Response of growth and yield traits of two mung bean cultivars under nano-fertilization application

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Abstract

The current study was conducted to determine the proper rate of nano-NPK fertilizer to the growth and yield traits of two Mung bean cultivars. The experiment contained two Mung bean cultivars (Black gram and Green gram), three levels of Nano NPK fertilizer (0, 1.5 and 3 gm/L of Nano NPK), and their interactions. The experiment was designed with Randomized Complete Blocks Design (R.C.B.D) with a spilt block system with three replications. The Green gram cultivar and 3 gm/L Nano NPK fertilizer produced maximum values in all studies traits: Plant height (43.14, 48.80 cm), number of branches (4.29, 4.67 branch), number of pods (23.78, 26,17 pod), pod length (7.02, 6.42 cm), number of grains pod^{-1} (6.20, 6.73 grain), and grain yield (5.19, 6.48 g $plant^{-1}$) respectively . The findings of this study conclude that choosing the proper cultivar and applying suitable Nano NPK fertilizer can enhance grain yield and the components of mung beans.

KEYWORDS: Mung bean, Cultivar, Nano NPK fertilizer

Introduction

Mung bean belongs to the Fabaceae family, including two common species, green gram (*vigna radiata* L.) and black gram (*vigna mungo* L.), which are widely cultivated worldwide. Mung bean grain is an excellent source of high-quality protein, low fat and a high amount of minerals and vitamins, which are easily digested (11). Furthermore, the plants are used as green or dried fodder, green manure and soil conservation and soil fertility improvement crops during its capability to fix atmospheric nitrogen by root nodules in the soil that up to 35 kg per hectare (13). Despite the importance of this crop, however, the grain yield is low in Iraq compared to global production (1). In Iraq, the average productivity of Mung bean was about 6994 tons for 4554 hectares, with an average productivity 1.536 tons per hectare in 2020 (6). A possible explanation for this might be an inefficient application of fertilizers, mainly NPK fertilizer, which is crucial for obtaining higher grain yield. Composited fertilizer contains 2-3 N, P and K macronutrients, such as NPK fertilizer (3 , 12). A nano fertilizer can decrease the amount of application fertilizers by improving the use efficiency. The application of NPK fertilizer is fundamental for high grain production. The significance of NPK fertilizers comes from their function in providing the essential nutrients for crop growth (7). The current study concluded that nano foliar application could increase the plant height, primary branches per plant, 100-grain weight and grain yield of chickpea compared with the control treatment (8). This result confirms that nano NPK fertilizer applications promote growth and yield traits. Therefore, this study aimed to select the proper application of Nano-NPK fertilizer

on the growth and yield traits of two Mung bean cultivars.

Materials and Methods

The experiment was carried out in the planting season of the year (2022-2023) was conducted at the farmer field at Al-Abbasiya, which is located 11 kilometers northeast of Nineveh Governorate, Iraq (longitude 36°27'22.8 North, latitude 43°11'26.1 East), the study included the effect of nano-Fertilizer (N20, P20, K20) at three levels on growth and yield of two types of Mush (Mung bean). The planting land has been prepared by using a triple plow with prependicular plowing, then Smoothing process and Settlement was carried out. The experiment was designed according to a randomized Complete block design (RCBD) with a split plots system with three replications. The data obtained from the experiment were analyzed by using a computer according to (Genstant software) program and the Duncan's Multiple Range Test, was used according to AL-Rawi; and Khalaf Allah (2000). Therfore, the means that differed from each other were distinguished by different alphabetic letters. The crop was sown on 1/6/2023, while the harvested date was 31/8/2023. The first factor included three levels of nano fertilizer at three concentration (zero, 1.5, 3) gm/L. The plants was sprayed (until completely wet) by using a Sprinkler Dorsal in two stages. The first stages was applied after 30 days of planting, and the second at the beginning of flowering stage. The second factor was included two varietes of mung bean (Green gram, Black gram). The experimental units were designed (2 x 1.5 m^2). Each experimental unit included 4 lines. The distance between line and another was (30 cm), and between each experimental unit (50 cm) and between each replicate (1 m). The soil at the experimental location was analyzed to determined its Physical and chemical properties by taking random samples from the soil at the depth of (30 cm) as shown in the Table (1) .

