in nitrogen levels was supported with earlier findings by Meena *et al.* (2013) [15] and Sultana *et al.* (2018) [23]. The application of 100 kg P₂O₅ ha⁻¹ recorded highest drymatter accumulation at harvest (7213 kg ha⁻¹) was found significantly superior over 50 kg P₂O₅ ha⁻¹ but was not comparable with 75 kg P₂O₅ ha⁻¹ (6730 kg ha⁻¹). This might be due to the beneficial effect of phosphorus attributed towards root proliferation, nodulation and synthesis of protoplasm gave higher pace of drymatter accumulation.

Yield Attributes

There was significant change in the number of pods plant⁻¹ with an increase in the levels of nitrogen and phosphorus. With increase in the nitrogen levels from 20 kg ha⁻¹ to 80 kg ha⁻¹, the number of pods plant⁻¹ was significantly increased. The highest number of pods plant⁻¹ (711) was recorded with an application of 80 kg N ha⁻¹ which was on par with 60 kg N ha⁻¹ (682). However, significant difference was found between the 80 kg ha⁻¹ and 40 kg ha⁻¹, 60 kg ha⁻¹ and 20 kg ha⁻¹. The least number of pods plant⁻¹ (528) were recorded with an application of 20 kg N ha⁻¹. With an increase in the nitrogen levels, there was an increase in the number of functional leaves, and resulting in higher photosynthetic and assimilation rates, metabolic activity and cell division, which consequently increased yield components like pods plant⁻¹ in pigeonpea. These results are in accordance with those of Singh *et al.* (2016) [21] and Sultana *et al.* (2018) [23]. Increase in the phosphorus levels from 50 to 100 kg ha⁻¹ resulted in the significant increase in the number of pods plant⁻¹. The higher level of phosphorus (100 kg ha⁻¹) produced more number of pods plant⁻¹ (678) than that of 75 kg P₂O₅ ha⁻¹ (629). However, the difference between these levels was not comparable and significant difference was noticed between 100 kg P₂O₅ ha⁻¹ and 50 kg P₂O₅ ha⁻¹. The reason behind the increase in the production of the number of pods plant⁻¹ might be due to the role of phosphorus in improving the rate of symbiotic N fixation and in turn, stimulates the growth and number of pods plant⁻¹. These

findings are in close conformity with those of Goud *et al.* (2012)^[8] and Singh *et al.* (2016)^[21].

Grain yield and quality

The increase in the nitrogen levels from 20 to 80 kg N ha⁻¹ showed significant difference in the seed yield. The highest seed yield of 1911 kg ha⁻¹ was recorded at higher level of 80 kg N ha⁻¹ than that of other lower levels of nitrogen. However, the differences

between 80 kg N ha⁻¹ & 60 kg N ha⁻¹ and 40 kg N ha⁻¹ & 20 kg N ha⁻¹ could not reach the level of significance. But significant increase in seed yield was observed when nitrogen level was increased from 40 kg ha⁻¹ to 60 kg ha⁻¹. The lowest yield (1665 kg ha⁻¹) was recorded at reduced level of 20 kg N ha⁻¹ and it was not comparable with subsequent increased level of 40 kg N ha⁻¹ (1719 kg ha⁻¹). The highest yield advantage of 14.1% and 10.9% were recorded when the nitrogen level rose from 20 kg ha⁻¹

Table 1: Growth, yield attributes and yield of hybrid pigeonpea as influenced by nitrogen and phosphorus levels

