The Pharma Innovation Journal 2022; 11(3): 2357-2360

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 2357-2360

www.thepharmajournal.com
Received: 04-12-2021
Accepted: 09-02-2022

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Effect of Nitrogen and Panchagavya on Growth and Yield of Cowpea (*Vigna unguiculata* L.) Under the agro-climatic conditions of Prayagraj region

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Abstract
The field experiment was conducted during *Zaid* season of 2021 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The soil of the experiment plot was sandy loam in texture, nearly neutral in soil reaction ($_p$H 7.1), low in organic carbon (0.82%), available N (291.24 kg/ha), available P (32.85 kg/ha) and available K (264.78 kg/ha). The treatment consisted of two sources (Nitrogen levels 10, 15, 20 kg/ha) and (foliar application of Panchagavya at 2.5%, 5%) respectively. The experiment was laid out in Randomized Block Design with nine treatments replicates thrice. Result defined that maximum plant height (73.83), number of nodules (18.33), dry weight (25.88), pods/plant (17.60), test weight (20.27), seed yield (1523.33), straw yield (1533.33), harvest index (52.05), maximum gross returns (137,866.4), net returns (98,971.90) and benefit cost ratio (2.54) were obtained in the treatment combination of Nitrogen 20 kg/ha + panchagavya 5% compared to other treatments.

Keywords: Economics, nitrogen, panchagavya, seed yield, straw yield

Introduction
Cowpea (*Vigna unguiculata* L.), a member of Leguminaceae family, popularly known as black eye pea or labia is one of the important pulses grown during summer and rainy season for its long green tender pods, which are used as vegetable and dry seeds as pulse. Its foliage is used as fodder and plants as green manure. It is a major source of poor man's protein, as the protein content in its green leaves is about 3-4%, in immature green pods 4-5% and in manure seeds 23.09-28.75%. The green pods are rich in carbohydrates, minerals, B group vitamins, lysine, and tryptophan. Its protein is of high biological value, as it can fortify the carbohydrates rich diet appreciably to improve its nutritive value. However, anti-nutritional factors such as hydrates, oligosaccharides and protease inhibitors have also been reported in its dry seeds. Cowpea is well adapted to drier regions of the tropics and subtropics, where other food legumes do not perform well. Although it is grown worldwide but Africa is the leading producer with Nigeria and Niger the predominating countries followed by Brazil, India, Myanmar, America, West Indies and Australia also have significant production.
Cowpea is an annual herbaceous legume from the genus Vigna, belonging to family Fabaceae. Due to its tolerance for sandy soil and low rainfall, it is an important crop in the semiarid regions across Africa and Asia. It requires very few inputs, as the plant's root nodules are able to fix nitrogen, making it a valuable crop for resource-poor farmers and well-suited to intercropping with other crops. The whole plant is used as forage for animals, with its use as cattle feed likely responsible for its name. In India it is cultivated mainly in Maharashtra, Bihar, Punjab, Karnataka, Tamil Nadu, Kerala etc., where it is growth for both vegetable and pulse purpose and is a highly remunerative crop. The seeds are usually cooked and made into stews and curries, or ground into flour or paste.
Most cowpeas or grown on the African continent, particularly in Nigeria and Niger, which account for 66% of world population.
Being a shade tolerant crop, it can easily grow as intercrop with maize, millets, sorghum, and sugarcane in orchards. It is one of the best components of crop diversification in traditional rice-wheat cropping system. It has the ability to fix atmospheric nitrogen into the soil at the rate of 56 kg/ha, through root nodules containing Rhizobium bacteria under favourable conditions, thus, it is also used as green manure crop. The per capita availability of pulses in India is 35.5 g/day as against the minimum requirement of 70 g/day/capita as advocated by

India Council of Medical Research Anonymous (2009). In addition, the crop has heavy vegetative growth and covers the ground so well that it checks soil erosion as well that itchecks soil erosion as well as growth of weeds. In India pulses are grown nearly in 25.43 m ha with an annual production of 17.28 million tonnes and an average productivity of 679 kg/ha Anonymous (2012). Though it is a legume crop, it responds well to fertilizer application, especially nitrogen and panchagavya.

Nitrogen supply is essential for vegetative as well as, reproductive growth of a crop. It is applied to field crops mainly through soil. However, foliar application of nitrogen efficiently increases the vegetative as well reproductive growth. During early development of grain legumes the photosynthates are utilized for growth and functioning of root nodules, but at the onset of flowering the developing seeds requires higher levels of nitrogen.Therefore leaf nitrogen gets diverted to grain filling, leading to flower shedding and poor realization of sink. Nitrogen at the time of flowering increases the pod setting and yield.