Table (1) Physical and chemical characteristics of Al-Abbasiya

Location	Clay %	Silt %	Sand %	Textural	N (ppm)	P (ppm)	K (ppm)	Organic matter %	PH	EC us/cm
Al-Abbasiya	42.65	41.75	15.60	Silty-clay	0.033	9.58	8.143	1.424	7.1	1080

At central laboratory of Agriculture and Forestry College of University of Mosul

Observations recorded

1- Plane highe (cm) was measured from the soil surface to the top of the plant.
2- The number of branches per plant was calculated from the mean branch number of ten plants at harvest time.
3- Number of Pod per plant was calculated by counting the pods of ten plants and taking their average.
4- The pod length (cm) was calculated by measuring the length of ten pods and taking their average.
5- Number of grain per Pod was calculated by counting the grain per pod of ten pods and taking their average.
6- 100 grain weight (g) was calculated by counting 100 grains and weight it.
7- Grain yield (g) per plant was estimated by harvesting the pods of the whole plot at maturity.

Result and Discussion

The result in Table 2 shows a significant effect of cultivars, Nano-NPK fertilizer, and the interactions between cultivars with Nano-NPK fertilizer on growth and yield

traits. Cultivars and the application of Nano-NPK fertilizer influenced the Plant height. The highest plant height was achieved with Green gram (43.14 cm), while the lowest plant height was reached with Black gram (42.87 cm). The Nano-NPK fertilizer 3g per L produced the highest plant height (48.80 cm), compared with the control application 38.03 cm. The interactions between the Black gram cultivar with Nano-NPK fertilizer 3g per L gave the highest plant height (49.67 cm), compared to the Green gram cultivar with control fertilizer (37.00 cm). The Number of branches plan^{-1} increased significantly with the Green gram cultivar (4.29 branch plant^{-1}), compared to the Black grum cultivar (3.51 branch plant^{-1}). This is due to the genetic differences between the two Mung bean cultivars in the vegetative growth traits. For Nano-NPK fertilizer, the application of 3g per L achieved the maximum Number of branches (4.67 branch plant^{-1}) compared to the control, which provided the minimum Number of branches (3.18 branch plant^{-1}). The interactions between the Green gram cultivar with Nano-NPK fertilizer 3g per L gave the highest number of branches (5.27 branch plant^{-1}), compared to the Black gram cultivar with control fertilizer (2.97 branch plant^{-1}). The reason for that may be due to the impact of nano fertilizer, which increases the available nutrients to plants and high formation of chlorophyll content; the photosynthesis process leads to improved vegetative growth traits overall (2 ; 4).

According to Table (2 and 3), there was a significant difference in the Number of Pod plant^{-1} between the cultivars, Nano-NPK fertilizer and its interactions. The Green gram cultivar had the highest number of Pod (23.78 Pod plant^{-1}) compared to the Black gram cultivar had the lowest number of Pod (22.33 Pod plant^{-1}). This is because the Green gram owns a high number of branches compared to the black gram, which produced more pods plant^{-1} (9 , 10). For Nano-NPK fertilizer, the application of 3g per L achieved the greatest number of Pod (26.17 Pod plant^{-1}), while the control gave the lowest number of Pod (21.00 Pod plant^{-1}). The interactions between the Green gram cultivar with Nano-NPK fertilizer 3g per L provided the highest number of Pod (27.00 pod plant^{-1}) compared to the Black gram cultivar with control fertilizer (20.67 pod plant^{-1}).

