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

www.agronomyjournals.com
2024; SP-7(6): 486-488
Received: 13-04-2024
Accepted: 16-05-2024

Sai Kumari G
Department of Agronomy, Agricultural College, Acharya N.G. Ranga Agricultural University, Bapatla, Guntur, Andhra Pradesh, India

Venkata Rao P
Department of Agronomy, Agricultural College, Acharya N.G. Ranga Agricultural University, Bapatla, Guntur, Andhra Pradesh, India

Sree Rekha M
Department of Agronomy, Agricultural College, Acharya N.G. Ranga Agricultural University, Bapatla, Guntur, Andhra Pradesh, India

Srinivasa Rao V
Department of Agronomy, Agricultural College, Acharya N.G. Ranga Agricultural University, Bapatla, Guntur, Andhra Pradesh, India

Corresponding Author:
Sai Kumari G
Department of Agronomy, Agricultural College, Acharya N.G. Ranga Agricultural University, Bapatla, Guntur, Andhra Pradesh, India

Management of nitrogen and phosphorus for higher productivity in hybrid pigeonpea under rainfed conditions of coastal agro-ecosystem

Sai Kumari G, Venkata Rao P, Sree Rekha M and Srinivasa Rao V

DOI: https://doi.org/10.33545/2618060X.2024.v7.i6Sg.927

Abstract
A field experiment was conducted during *kharif* season, 2018 at Regional Agricultural Research Station, Lam on deep black cotton soils on Management of nitrogen and phosphorus for higher productivity in hybrid pigeonpea under rainfed conditions of Coastal agro-ecosystem. The experiment was laid out in factorial randomized block design comprised of four nitrogen levels (N_1: 20 kg ha^{-1}, N_2: 40 kg ha^{-1}, N_3: 60 kg ha^{-1}& N_4: 80 kg ha^{-1}) and three phosphorus (P_2O_5) levels (P_1: 50 kg ha^{-1}, P_2: 75 kg ha^{-1}and P_3: 100 kg ha^{-1}). The pigeonpea hybrid was used in the study ICPH-2740.The results indicated that the hybrid pigeonpea (ICPH- 2740) was responded well to higher levels of nitrogen and phosphorus. Higher seed yield (1911 kg ha^{-1}) of hybrid pigeonpea was obtained with application of 80 kg N ha^{-1}, irrespective of phosphorus application and there was no significant difference with 60 kg N ha^{-1} (1900 kg ha^{-1}). Application of higher phosphorus level of 100 kg ha^{-1} resulted the maximum seed yield (1880 kg ha^{-1}), irrespective of nitrogen application and this was on par with 75 kg P_2O_5 ha^{-1}. Thus, for getting economically higher yield from hybrid pigeonpea (ICPH- 2740) in Krishna zone of Andhra Pradesh, it may be applied with 60 kg N ha^{-1} and 75 kg P_2O_5 ha^{-1}.

Keywords: Hybrid pigeonpea ICPH-2740, nitrogen levels, phosphorus levels and yield

Introduction

In India, pigeonpea (*Cajanus cajan* L.) among the *kharif* grain legumes, occupies first place is the second most important pulse crop next to chickpea as a whole. India has a virtual monopoly in pigeonpea production by accounting 90 percent of the world's total production. It is one of the protein rich legume crops of semi-arid and sub-tropics and requires due attention in view of large-scale shortage of pulses to meet the domestic requirement. India is the largest producer of pigeonpea with 4.2 M t of production in an area of 4.4 M ha with an average productivity of 960 kg ha^{-1}.

Demand for pigeonpea in India is ever increasing and the scope for expansion is limited, therefore attention is now focused on increasing it's per unit productivity. This can be achieved only by adopting a proven technology like hybrids. A beginning in this direction has already been made through the release of hybrid ICPH-2740. It is the first commercial pigeonpea hybrid released in Telangana state as "*Mannem Konda Kandi*" in 2015. This hybrid has demonstrated a significant yield advantage over the most popular cultivars in Andhra Pradesh and Telangana. In order to achieve higher yields, the adoption of optimum use of nutrient levels will go a long way in making efficient use of limited resources and thus to stabilize the productivity of pigeonpea.