Panchagvaya, an organic product has the potential to play the role of promoting growth and providing immunity in plant system. Panchagavya consists of five products *viz*. cow dung, cow urine, milk, curd, ghee. When suitably mixed and used, these have miraculous effects. Plants sprayed with panchagavya invariably produce bigger leaves and develop denser canopy. The photosynthetic system is activated for enhanced biological efficiency, enabling synthesis of maximum metabolites and photosynthates. The trunk produces side shoots, which are study and capable of carrying maximum fruits to maturity. Branching is comparatively high. The rooting is profuse and dense. Further they remain fresh for a long time. The roots spread and grow into deeper layers were also observed. All such roots help maximum intake of nutrients and water.

Materials and Methods

The present experiment was carried out during *Zaid* 2021 at Crop Research Farm, Department of Agronomy, SHUATS and Prayagraj (U.P). Which is located 25.28^0 N latitude, 81.54^0 E longitude, P^H (7.2), organic carbon (0.22%), available nitrogen (219 ka/ha), phosphorous (12.3 kg/ha) and potassium (235.7 kg/ha). The climate of the region is semi-arid subtropical.

Experimental design and treatment combinations

The experiment was laid out in Randomized Block Design. The treatments consists of three levels of nitrogen (10, 15 and 20 kg/ha) and two levels of panchagavya (2.5% and 5%) respectively. Where nitrogen (10, 15 and 20 kg/ha) was applied as soil application and panchagvaya (2.5% and 5%) was applied as a foliar spray at 10, 20, 30 DAS interval. The treatments are T_1 10 kg N /ha + water spray, T_2 10 kg N/ha + 2.5% panchagavya, T_3 10 kg N/ha + 5% panchagavya, T_4 15 kg N/ha + water spray, T_5 15 kg N/ha + 2.5% panchagavya, T_6 15 kg N/ha + 5% panchagavya, T_7 20 kg N/ha + water spray, T_8 20 kg N/ha + 2.5% panchagavya, T_9 20 kg N/ha + 5% panchagavya. Benefits: Nitrogen consists of proteins and chlorophyll. Imparts dark green to plants. Promotes vegetative growth to the plant, improves the quality of leafy vegetable. Panchagvaya is an organic liquid product and has potential to play role of promoting growth and providing immunity in plant system. These are the nine treatments replicated thrice during *Zaid* season 2021.

Crop management

Cowpea variety (Ankur Gomati) sown at the rate of 20 kg/ha. This variety is strong, semi viny growth with dense foliage and big leaves and high yield potential. Seed of this variety are brownish white in color. It is 90-120 days duration crop. The recommended dose of fertilizer 20:60:40 NPK kg/ha. The nutrient sources were Urea, SSP and MoP to fulfill the requirement of nitrogen, phosphorous and potassium. Six irrigations were given to the crop. Two hand weeding was done manually with *Khurpi* at 15DAS and 50DAS.

Statistical Analysis

The data recorded were different characteristics were subjected to statistical analysis by adopting Fishers the method Analysis of Variance (ANOVA) as described by Gomez and Gomez (2010). Critical Difference (CD) values were calculated the F test was significant at 5% level.

Plant Sampling

Yield attributes: After harvest, pods per plant are selected randomly according to treatment wise from harvested plants then plant height, nodules per plant, plant dry weight, pods per plant, seed index (g), seed yield, stover yield and harvest index were recorded randomly from five tagged plants and their averages were recorded. Pods from harvested area (1.0 m^2) were dried in sun and seeds were removed after that they are weighed separately from each plot for calculating seed yield. For stover yield, plants from harvest area (1.0 m^2) were dried in sun after they are weighed separately from each plot.

Results and Discussion

Performance of nitrogen and panchagavya on plant height (cm) of cowpea

Observations regarding the plant height of cowpea are given in the Table 1. There was an increasing in crop age plant height which was progressively increased with the advancement of crop during the experimentation. The analysis on plant height was found to be significantly higher in all the different growth intervals with the application of nitrogen and panchagvaya. Highest and significant plant height (86.39) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other treatments except N 20 kg/ha with 2.5% panchagavya/ha (84.11) was found to be statistically at par with N 20 kg/ha with 5% panchagavya/ha. Nitrogen consists of proteins and chlorophyll, promotes vegetative growth and improves quality of leafy vegetables. Similar results were also reported by (Chowdhury *et al.* (2000) [4] and (Thirumeninathan *et al.* (2018) [10] with application of different doses of nitrogen and panchagavya leads to an increase in plant height of cowpea.

