Biological Forum – An International Journal **14(1): 998-1002(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Nutrient uptake by the Summer Black Gram (*Vigna mungo* L.) *var* SHEKHAR-2 Enhanced after Application of different Levels of NPK and Rhizobium as Biofertilizer

Raghu Nandan Singh Khatana[1*], Tarence Thomas[2], Jayasree Midde[3] and Mutyalu sheshu[4]
[1]Research Scholar, Department of Soil Science and Agricultural Chemistry,
NAI, SHUATS, Prayagraj, (Uttar Pradesh), India.
[2]Professor, Department of Soil Science and Agricultural Chemistry,
NAI, SHUATS, Prayagraj, (Uttar Pradesh), India.

(Corresponding author: Raghu Nandan Singh Khatana)*
(Received 09 November 2021, Accepted 12 January, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: At Research Farm Soil Science and Agricultural Chemistry, NAI, SHUATS, a field experiment was done on the effect of Rhizobium and NPK on soil characteristics, morphology, yield parameters, and nutrient uptake of black gram (*Vigna mungo* L.). The experiment used Randomized Block Design and was duplicated three times in twenty-seven plots. At 60 DAS, administration of 100 percent Rhizobium + 100 percent NPK considerably increased plant height (60.16 cm), as well as the number of leaves (33) on the plants. The application of 100 percent rhizobium + 100 percent NPK resulted in the highest total dry matter accumulation (20.34). Treatment T_1 (0 percent rhizobium + 0 percent NPK) had the lowest value of these parameters. Plant uptake of nutrients was also higher with 100 percent Rhizobium + 100 percent NPK afterwards maximum Nitrogen Phosphorus Potassium uptake in seed (37.8, 4.70, 9.78 kg ha-1) Significantly min uptake of NPK in seed (24.8, 2.24, 6.70 kg ha^{-1}), in stover (23.9, 2.62,7.06 kg ha^{-1}) and the total NPK uptake (72.5, 10.04, 19.86 kg ha^{-1}) respectively was found in treatment T_9 (100% Rhizobium+100% NPK).

Keywords: Rhizobium, NPK, Nutrient uptake, Black gram

INTRODUCTION

India produced 25.42 million metric tonnes of pulses in the fiscal year 2018-2019. From 2017 to 2018, annual pulse production increased by 2.29 million metric tonnes (23.13). This reflects a rise in overall production across the South Asian country. Madhya Pradesh ranked first in pulse output for the fiscal year 2018-2019, with 6045.41 Mt. Uttar Pradesh produced 2408.01 million tonnes during the fiscal year (Anon. 2019). In India, one of the most important pulse crops is black gram (*Vigna mungo* L. Hepper). The black gram is very important pulse crop of India which belongs to “Leguminosae” and genus “Vigna”. Pulses occupy a unique position in cropping system as a main crop, catch crop, cover crop and as fodder crop (Bonepally *et al.*, 2021). Black gram, because it is a legume crop, it not only enhances soil fertility but also contributes to the nitrogen economy of the following crop. Black gram (*Vigna mungo* L.) is one among the most widely produced pulse crops in India. Phosphorus is essential because it has beneficial effects on the body. Black gram has a protein composition of about 24%, as well as a nutritional value of 12 percent moisture, 1.4 percent fats, and 60.3 percent carbohydrates (Shroti *et al.*, 2018). On the one hand, chemical fertilisers serve a critical role in nitrogen management for crop growth and long-term productivity. Chemical fertilisers, on the other hand, pollute soil and pose a long-term threat to the environment's survival. As a result, the usage of chemical fertilisers must be restricted. Organic nutrient sources are preferred over chemical fertilisers since they do not pollute the environment and reduce the higher cultivation costs associated with mineral fertilisers (Tripathi *et al.*, 2021). To increase the output of black gramme, proper fertilisation is required. It can meet its nitrogen needs by symbiotically fixing nitrogen from the atmosphere. Phosphorus and sulphur are two nutrients that require special care. Sulphur treatment has a strong effect on black gramme. Both phosphorus and sulphur can help to boost the crop's quality and quantity. Soil microorganisms, in particular, are effective in solubilizing and mineralizing phosphate from total soil phosphorus. A phosphorus beginning dose is universally acknowledged as increasing crop yield. The goal of this experiment was to see how Rhizobium, PSB inoculation, and phosphorus levels influenced yield, nutrient concentration, and absorption. Biofertilizers, in addition to traditional fertilisers, may show to be a viable option for long-term agricultural productivity. Microorganisms are well known for their involvement in solubilizing inorganic phosphates in soil and making them accessible to plants (Barroso *et al.*, 2006). Pulses have nutritional needs similar to cereals, although nitrogen requirements in pulse crops are typically low due to pulses' unique capacity to fix nitrogen. The amount of nitrogen fixed is affected by Rhizobium strains, plant species, and environmental conditions. To grow and live in the soil, Rhizobium need phosphorus. Integrated nutrient management increases output while lowering the expense of chemical fertilisers. It also improves the soil's health and microbiological growth (Singh and Singh 2017).