Tables 2 and 3 show the significant effect of cultivars and Nano-NPK fertilizer on the Pod length. The Green gram cultivar produced the longest pod length (7.02 cm), compared to the Black grum cultivar gave the lowest pod length (5.68 cm). For Nano-NPK fertilizer, the application of 3g per L had the maximum pod length (7.42 cm) compared to the control, which had the lowest pod length (5.32 cm). This may be due to the highest amount of Nano fertilizer attributed to the main nutrients (N, P, K) on the formation of protoplasmic material, cell division and elongations leading to the production of more biomass such as the number of pods and Pod length (5). The interactions between the Green gram cultivar with Nano-NPK fertilizer 3g per L provided the highest pod length (7.03 cm) compared to the Black gram cultivar with control fertilizer (4.90 cm). Among the Mung bean cultivar, the green gram had the highest number of grains pod^{-1} (6.20 grain pod^{-1}), while the black gram had the lowest number of grains (5.81 grain pod^{-1}). This is due to the genetic makeup of the two cultivars, the green gram cultivar and the number of grains pod^{-1}. For Nano-NPK fertilizer, the application of 3g per L produced the greatest number of grains pod^{-1} (6.73 grain pod^{-1}) compared to the control, which produced the lowest number of grains

pod^{-1} (5.13 grain pod^{-1}). The reason for that may be that the high level of nano fertilizer can increase the availability of nutrients in the plants, and photosynthesis outputs lead to the production of a high number of grains pod^{-1} (2 , 14). The interactions between the Green gram cultivar with Nano-NPK fertilizer 3g per L provided the highest number of grains pod^{-1} (6.77 grain pod^{-1}) compared to the Black gram cultivar with control fertilizer (4.77 grain pod^{-1}).

As shown in Table (3), there was no statistically significant difference in 100-grain weight between the Mung bean cultivar. However, among Nano-NPK fertilizers, 3g and 1.5g per L applications produced the highest 100-grain weight compared with the control application. The result in Table 2 indicates a significant effect of cultivars, Nano-NPK fertilizer, and the interactions between cultivars with Nano-NPK fertilizer on grain yield. The highest grain yield was achieved with Green gram (5.19 g), while the lowest grain yield was produced by Black gram (4.58 g).

(Table 2) Effects of cultivar and Nano Fertilizer on the agronomic traits

Cultivar	Plant height (cm)	Number of Branch plant^{-1}	Number of Pod plant^{-1}	Pod length (cm)	Number of Grain Pod^{-1}	100-grain Weight (g)	Grain yield (g) plant^{-1}
Black gram	42.87 b	3.51 b	22.33 b	5.68 b	5.81 b	3.43 a	4.58 b
Green gram	43.14 a	4.29 a	23.78 a	7.02 a	6.20 a	3.44 a	5.19 a
Nano-Fertilizer							
Nano zero gm/L	38.03 c	3.18 c	21.00 b	5.32 c	5.13 c	3.10 b	3.36 c
Nano 1.5 gm/L	42.18 b	3.85 b	22.00 b	6.32 b	6.15 b	3.53 a	4.81 b
Nano 3 gm/L	48.80 a	4.67 a	26.17 a	7.42 a	6.73 a	3.68 a	6.48 a

(Table 3) Effects of the interactions between cultivar and Nano Fertilizer on the agronomic traits

Cultivar	Nano-Fertilizer gm/L	Plant height (cm)	Number of Branch Plant^{-1}	Number of Pod plant^{-1}	Pod length (cm)	Number of Grain Pod^{-1}	100-grain Weight (g)	Grain yield (g)plant^{-1}
Black gram	Nano zero	37.00 c	2.97 d	20.67 c	4.90 d	4.77 d	3.10 b	3.07 d
	Nano 1.5	41.93 b	3.05 c	21.00 c	5.60 cd	5.97 bc	3.50 a	4.41bc
	Nano 3	49.67 a	4.07 b	25.33 a	6.53 b	6.70 ab	3.70 a	6.26 a
Green gram	Nano zero	39.07 bc	3.40 cd	21.33 bc	5.73 c	5.50 c	3.10 b	3.66 cd
	Nano 1.5	42.43 b	4.20 b	23.00 b	7.03 a	6.33 ab	3.57 a	5.20 b
	Nano 3	47.93 a	5.27 a	27.00 a	8.30 a	6.77 a	3.67 a	6.70 a

The Nano-NPK fertilizer 3g per L produced the highest grain yield (6.48 g), compared with the control application (3.36 g). Taken together, the highest grain yield of the Green gram cultivar and 3g per L Nano-NPK fertilizer is due to the superiority in all yield components leading to the maximum grain yield, as shown in Table 2. The interactions between the Black gram cultivar with Nano-NPK fertilizer 3g per L gave the highest plant height (6.70 g), compared to the Green gram cultivar with control fertilizer (3.07 g).