Performance of nitrogen and panchagavya on number nodules per plant in cowpea

Observations regarding the number of nodules per plant in cowpea are given in Table 1 and data showed in increasing tendency from 15DAS to 45DAS. Maximum number of nodules (18.33) per plant was recorded with application of N 20 kg/ha with 5% panchagavya which was significantly superior over all other treatments except with application of N 15 kg/ha with 5% panchagavya (17.33).Similar findings are stated by Anita Dhakad *et al.* (2004) [5].

Performance of nitrogen and panchagavya on dry weight (g) of cowpea: Observations regarding the dry matter accumulation (g) of cowpea are given in the Table 1 and data showed and increasing tendency from 15DAS to harvest. At harvest, maximum dry matter accumulation (39.22 g) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other all treatments except with application of N 15 kg/ha with 5% panchagavya/ha (38.33 g). Cowpea dry matter accumulation significantly increased by increasing in nitrogen levels and panchagvaya concentration. A similar statement was also given by Yadav (2011) [12], Abayomi *et al.* (2008) [1], Jalali *et al.* (2015) [6] in application of nitrogen and Thirumeninathan *et al.* (2018) [10] in panchagavya.

Table 1: Performance of growth attributes on cowpea

Treatments	Plant Height (cm)	Number of Nodules/plant	Dry weight (g)
N 10 kg/ha + water spray	73.60	13.22	31.44
N 10 kg/ha + 2.5% panchagavya	74.85	14.55	34.22
N 10 kg/ha + 5% panchagavya	77.37	14.66	34.33
N 15 kg/ha + water spray	74.25	14.11	33.44
N 15 kg/ha + 2.5% panchagavya	78.20	15.11	35.11
N 15 kg/ha + 5% panchagavya	84.11	17.33	38.33
N 20 kg/ha + water spray	74.66	14.44	34.11
N 20 kg/ha + 2.5% panchagavya	82.19	15.11	36.33
N 20 kg/ha + 5% panchagavya	86.39	18.33	39.22

Performance of nitrogen and panchagavya on yield of cowpea

The data presented on yield attributes and yield of cowpea were statistically analyzed and have been presented in Table 2. The maximum number of pods per plant (15) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other treatments except with application of N 15 kg/ha with 5% panchagavya/ha (14.03). Increase in N at 20 kg/ha influences increase in number of pods per plant in cowpea was reported by Singh *et al.* (2018) [9]. Maximum seeds index (15.43) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other all treatments except with application of N 15 kg/ha with 5% panchagavya/ha (14.63).Maximum seed yield (1523.33 kg/ha) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other all treatments except with application of N 15 kg/ha with 5% panchagavya/ha (1293 kg/ha). Shaik and Mungse (1998) [8]was also observed similar results by the basal application of nitrogen. Maximum straw yield (1533.33) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other all treatments except with application of N 15 kg/ha with 5% panchagavya/ha (1366.67 kg/ha), N 20 kg/ha with 2.5% panchagavya/ha (1366.67) and N 15 kg/ha with 2.5% panchagavya/ha (1333.33). Maximum harvest index (52.05%) was recorded with application of N 20 kg/ha with 5% panchagavya/ha which was significantly superior over all other all treatments.

Table 2: Performance of yield attributes on cowpea

Treatments	Pods per plant	Seed index (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
N 10 kg/ha + water spray	10.37	10.30	803.33	816.67	49.68
N 10 kg/ha + 2.5% panchagavya	11.33	12	893.33	1106.67	44.36
N 10 kg/ha + 5% panchagavya	11.43	13.10	950	1133.33	45.45
N 15 kg/ha + water spray	10.53	11.03	896.67	1003.33	47.09
N 15 kg/ha + 2.5% panchagavya	12.77	13.13	990	1333.33	40.73
N 15 kg/ha + 5% panchagavya	14.03	14.63	1293.33	1366.67	48.63
N 20 kg/ha + water spray	10.73	11.13	933.33	1010	48.17
N 20 kg/ha + 2.5% panchagavya	13.67	14.27	1000	1366.67	42.29
N 20 kg/ha + 5% panchagavya	15.00	15.43	1523.33	1533.33	49.91

Conclusion

On the basis of one season experimentation, it is concluded that treatment with application of N 20 kg/ha with 5% panchagavya was recorded significantly higher growth attributes plant height (86.39 cm), higher number nodules per plant (18.33), higher dry weight (39.22 g) and higher yield attributes pods per plant (15), seed index (15.43), seed yield (1523.33), stover yield (1533.33 kg) and as well as harvest index (52.05%) viable.

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