MATERIALS AND METHODS

Experimental site: The experiment took place at SHUATS' Soil Science Research Farm in Prayagraj, which is located at 25°24′30′′N latitude, 81°51′10′′E longitude, and 98 metres above sea level (MSL), and is 6 kilometres away on the right bank of the Yamuna River, representing the Agro-Ecological Sub Region [North Alluvium plain zone (0-1 percent slope)] and Agro-Climatic Zone (Upper Gangetic Plain Region). Prayagraj has a subtropical climate with summer and winter extremes. Winter temperatures, particularly in December and January, can drop to as low as 3-5°C, while summer temperatures (May-June) can reach 45-48°C. Of the summer, scorching winds are typical, but frost can happen at any time during the year. The annual rainfall ranges from 850 to 1100 mm, with the majority falling during the monsoon season (July to September) and a few showers sprinkled throughout the winter months.

Treatments and Design of Experiments: The experiment was conducted using a randomised block design (RBD) with varying amounts of Rhizobium and NPK. The experimental area was divided into twenty-seven plots with the plot size was 2m x 2m.All nine treatments were replicated three times starting from T_1Control (@ 0 %NPK + @ 0 %Rhizobium), T_2@ 0 % NPK + @ 50% Rhizobium), T_3 (@0 %NPK + @100% Rhizobium), T_4 (@50% NPK + @ 0% Rhizobium), T_5 (@ 50% NPK + @ 50% Rhizobium), T_6 (@ 50% NPK + @ 100% Rhizobium), T_7(@ 100 NPK + @ 0 % Rhizobium), T_8 (@ 100 NPK + @ 50 % Rhizobium) T_9 (@ 100% NPK+ @ 100% Rhizobium).

Soil physical properties i.e. BD, PD, % Pore space and Water Retaining Capacity was determined by Graduated Measuring Cylinder and soil texture by hydrometer (Muthuval *et al.,* 1992). In chemical properties, pH was determined by potentiometric method by making soil water suspensions whereas a digital EC metre was used to determine the EC. The wet-oxidation method was used to evaluate Organic Carbon (Black, 1965). The alkaline permanganate method was used to assess available Nitrogen in an 800ml kjeldahl flask (Subbiah and Asija 1956). The amount of available Phosphorus was calculated using a colorimetric technique and a spectrophotometer (Olsen *et al.,* 1954). The amount of available Potassium and neutral ammonium acetate solutions (Toth and Prince 1949). Available Zinc was estimated by DTPA extraction by using Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978). The amount of Phosphorus uptake by plant sample was estimated by Vanadomolybdo phosphoric acid yellow colour method (Jackson, 1973).