Treatments	Plant height (cm)	Drymatter accumulation (kg ha ⁻¹)	Number of pods plant ⁻¹	Pod length (cm)	Seeds pod ⁻¹	100 seed weight (g)	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)	Protein content (%)
Nitrogen levels (kg ha⁻¹)									
20	207.4	6068	528	5.1	4.0	12.9	1665	5504	20.5
40	210.2	6413	562	5.1	4.0	13.1	1719	5692	21.4
60	227.5	7052	682	5.2	4.1	13.2	1900	6177	22.4
80	232.4	7347	711	5.2	4.1	13.2	1911	6245	23.2
SEm±	6.68	294.59	24.77	0.03	0.09	0.08	61.08	174.23	0.57
CD (p=0.05)	19.6	864	73	NS	NS	NS	179	511	1.7
Phosphorus (P₂O₅) levels (kg ha⁻¹)									
50	204.2	6218	558	5.1	4.0	13.0	1684	5583	20.8
75	223.4	6730	629	5.1	4.0	13.1	1833	6000	22.2
100	230.6	7213	678	5.1	4.0	13.2	1880	6130	22.6
SEm±	5.79	255.13	21.45	0.03	0.08	0.07	52.9	150.89	0.50
CD (p=0.05)	17.0	748	63	NS	NS	NS	155	443	1.5
Interaction (N×P)									
SEm±	11.57	510.26	42.91	0.06	0.16	0.14	105.79	301.77	0.99
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	9.1	13.2	12.0	1.9	6.8	1.9	10.2	8.9	7.9

to 60 kg ha⁻¹ and 40 kg ha⁻¹ to 60 kg ha⁻¹, respectively. This might be due to the fact that added fertilizers enhanced the availability of nutrients to plants resulting in profuse shoot growth, and thereby activating greater absorption of these nutrients from soil. Similar results were also reported by Goud *et al.* (2012)^[8], Umesh and Shankar (2013)^[24] and Singh *et al.* (2016)^[21].

The maximum seed yield (1880 kg ha⁻¹) was recorded with application of higher level of phosphorus (100 kg P₂O₅ ha⁻¹) than that of lower level of phosphorus (75 kg P₂O₅ ha⁻¹ and 50 kg P₂O₅ ha⁻¹). However, significantly superior yield was observed at 100 kg P₂O₅ ha⁻¹ when it was compared with lower level of 50 kg P₂O₅ ha⁻¹. But the differences in seed yields did not reach the level of significance between 100 kg P₂O₅ ha⁻¹ and 75 kg P₂O₅ ha⁻¹. Phosphorus plays a pivotal role in the higher yield, by stimulation of root development, energy transformation and metabolic processes in the plants, which in turn, resulted in greater translocation of photosynthates towards the sink development. Ultimately the seed yield plant⁻¹ was improved which resulted in higher seed yield. Similar results were reported by Goud *et al.* (2012)^[8], Aher *et al.* (2015)^[3] and Ade *et al.* (2018)^[2] and Kakade *et al.* (2018)^[10].

With an incremental increase in the nitrogen level from 20 to 80 kg N ha⁻¹ stalk yield increased and the maximum stalk yield (6524 kg ha⁻¹) was observed with higher level of 80 kg N ha⁻¹ than that of other three levels of nitrogen. The differences were comparable between 80 kg N ha⁻¹ and 40 kg N ha⁻¹ and 60 kg N ha⁻¹ and 20 kg N ha⁻¹. Application of nitrogen enhanced the stalk yield. This could be ascribed to its positive influence on both vegetative and reproductive growth of the crop which leads to increase in stalk yield due to increased drymatter production per plant. These results are in close conformity with those of Yadav and Singh (2009)^[26], Meena *et al.* (2013)^[15], Umesh and Shankar (2013)^[24], Rathod *et al.* (2015)^[18], Singh *et al.* (2016)^[21] and Ramanjaneyulu *et al.* (2017)^[17].

There was significant influence of phosphorus on the stalk yield

with increase in the levels of phosphorus from 50 to 100 kg P₂O₅ ha⁻¹. The stalk yield recorded was highest with 100 kg P₂O₅ ha⁻¹ (6130 kg ha⁻¹) followed by 75 kg P₂O₅ ha⁻¹ (6000 kg ha⁻¹) and 50 kg P₂O₅ ha⁻¹ (5583 kg ha⁻¹). Application of higher phosphorus levels leads to higher photosynthetic activity in pigeonpea which leads supply of carbohydrates thereby production of more biomass. These results are in accordance with Pandey and Kushwaha (2009)^[16], Goud *et al.* (2012)^[8] Kumar *et al.* (2012)^[12], Kumar and Singh (2014)^[13], Aher *et al.* (2015)^[3] and Kumar *et al.* (2015)^[11].