References

1. Al-Dabbagh, E.J.J. and Al-Duleimi, B.H.A. (2017). The effect of foliar application boron and salicylic acid in the Production and quality characteristics of two genotypes of mung bean (Vigna radiata L.). AL-Anbar Journal of Agricultural Science,15 (1) :162–180.
2. Alhabbar, Z. (2023). Effect of Phosphorus and Nitrogen fertilizer applications on growth and yield traits of Mung Bean (Vigna Radiata L.) under northern Iraq conditions. Euphrates Journal of Agricultural Science, 15(3)):31-38.
3. Ali, N.Sh. (2012). Fertilizers technology and uses. Ministry of higher education and scientific research, University of Baghdad, College of Agriculture, Iraq. The university house for printingand translation, pp202.
4. Aziz, B. R. (2021). Effect of Foliar Application of Nano-NPK Fertilizer on Growth and Yield of Broad bean (Vicia faba L.). Zanco Journal of Pure and Applied Sciences, 33(4): 90-99.
5. Bahar, J. M., Rabar, F. S., Solin, I. H., and Chra, A. F. (2021). Interaction Effect of Different Concentrations of Nano-Fertilizer (NPK) and Sources of Charcoal on Growth and Yield Parameters of Faba bean (*Vicia faba* L.). In IOP Conference Series: Earth and Environmental Science 761(1):1-10.
6. CSO, Central Statistical Organization (2021). Production of Secondary crops and vegetables according to governorates for year 2020. Directorate of Agricultural Statistics, Ministry of Planning, Iraq.
7. Diwani, G. E., Motawie, N., Shaarewy, H. H., & Shalaby, M. S. (2013). Nitrogen slow release biodegradable polymer based on oxidized starch prepared via electrogenerated mixed oxidants. *J. Appl. Sci. Res*, *9*(3), 1931-1939.
8. Drostkar, E.; Talebi, R. and Kanouni, H.(2016). Foliar application of Fe, Zn and NPK nano-fertilizers on seed yield and morphological traits in chickpea under rainfed condition. Journal of Research in Ecology, 4(2): 221-228.
9. El-Sayed, S.A.; Algarni, A.A. and Shaban, Kh.A.H. (2020). Effect of NPK Nano-fertilizers and Compost on Soil Fertility and Root Rot Severity of Soybean Plants Caused by Rhizoctonia solani. Plant Pathol. J., 19(2): 140-150.
10. Jamro, S., Ansari, M. A., Jamro, M. A., Ahmad, M. I., Siddiqui, W. A., Junejo, S. A., ... & Jamro, S. A. (2018). Growth and yield response of Mungbean under the influence of nitrogen and phosphorus combination levels. Journal of Applied Environmental and Biological Sciences, 8(7), 10-19.
11. Majumdar, D.K. (2011). Pulse Crop Production Principles and Technologies. Published by PHI Learning Private Limited, New Delhi, India. pp. 567.
12. Mohsen, H.A.; Alhhasany, A.R. and Noaema, A.H. (2020). Effect of spraying dates and concentrations with NPK nanoparticles on the growth and yield of beans (Vicia faba l.). Plant Archives, 20 (Supplement 1): 335-338.

13. Reddy, B.V.V. and Shikha, S. (2021). Response of foliar applied Boron and Salicylic acid on Greengram (*Vigna radiata* L.). The Pharma Innovation Journal, 10(9): 2032-2035.

14. Wu, L. and Liu, M. (2008). Preparation and properties of chitosan-coated NPK compound fertilizer with controlled-release and water-retention. Carbohydrate Polymers, 72: 240–247.