All other actions were carried out in accordance with the crop's recommendations. Data on a variety of growth parameters, yield characteristics, seed and stover yields were collected under various treatments. The micro Kjeldahl method was used to assess the nitrogen content of seed and stover samples. The amount of phosphorus and potassium in the digest was measured using standard methods ($HClO_4$:HNO_3, 9:4) (Jackson, 1958). Nutrient uptake in seeds and stovers was calculated by multiplying nutrient content by seed and stover yield. Because the results of both years were practically identical, the data from both years was merged and statistically analysed to draw appropriate conclusions using the standard ANOVA technique published by Gomez and Gomez (1984).

Formulae used for nutrient uptake-

Nutrient uptake by seed (kgha^{-1}) = seed yield (qha^{-1}) x Nutrient content (%)

Nutrient uptake by stover (kgha^{-1}) = stover yield (qha^{-1}) x Nutrient content (%)

Total nutrient uptake (kgha^{-1}) = nutrient uptake seed+ nutrient uptake stover

RESULT AND DISSCUSION

A. Physical properties of post harvest soil

The treatment of various doses of rhizobium and NPK had no significant effect on the bulk density and particle density of soil, according to the findings. Treatment T_1 (1.25) had the highest bulk density (Mg m^{-3}) and treatment T_9 (1.09) had the lowest, while treatment T_7 (2.62) had the highest particle density (Mg m^{-3}) and treatment T_1 (1.25) had the lowest (2.34). Other physical characteristics like pore space (percent) and water holding capacity (percent) showed a significant influence, with max pore space recorded in treatment T_9 (57.26) and min pore space observed in treatment T_1 (44.20) respectively.

B. Chemical properties of post harvest soil

The chemical parameters were found to be significant when different doses of rhizobium and NPK were applied; the maximum pH was observed in treatment T_1 (7.25) and the minimum pH was observed in treatment T_9 (6.80) (dS m^{-1}). Treatment T_9 (0.26) had the highest EC while treatment T_1 (0.18) had the lowest percent Treatment T_9 (0.74) had the highest OC while treatment T_1 had the lowest (0.54), Available Nitrogen (kg ha^{-1}). The maximum available Nitrogen was observed in treatment T_9 (335.23) and the minimum available Nitrogen was observed in treatment T_1 (290.50), Available Phosphorus (kg ha^{-1}). The maximum available Phosphorus was observed in treatment T_9 (34.86) and the minimum available Phosphorus was observed in treatment T_1 (24.50), and Available Potassium (kg ha^{-1}). The maximum available Potassium was observed in treatment T_9 (205.54) (132.90) respectively.

Table 1: Effect of different levels of NPK and rhizobium as biofertilizer on growth parameters.

Treatment	Plant height			No of leaves			Total dry matter (g plant^{-1}) at harvest
	30	45	60	30	45	60	
T_1	35.33	42.44	51.10	12.00	25.00	28.00	14.40
T_2	35.57	42.90	53.15	13.00	26.00	29.00	15.82
T_3	36.10	43.57	53.90	13.00	26.00	29.00	16.20
T_4	36.18	44.10	55.50	14.00	26.50	29.00	16.89
T_5	37.23	44.92	55.87	14.00	27.00	30.00	17.52
T_6	37.57	45.33	57.12	15.00	27.00	30.00	17.94
T_7	38.84	46.15	57.54	16.00	28.00	31.00	18.08
T_8	39.42	47.33	58.15	17.00	29.00	32.00	19.22
T_9	40.90	49.12	60.16	18.00	30.00	33.00	20.34
F-Test	S	S	S	S	S	S	S
SE+M	0.03	0.05	0.01	0.16	0.16	0.27	1.04
CD+@5%	0.006	0.011	0.02	0.33	0.33	0.58	3.06