Materials and Methods

A field experiment was conducted during *kharif*, 2018 on black cotton soils at Regional Agricultural Research Station-Lam Farm, Guntur, which is situated at an altitude of 35.1 m above mean sea level, 16º2'N latitude, 80º3'E longitude in Krishna Agro Climatic Zone of Andhra Pradesh, India. Based on soil analysis, the soil of the experimental site was classified as clay 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 comprised of four nitrogen levels (N_1: 20 kg ha^{-1}, N_2: 40 kg ha^{-1}, N_3: 60 kg ha^{-1}& N_4: 80 kg ha^{-1}) and three phosphorus (P_2O_5) levels (P_1: 50 kg ha^{-1}, P_2: 75 kg ha^{-1}and P_3: 100 kg ha^{-1}) of hybrid pigeonpea ICPH-2740. The nitrogen and phosphorus were applied as basal as per the treatments. The crop was sown on 17th July, 2018 with a spacing of 180 cm × 20 cm. The total rainfall received during the crop growth period was 391.1 mm in 21 rainy days. The data was collected in five plants selected randomly from each treatment. The crop was harvested on 12th January, 2019. Data collected were analyzed by using standard statistical procedures. The comparison of treatment means was made by critical difference (CD) at $P \leq 0.05$.

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) [2], Meena *et al.* (2013) [3] and Singh *et al.* (2016) [4]. 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 P_2O_5 ha^{-1} and was on par with 75 kg P_2O_5 ha^{-1} (223.4 cm) and superior over 50 kg P_2O_5 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) [2].

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) [3] and Sultana *et al*. (2018) [5]. The application of 100 kg P_2O_5 ha^{-1} recorded highest drymatter accumulation at harvest (7213 kg ha^{-1}) was found significantly superior over 50 kg P_2O_5 ha^{-1} but was not comparable with 75 kg P_2O_5 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) [4] and Sultana *et al*. (2018) [5]. 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 P_2O_5 ha^{-1} (629). However, the difference between these levels was not comparable and significant difference was noticed between 100 kg P_2O_5 ha^{-1} and 50 kg P_2O_5 ha^{-1}.

Table 1: Yield attributes of hybrid pigeonpea ICPH- 2740 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}
Nitrogen levels (kg ha^{-1})					
20	207.4	6068	528	5.1	4.0
40	210.2	6413	562	5.1	4.0
60	227.5	7052	682	5.2	4.1
80	232.4	7347	711	5.2	4.1
SEm±	6.68	294.59	24.77	0.03	0.09
CD (p=0.05)	19.6	864	73	NS	NS
Phosphorus (P_2O_5) levels (kg ha^{-1})					
50	204.2	6218	558	5.1	4.0
75	223.4	6730	629	5.1	4.0
100	230.6	7213	678	5.1	4.0
SEm±	5.79	255.13	21.45	0.03	0.08
CD (p=0.05)	17.0	748	63	NS	NS
Interaction (N×P)					
SEm±	11.57	510.26	42.91	0.06	0.16
CD (p=0.05)	NS	NS	NS	NS	NS
CV (%)	9.1	13.2	12.0	1.9	6.8

Table 2: Seed yield, Stalk yield and Harvest index of hybrid pigeonpea ICPH-2740 as influenced by nitrogen and phosphorus levels

Treatments	100 seed weight (g)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	HI (%)
Nitrogen levels (kg ha^{-1})				
20	12.9	1665	5504	23.24
40	13.1	1719	5692	23.36
60	13.2	1900	6177	23.51
80	13.2	1911	6245	23.52
SEm±	0.08	61.08	174.23	0.91
CD (p=0.05)	NS	179	511	NS
Phosphorus (P_2O_5) levels (kg ha^{-1})				
50	13.0	1684	5583	23.26
75	13.1	1833	6000	23.38
100	13.2	1880	6130	23.59
SEm±	0.07	52.9	150.89	0.79
CD (p=0.05)	NS	155	443	NS
Interaction (N×P)				
SEm±	0.14	105.79	301.77	1.57
CD (p=0.05)	NS	NS	NS	NS
CV (%)	1.9	10.2	8.9	11.7

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) [2] and Singh *et al*. (2016) [4].