The data shown in the Table 2 revealed that the application of 80 kg N ha⁻¹ was registered with highest protein content of 23.2% which was superior over the lower levels of 20 and 40 kg N ha⁻¹ and statistically on par with 60 kg N ha⁻¹ (22.4%). The improvement in quality of pigeonpea seed could be attributed to greater availability of N and P, regular supply of nutrients and, thus, improved translocation of nutrients from source to sink, increased protein yield. Similar findings were also reported by Zadode *et al.* (2014)^[27].

Nutrient Uptake

The nutrient uptake by the seed and stalk were given in the Table 2. The highest nitrogen uptake by the seed (71.4 kg ha⁻¹) and stalk (89.5 kg ha⁻¹) were registered with 80 kg N ha⁻¹ than that of other levels of nitrogen but it was on par with 60 kg N ha⁻¹ in both seed (68.0 kg ha⁻¹) and stalk (80.2 kg ha⁻¹). The lower levels of 40 kg N ha⁻¹ and 20 kg N ha⁻¹ were on par with each other and inferior to their highest level. Application of 100 kg P₂O₅ ha⁻¹ was registered with maximum nitrogen uptake in seed (67.8 kg ha⁻¹) and stalk (82.1 kg ha⁻¹) and this was on par with 75 kg P₂O₅ ha⁻¹ (65.5 kg ha⁻¹ and 78.0 kg ha⁻¹ in seed and stalk, respectively). Total nitrogen uptake by seed and stalk was registered maximum with higher level of 80 kg N ha⁻¹ (160.9 kg ha⁻¹) which was not comparable with 60 kg N ha⁻¹ (148.3 kg ha⁻¹). The lower two levels of nitrogen 40 kg ha⁻¹ and 20 kg ha⁻¹ were statistically on

par. In case of phosphorus, the highest level was obtained with maximum uptake (150.0 kg ha^{-1}) and was on par with 75 kg ha^{-1} (143.5 kg ha^{-1}). The lowest level of phosphorus (50 kg ha^{-1}) recorded lowest uptake of 124.8 kg ha^{-1} . The increase in the nitrogen uptake by pigeonpea could be attributed to higher yield coupled with slight improvement in nitrogen concentration of grain and non-grain parts. Application of higher levels of phosphorus developed better root system and increased absorption of nitrogen from soil. These results are supported with the findings of Meena *et al.* (2013) [15], Ahirwar *et al.* (2016) [4], Kakade *et al.* (2018) [10] and Sultana *et al.* (2018) [23].

The phosphorus uptake at harvest by the seed and stalk of pigeonpea was registered maximum with 80 kg N ha^{-1} (9.2 kg ha^{-1} and 17.5 kg ha^{-1} , respectively) and this was on par with 60 kg N ha^{-1} in seed (8.7 kg ha^{-1}) and stalk (16.1 kg ha^{-1}). The lower levels of nitrogen (40 kg ha^{-1} and 20 kg ha^{-1}) were on par and statistically inferior to the highest level of nitrogen. With highest phosphorus level of 100 kg ha^{-1} , the maximum uptake was realised in seed (8.7 kg ha^{-1}) and was significantly greater than that of $50 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (7.3 kg ha^{-1}) but the difference was on par with 75 kg ha^{-1} (8.2 kg ha^{-1}). In stalk, the highest uptake was recorded with $100 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (16.0 kg ha^{-1}) which was on par with $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (14.8 kg ha^{-1}). There was no significant influence of interaction on the phosphorus uptake.