It is clear from data (Table 1) that the growth parameters significantly increased by application of different levels of rhizobium and NPK, the max plant height at 30, 45, 60 DAS was observed in treatment T_9 (40.90), (49.12), (60.16) and no of leaves was observed in treatment T_9 (18.00), (30.00), (33.00) at 30, 45, 60 DAS. The lowest plant height was observed in treatment T_1 (35.33), (42.44), (51.10) at 30, 45, 60 DAS and no of leaves was observed in treatment T_1 (12.00), (25.00), (28.00) at 30, 45, 60 DAS respectively. The total dry matter at harvest was observed highest by application of 100% Rhizobium + 100% NPK in treatment T_9 and lowest was observed in control 0% Rhizobium + 0% NPK in treatment

The combined application of Bio fertilisers and NPK might be related to the improvement in growth indices such as plant height and number of leaves. The rhizobium improved root activity by increasing microbial activity in the root. Greater root activity resulted in higher nutrient intake, which boosted growth rate. Similar findings were reported by Lokhande *et al.* (2018).

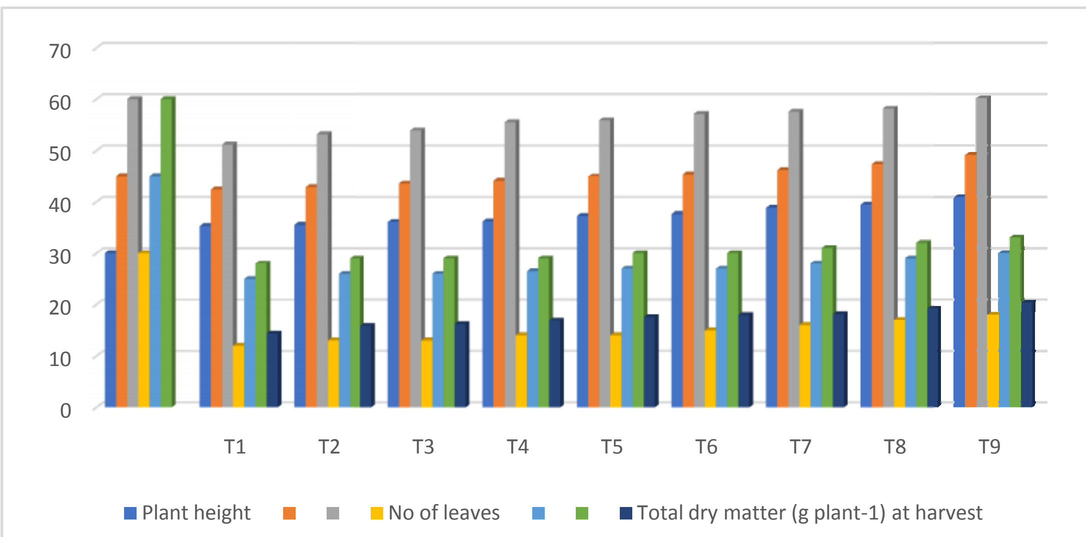

Fig 1. Effect of different levels of NPK and rhizobium as biofertilizer on growth parameters.

Table 2: Effect of different levels of NPK and rhizobium as biofertilizer on yield and yield attributes.

Treatment	No of pods plant^{-1}	No of seeds pod^{-1}	Seed yield q ha^{-1}	Stover yield q ha^{-1}	Biological yield q ha^{-1}
T_1	11.50	9.20	8.68	24.30	32.98
T_2	12.89	9.81	9.15	25.62	34.77
T_3	16.33	10.08	9.62	26.93	36.55
T_4	19.22	10.89	9.95	27.86	37.81
T_5	23.77	11.22	10.38	29.06	39.44
T_6	24.78	11.76	10.72	30.01	40.73
T_7	28.22	12.18	11.13	31.66	42.79
T_8	31.56	12.64	11.60	32.48	44.08
T_9	38.77	13.12	12.10	33.88	45.98
F-Test	S	S	S	S	S
SE+M	0.80	0.32	0.04	1.45	0.98
CD+@5%	1.69	0.91	0.08	4.23	3.21