Yield

The increase in the nitrogen levels from 20 to 80 kg N ha^{-1} showed significant difference in the seed yield (Table 2). The highest seed yield of 1911 kg ha^{-1} was recorded with 80 kg N ha^{-1} than that of other levels of nitrogen. However, the difference between 80 kg N ha^{-1}& 60 kg N ha^{-1} and 40 kg N ha^{-1}& 20 kg N ha^{-1} were not reached the level of significance. But significant increase in seed yield was noticed when nitrogen level increased from 40 kg ha^{-1} to 60 kg ha^{-1}. The lowest was recorded with 20 kg N ha^{-1} (1665 kg ha^{-1}) and it was not comparable with next level of 40 kg N ha^{-1} (1719 kg ha^{-1}). 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) [2], Umesh and Shankar (2013) [6] and Singh *et al*. (2016) [4].

The maximum seed yield of 1880 kg ha^{-1} was recorded with an application of highest level of phosphorus (100 kg P_2O_5 ha^{-1}) than that of lowers level of phosphorus (75 kg P_2O_5 ha^{-1} and 50 kg P_2O_5 ha^{-1}). But the differences in seed yields did not reached the level of significance between 100 kg P_2O_5 ha^{-1} and 75 kg P_2O_5 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. The similar results were reported by Goud *et al.* (2012) [2].

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 enhances 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 dry matter production per plant. These results are in close conformity with those of Meena *et al.* (2013) [3], Umesh and Shankar (2013) [6] and Singh *et al*. (2016) [4].

There was significant influence of phosphorus on the stalk yield was noticed with an increase in the levels of phosphorus from 50 to 100 kg P_2O_5 ha^{-1}. The stalk yield was recorded highest with 100 kg P_2O_5 ha^{-1} (6130 kg ha^{-1}) followed by 75 kg P_2O_5 ha^{-1} (6000 kg ha^{-1}) and 50 kg P_2O_5 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 Goud *et al*. (2012) [2].

Conclusion

It was observed from the above results that the hybrid pigeonpea ICPH- 2740 was responded well to higher levels of nitrogen and phosphorus. Higher seed yield (1911 kg ha^{-1}) of hybrid pigeonpea was obtained with application of 80 kg N ha^{-1}, irrespective of phosphorus application and there was no significant difference with 60 kg N ha^{-1} (1900 kg ha^{-1}). Application of higher phosphorus level of 100 kg ha^{-1} resulted the maximum seed yield (1880 kg ha^{-1}), irrespective of nitrogen application and this was on par with 75 kg P_2O_5 ha^{-1}. Thus, for getting economically higher yield from hybrid pigeonpea ICPH-2740 in Krishna zone of Andhra Pradesh, it may be applied with 60 kg N ha^{-1} and 75 kg P_2O_5 ha^{-1}.

References

1. Annual Report DPD, 2017-2018; Ministry of Agriculture, Government of India.
2. 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.
3. Meena BK, Hulihalli HK, Sumeriya HK, Padiwal NK. Physical characters, yield and nutrient concentration and its 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.
4. Singh SK, Kumari N, Singh CS, Karmakar S, Puran AN. Performance of hybrid pigeonpea (*Cajanus cajan* L.) as influenced by nutrient and lime levels under rainfed condition of Jharkhand. Bioscan. 2016;11(1):327-330.
5. Sultana S, Rao PV, 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.
6. 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; c2013.