Total phosphorus uptake (seed and stalk) was recorded higher with application of 80 kg N ha^{-1} (26.6 kg ha^{-1}) which was on par with 60 kg N ha^{-1} (24.8 kg ha^{-1}). The lower two levels (40 kg N ha^{-1} and 20 kg N ha^{-1}) did not differ statistically. The similar trend was also observed with that of phosphorus levels. Higher phosphorus level ($100 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$) registered higher total phosphorus uptake (24.7 kg ha^{-1}) and it was statistically not significant with $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (23.0 kg ha^{-1}). Application of graded levels of nutrients (nitrogen and phosphorus) significantly increased the total uptake of phosphorus by hybrid pigeonpea. The positive influence on phosphorus uptake might be due to the impact of phosphorus on carbon cycle in the plant *i.e.*, higher

carbondioxide fixation and their efficient translocation. The maximum uptake of phosphorus might be owing to the increased crop biomass as well as nutrient content. These results are in close conformity with those of Dutta (2007) [6] and Sai Kumari *et al.* (2024) [19].

The maximum potassium uptake in seed of pigeonpea was registered with higher level of nitrogen applied treatment which was significantly superior than rest of nitrogen levels. Potassium uptake by stalk at harvest did not shown any comparable difference among the three lower levels of nitrogen (60 kg ha^{-1} , 40 kg ha^{-1} and 20 kg ha^{-1}). With $100 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ the maximum potassium uptake by seed of hybrid pigeonpea (10.8 kg ha^{-1}) was observed which was on par with $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (10.2 kg ha^{-1}) and it was found superior over the lower level of $50 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (9.2 kg ha^{-1}). Significant influence of phosphorus was noticed in respect of potassium uptake by the stalk. Highest uptake of potassium by stalk was recorded with increased level of $100 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (87.9 kg ha^{-1}) and it was on par with $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (83.5 kg ha^{-1}).

The maximum total potassium uptake (seed and stalk) was reported with 80 kg N ha^{-1} (101.7 kg ha^{-1}) than other levels of nitrogen. The highest level of nitrogen 80 kg ha^{-1} has not reached level of significance with 60 kg ha^{-1} (97.5 kg ha^{-1}) in respect of total potassium uptake by hybrid pigeonpea and both 60 kg N ha^{-1} and 40 kg N ha^{-1} were on par with each other. There was significant influence of phosphorus on the total potassium uptake. Application of $100 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ reported maximum total potassium uptake (98.7 kg ha^{-1}) and this was not significantly superior than $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ (93.6 kg ha^{-1}). With increase in the nutrient levels, there will be increase in the potassium uptake. There will be profuse root development which helps in greater absorption of potassium from rhizosphere of the soil. Increase in the potassium uptake with increase in phosphorus levels was in similar trend with findings of Meena *et al.* (2013) [15], Umesh and Shankar (2013) [24] and Ahirwar *et al.* (2016) [4] and Kakade *et al.* (2018) [10].

Table 2: Nitrogen, Phosphorus and Potassium uptake (kg ha^{-1}) of hybrid pigeonpea as influenced by nitrogen and phosphorus levels

Treatment	Nutrient uptake (kg ha^{-1})								
	Nitrogen			Phosphorus			Potassium		
	Seed	Stalk	Total	Seed	Stalk	Total	Seed	Stalk	Total
Nitrogen levels (kg ha^{-1})									
20	54.6	65.9	120.5	6.9	11.9	18.9	8.7	75.3	84.0
40	59.2	69.0	128.1	7.5	13.1	20.6	9.4	78.2	87.6
60	68.0	80.2	148.3	8.7	16.1	24.8	10.8	86.7	97.5
80	71.4	89.5	160.9	9.2	17.5	26.6	11.2	90.5	101.7
SEm±	3.00	3.97	4.82	0.41	0.64	0.74	0.48	3.58	3.49
CD (p=0.05)	8.8	11.6	14.1	1.2	1.9	2.2	1.4	10.5	10.2
Phosphorus (P_2O_5) levels (kg ha^{-1})									
50	56.4	68.4	124.8	7.3	13.2	20.5	9.2	76.6	85.8
75	65.5	78.0	143.5	8.2	14.8	23.0	10.2	83.5	93.6
100	67.8	82.1	150.0	8.7	16.0	24.7	10.8	87.9	98.7
SEm±	2.60	3.44	4.17	0.35	0.56	0.64	0.41	3.10	3.03
CD (0.05)	7.6	10.1	12.2	1.0	1.6	1.9	1.2	9.1	8.9
Interaction (N×P)									
SEm±	5.20	6.87	8.35	0.71	1.11	1.27	0.83	6.21	6.05
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	14.2	15.6	10.4	15.2	13.2	9.7	14.3	13.0	11.3