It is clear from data (Table 1) that the growth parameters significantly increased by application of different levels of rhizobium and NPK, the max plant height at 30, 45, 60 DAS was observed in treatment T_9 (40.90), (49.12), (60.16) and no of leaves was observed in treatment T_9 (18.00), (30.00), (33.00) at 30, 45, 60 DAS. The lowest plant height was observed in treatment T_1 (35.33), (42.44), (51.10) at 30, 45, 60 DAS and no. of leaves was observed in treatment T_1 (12.00), (25.00), (28.00) at 30, 45, 60 DAS respectively. The total dry matter at harvest was observed highest by application of 100% Rhizobium + 100% NPK in treatment T_9 and lowest was observed in control 0% Rhizobium + 0% NPK in treatment T_1.

The combined application of Bio fertilisers and NPK might be related to the improvement in growth indices such as plant height and number of leaves. The rhizobium improved root activity by increasing microbial activity in the root. Greater root activity resulted in higher nutrient intake, which boosted growth rate. Similar findings were reported by Lokhande *et al.* (2018); Bonepally *et al.* (2021).

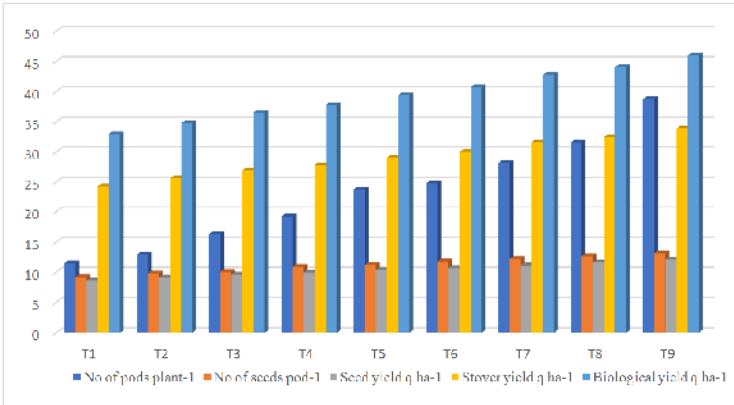

Fig. 2. Effect of different levels of NPK and rhizobium as biofertilizer on yield and yield attributes.

Table 3: Effect of different levels of NPK and rhizobium as biofertilizer on nutrient uptake.

Treatment	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	Seed	Stover	Total	Seed	Stover	Total	Seed	Stover	Total
T_1	24.8	23.9	48.7	2.24	2.62	4.86	6.70	7.06	13.76
T_2	25.2	24.6	49.8	2.51	2.84	5.35	6.92	7.48	14.40
T_3	25.9	24.7	50.6	3.13	3.36	6.49	7.18	8.14	15.32
T_4	26.3	25.1	51.4	3.66	3.89	7.55	7.76	8.35	16.11
T_5	27.5	25.8	53.3	3.82	4.08	7.90	8.06	8.42	16.38
T_6	28.4	26.3	54.7	3.94	4.35	8.29	8.32	9.12	17.44
T_7	32.6	30.5	61.1	4.26	4.86	9.12	8.86	9.45	18.31
T_8	35.4	32.2	67.6	4.54	5.06	9.60	9.12	9.86	18.98
T_9	37.8	34.7	72.5	4.70	5.32	10.04	9.78	10.08	19.86
F-Test	S	S	S	S	S	S	S	S	S
SE+M	0.65	0.54	1.18	0.12	0.11	0.16	0.18	0.15	0.28
CD+@5%	1.78	1.45	3.52	0.32	0.32	0.48	0.46	0.52	0.78

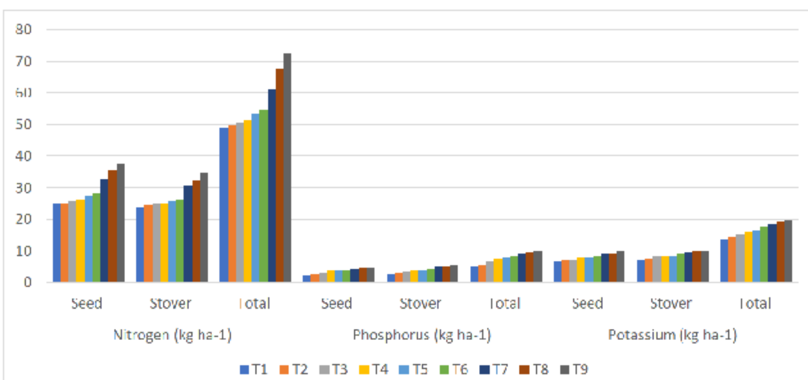

Fig. 3. Effect of different levels of NPK and rhizobium as biofertilizer on nutrient uptake.

The results revealed that application of 100% rhizobium and 100% NPK significantly increased the uptake of NPK by seed, stover and total uptake over absolute control. Application of 100% rhizobium +100% NPK recorded max uptake of NPK in seed (37.8, 4.70, 9.78 kg ha^{-1}) in stover (34.7, 5.32, 10.08 kg ha^{-1}) in total uptake (72.5, 10.04, 19.86 kg ha^{-1}). Significantly min uptake of NPK in seed (24.8, 2.24, 6.70 kg ha^{-1}) in stover (23.9, 2.62, 7.06 kg ha^{-1}) in total uptake (72.5, 10.04, 19.86 kg ha^{-1}) was found in treatment T_1 (0% Rhizobium + 0%NPK). Biofertilizers combined with NPK enhanced nutrient uptake by seed, stover, and yield compared to controls. This might be due to a balanced fertiliser and bio-fertilizer application, which improved microbial development, leading in greater nutrient translocation and absorption, resulting in increased dry matter accumulation by plants, indicating increased nutrient uptake by plants Kumpawat (2010).

CONCLUSION

Today's agricultural challenges include soil fertility loss, climate change, and increased pathogen and pest infestations. Environmentally friendly practices such as the use of biofertilizers, biopesticides, and the return of crop residues are used to produce sufficient quantities in a sustainable and healthy farming system. In terms of N_2 fixation capability and tolerance to harsh environments, the Rhizobium-legume symbiosis outperforms other N_2-fixing systems. Several legume symbiotic systems are resistant to salinity, alkalinity, acidity, drought, fertilizer, metal toxicity, and other severe environments. The biological fixation of nitrogen is an important process in sustainable agriculture, notably in the legume farming system. To get the most out of leguminous crops, it's a good idea to choose symbiotic partnerships that can withstand harsh conditions and fix a lot of nitrogen. Phosphorus potassium application above the level required for plant growth may not increase plant yield, but it may promote nodule growth or other activities in the soil, potentially improving soil fertility and plant growth. However, some rhizobia strains can be used to protect plants from pests and pathogens. According to the findings, using 100 percent rhizobium and 100 percent NPK resulted in greater growth, higher seed output, and increased nutrient uptake by seed, stover, and total. Because of nitrogen absorption and photosynthate transfer to parts above, nutrient uptake by seed stover and total increased. Because black gram is a legume root interception might plays a vital role in nutrient uptake For increased crop yield and general improvement of the black gram crop, a combination of biofertilizers and NPK nutrients may be recommended.

Acknowledgement. The authors are thanks to Hon'ble Vice Chancellor SHUATS, Department of Soil Science and Agricultural Chemistry, Naini Agriculture Institute, for taking an active interest in the project and encouraging them to complete it.

Conflict of Interest. None.

REFERENCES

Anonymous (2019). Press Information Bureau of India. Barroso, V., Pereria, G. T. and Nahas, E. (2006). Solubilization of $CaHPO_4$ by *Aspergillus niger* in culture media with different carbon and nitrogen sources. *Braz. J. Microbial.*, *37*: 434-438.