Conclusion

The results indicated that the highest yield, the quality (protein) and nutrient uptake of the hybrid pigeonpea (ICPH 2740) were higher with the higher levels of nitrogen and phosphorus application of 80 kg N ha^{-1} and $100 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$, irrespectively. And these were statistically on par with their subsequent lower

level of nitrogen (60 kg N ha^{-1}) and phosphorus ($75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$) and superior over the lowest levels. Protein content was also influenced by the levels of N and P_2O_5 and higher values noticed at higher levels of N and P_2O_5 . From the above study, it was concluded that the application of 60 kg N ha^{-1} and $75 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ would give better yield and quality in the Krishna Agro-climatic

zone of Andhra Pradesh.

References

1. Directorate of Pulses Development. Annual Report 2022-23. Ministry of Agriculture, Government of India; 2023.
2. Ade UK, Dambale AS, Jadhav DB. Effect of phosphorus and biofertilizer on growth, yield and economics of pigeonpea (*Cajanus cajan* L. Millsp.) under rainfed condition. *Int J Curr Microbiol Appl Sci*. 2018;6:1408-1416.
3. Aher SH, Gokhale DN, Kadam SR, Karanjikar PN. Effect of sources and levels of phosphorus on yield, quality and phosphorus uptake in pigeonpea. *Int J Agric Sci*. 2015;11(1):59-62.
4. Ahirwar RP, Mishra US, Mitra NG, Siouthia P, Ahirwar K. Effect of phosphorus and bio-fertilizers on nutrient contents and uptake by pigeonpea (*Cajanus cajan* L.) and residual soil constituents. *Int J Agric Sci*. 2016;8(54):2943-2945.
5. Talari A, Shakappa D. Role of pigeonpea (*Cajanus cajan* L.) in human nutrition and health: a review. *Asian J Dairy Food Res*. 2018;37(3):212-220.
6. Dutta D. Studies on the efficiency of rock phosphate as a source of phosphorus to pigeonpea (*Cajanus cajan* L.) in acid laterite soil of West Bengal. *Int J Agric Sci*. 2007;3(1):228-231.
7. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd ed. New York: Wiley; 1984.
8. Goud VV, Kale HB, Konde NM. Optimization of crop geometry and nutrient requirements of medium-duration pigeonpea hybrid under rainfed condition. *J Food Legumes*. 2012;25(3):243-245.
9. Jeyajothi R, Pazhanivelan S. Dry matter, nutrient uptake and yield of short-duration pigeonpea (*Cajanus cajan* L.) varieties under drip fertigation system. *Int J Curr Microbiol Appl Sci*. 2017;6(11):3958-3965.
10. Kakade SU, Mohurle LA, Bhale VM, Deshmukh JP, Goud VV. Response of split application of nutrients through fertigation on nutrient uptake, nutrient and water use efficiency and yield of pigeonpea. *Int J Curr Microbiol Appl Sci*. 2018;6:826-833.
11. Kumar HPB, Koppalkar BG, Basavanneppa MA, Ananda N, Narayanarao K. Effect of planting geometry and nutrient levels on yield, yield attributes and economics of pigeonpea genotypes. *Karnataka J Agric Sci*. 2015;28(2):160-163.
12. Kumar P, Rana KS, Rana DS. Effect of planting systems and phosphorus with bio-fertilizers on the performance of sole and intercropped pigeonpea (*Cajanus cajan*) under rainfed conditions. *Indian J Agron*. 2012;57(2):127-132.
13. Kumar S, Singh BP. Productivity and profitability of pigeonpea (*Cajanus cajan* L. Millsp.) genotypes as influenced by phosphorus and sulphur fertilization. *J Rural Agric Res*. 2014;14(1):23-27.
14. Kumari P, Kumar P, Roy S. Growth, instability and decomposition of pigeonpea production in India. *Pharma Innov J*. 2023;12(8):1056-1061.
15. Meena BK, Hulihalli HK, Sumeriya HK, Padiwal NK. Physical characters, yield, nutrient concentration and nutrient uptake by medium-duration pigeonpea hybrid ICPH-2671 as influenced by fertility levels and planting geometry. *Ann Agri Bio Res*. 2013;18(3):328-335.
16. Pandey A, Kushwaha HS. Productivity and profitability of pigeonpea under different sources of nutrients in rainfed condition of central India. *J Food Legumes*. 2009;22(4):303-304.
17. Ramanjaneyulu AV, Reddy KI, Bhatt PS, Neelima TL, Srinivas A. Influence of pigeonpea varieties, nitrogen levels and planting methods on yield and economics under rainfed conditions. *Legume Res*. 2017;40(5):911-915.
18. Rathod PS, Sharma A, Patil DH, Dodamani BM. Performance of pigeonpea under different sources of nutrients in rainfed conditions of Karnataka. *J Food Legumes*. 2015;28(2):141-143.
19. Sai Kumari G, Venkata Rao P, Sree Rekha M, Srinivasa Rao V. Growth response and economics variability in hybrid pigeonpea to nitrogen and phosphorus fertilization. *J Exp Agric Int*. 2024;46(7):413-418.
20. Sarkar S, Panda S, Yadav KK, Kandasamy P. Pigeonpea (*Cajanus cajan*): an important food legume in Indian scenario—a review. *Legume Res*. 2020;43(5):601-610.
21. Singh SK, Kumari N, Karmakar S, Puran AN, Pankaj SC. Productivity, economics and nutrient uptake of hybrid pigeonpea as influenced by different fertility and lime levels under rainfed condition. *Environ Ecol*. 2016;34(2A):726-729.
22. Sowmyasri S, Rani CS, Sudhakar C, Triveni S. Influence of integrated nutrient management on the productivity of kharif redgram (*Cajanus cajan* L.). *Int J Environ Clim Change*. 2023;13(10):2528-2532.
23. Sultana S, Venkata Rao P, Rekha MS, Rao VS. Response of hybrid pigeonpea (*Cajanus cajan* L.) to planting geometry and nitrogen levels. *Andhra Agric J*. 2018;65(4):826-829.
24. Umesh MR, Shankar MA. Yield performance and profitability of pigeonpea (*Cajanus cajan* L.) varieties under different nutrient supply levels in dryland Alfisols of Karnataka. *Indian J Dryland Agric Res Dev*. 2013;28(1):63-69.
25. Wu J, Zhou Q, Zhou C, Cheng KW, Wang M. Strategies to promote the dietary use of pigeonpea (*Cajanus cajan* L.) for human nutrition and health. *Food Front*. 2024;5:1014-1030.
26. Yadav MK, Singh RS. Effect of nitrogen levels and weed management practices on pigeonpea (*Cajanus cajan*) and rice (*Oryza sativa*) intercropping system under ridge-furrow planting system. *Indian J Agric Sci*. 2009;79(4):268-272.
27. Zadode RS, Sethi HN, Vilhekar SC. Response of pigeonpea to organic and inorganic fertilization. *Adv Res J Crop Improv*. 2014;5(2):181-184.