Balai, K., Jajoria, M., Verma, R., Deewan, P. and Bairwa, S. K. (2017). Nutrient content, uptake quality of chickpea and fertility status of soil influenced by fertilization of Phosphorus and Zinc *Journal of Pharmacognosy Phytochemistry*, *6*, 392-398.

Black, C. A. (1965). Methods of soil analysis vol.2, Am. Soc. Agraon., Madison, Wisconsin, U.S.A.

Bonepally, R., Umesha, C., and Mesharam M. R. (2021). Influence of spacing and Phosphorus levels on growth and yield of black gram. *Biological Forum An International Journal*, *13*(1): 82-85.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. John Wiely and Sons, New York. pp. 139-264.

Jackson, M.L. (1973) Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi.

Jackson, M. L. (1958). Soil chemical analysis, Second edition Indian Reprint, prentice hall of India, New Delhi. pp498.

Kumpawat, B. S. (2010). Integrated nutrient management in blackgram (*Vigna mungo*) and its residual effect on succeeding mustard (*Brassica juncea*) crop. *Indian Journal of Agricultural Sciences*, *80*(1): 76-79.

Lokhande, P. B., Indulkar, B. S., Vaidya, P. H., Padghan, A. D., Wagh, C. B., Ingole A. J., Patil, N. M. and Aundhkar, A.V. (2018**)**. Effect of phosphorus and zinc on growth yield nutrient uptake and quality of green gram (*Vigna radiata* L) in Inceptisol. *International journal of Engineering Science and Computing*, 8.

Lindsay, W. L. and Norvell, W. A. (1978). Development of a DTPA soil test for Zinc, Iron, Manganese and Copper. *Soil Science of American Journal*, *42*, 421-428.

Muthuval, P., Udaysoorian, C., Natesan, R. and Ramaswami, P. P. (1992). Introduction to Soil Analysis, Tamil Nadu Agricultural University, Coimbatore-641002.

Olsen, S. R., Cole, C. V., Watanhe, F. S. and Dean, L. A. (1954). Estimation of Available Phosphorus in soils by extraction with sodium bicarbonate *U.S. Deptt. Agr. Circ.*, 939.

Shroti, S. K., Pathak, A., Tiwari, A., Gupta, A. and Chauhan, S. K. (2018). Morphological, physiological and yield analysis of black gram under different levels of FYM, PSB and Phosphorus. *International Journal of Chemical Studies*, *6*(3): 403-411.

Singh, R. and Singh, A. P. (2017). Effect of Phosphorus, Sulphur and bio fertilizers on soil properties and yield of cow pea. *Annals of Plant and Soil Research*, *19*(3): 324-328.

Subbiah, B. V. and Asija, G. L. (1956). A rapid procedure for the estimate of *Available Nitrogen in soil current sciences*, *25*, 259-263.

Tripathi, S., Kumar, S., Kumar, M., Kumar, A., Dhyani B. P. and Kumar, Y. (2021). Effect of Rhizobium Inoculation Methods on Growth, Nodulation and Yield of Black Gram (*Vigna mungo* L.), *Int. J. Curr. Microbiol. App. Sci.*, *10*(01): 1588-1598.

Toth, S. J. and Prince A. L. (1949). Estimation of cation exchange capacity and exchangeable Ca, K and Na Content of Soil by Flame photometer technique. *Soil Sci*., *67*, 439-445.

How to cite this article: Raghu Nandan Singh Khatana, Tarence Thomas, Jayasree Midde and Mutyalu Sheshu (2022). Nutrient Uptake by the Summer Black Gram (*Vigna mungo* L.) *Var* SHEKHAR-2 Enhanced after Application of Different LEVELS of NPK and Rhizobium as Biofertilizer. *Biological Forum – An International Journal*, *14*(1): 998-1002.