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Research Article

Effect of Combined Soil and Foliar Application of Nutrients on Nodular Characteristics and Yield of Summer Green Gram

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Abstract

Coupling of soil and foliar application of fertilizers can be adapted to improve the yield and quality of crops could be a viable option for nutrient management. A field experiment was thus conducted with green gram (CV: NVL-516) in an acidic soil of the Agricultural Research Farm, Siksha 'O' Anusandhan, Bhubaneswar in order to study the impact of combined soil and foliar application of nutrients nodular characteristics and yield of summer green gram in Odisha. The experiment was laid out in a Randomized Block Design with three replications and eight treatments consisting of recommended dose of Nitrogen, Phosphorous, Potassium and Sulphur (NPKS) along with foliar application of 2% urea, diammonium phosphate (DAP), KCl, N: P: K (19:19:19) and 1% KNO_3 and control. Foliar application was done two times at 30 and 45 DAS. The highest yield (1582 kg ha^{-1}) was recorded in treatment where 1% KNO_3 was applied as foliar spray along with the recommended dose of NPKS and was at par with 2% DAP (1574 kg ha^{-1}). There was enhanced nodulation at 45 DAS as a result of increased rhizobial activity under the influence of foliar nutrition of 2% NPK (19:19:19), urea and DAP at 30 and 45 DAS.

Keywords: *foliar fertilization, greengram, effective nodule, potassium nitrate, yield.*

Introduction

Pulses are often considered as "magic crop" for offering multifaceted benefits to farmers, consumers as well as environment. These are phenomenal in maintaining the health and nutrient status of soils. Pulse crops help fix atmospheric nitrogen, release high quality organic matter in soil and facilitate moisture retention and nutrient cycling. Therefore, these are an important component of conservation agriculture, either as cultivated crops or as crop residue (Stagnari, *et al.*, 2017). Green gram is the third most important pulse crop in India. India contributes more than 70% of the world's green gram production (Nene, *et al.*, 2006; Chauhan, *et al.*, 2018). Despite having importance in our daily diet and in agricultural production, productivity of this crop is very low in India. The low productivity may be attributed to wide gap in adoption of recommended green gram production technology, improper fertilizer management, unavailability of healthy seeds, high cost of seeds, fertilizers and pesticides, high labour wage and non-remunerative price (Das, 2017 and Paradva, *et al.*, 2019). Balanced fertilization is important to improve the yield of green gram. Along with Nitrogen (N), Phosphorous (P) and Potassium (K), Sulphur (S) application is very essential to improve the yield of legumes as it influences biological

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nitrogen fixation (Das, 2017). Along with balanced soil fertilization, foliar application of fertilizers could be done for quick and efficient utilization of nutrients (Manonmani and Srimathi, 2009). Foliar fertilization also has other benefits like increasing crop yield, improving crop resistance to diseases and insect pests as well as crop tolerance to drought and enhancing the crop quality (Sarwar, 2012; Mohapatra, 2017). Considering the above facts, the experiment is planned to study the effect of foliar and soil application of fertilizers on yield and nodulation characteristics of green gram (*Vigna radiata L.)* in the east and south eastern coastal plains of Odisha.

Material and Methods

The field experiment was conducted during two successive summer seasons of 2021 and 2022 with green gram variety NVL-516 at the Instructional farm, Institute of Agricultural Sciences, Siksha 'O' Anusandhan, Bhubaneswar, Odisha. The experiment was laid out in randomized block design (RBD) with three replications and eight treatments. The treatments were absolute control (no fertilizers), NPK (basal), NPKS (basal), NPKS (basal) with two foliar application of 2 % Urea , MOP (muriate of potash), DAP (diammonium phosphate), KNO_3 and N:P:K(19:19:19) at pre-flowering stage. The recommended dose of 20, 40 and 20 kg ha^{-1} of N, P_2O_5 and K_2O respectively in the form of urea, DAP and MOP along with $ZnSO_4$ (25 kg ha^{-1}) was applied in all the treatments at the time of sowing. The soil of the experimental plot was sandy loam in texture, acidic (pH-6.2) in soil reaction and non-saline (Electrical conductivity-0.12 dSm^{-1}). The soil was low in organic carbon (0.49%), available N (248 kg ha^{-1}) sulphur (8.62 kg ha^{-1}), medium in available phosphorus (14.6 kg ha^{-1}) and potassium (162 kg ha^{-1}). Seeds were treated with *Rhizobium* culture before sowing and sown in rows with 20 cm apart and 10 cm plant to plant spacing. The initial soil sample at 0-15 cm depth was analysed for different parameters by following standard methods (Jackson, 1968). The number of root nodules was counted on 45^{th} day after sowing in randomly selected five plants. The plants were carefully removed from the soil without damaging the roots and roots were dipped in a bucket containing water to remove the soil and then nodules count was taken. The collected nodules were scrutinized to note their effectiveness by crushing them to see the presence of pink colour which indicates the presence of leghaemoglobin.

Results and Discussion

Effect of Foliar and Soil Application of Fertilizers

Yield

The pooled analysis of results showed that the seed yield was highest with foliar application of KNO_3 (1599 $kgha^{-1}$) which was at par with foliar application of DAP (1590 kg ha^{-1}). Their yield was significantly higher than rest of the treatments. The highest stover yield (2169 $kgha^{-1}$) as well as biomass yield was also found in the treatment with foliar application of KNO_3 (Figure 1). The increment of yield in green gram by foliar application of KNO_3 was also reported by Vekaria, *et al*., (2013) and Jagtap, *et al*., (2021). Around 30% increase in yield was found with additional foliar application of KNO_3 or DAP as compared to only recommended basal dose of fertilizer application. This might be due to the supply of nutrients through foliage during crop requirement and efficient translocation of photosynthates from source to sink.

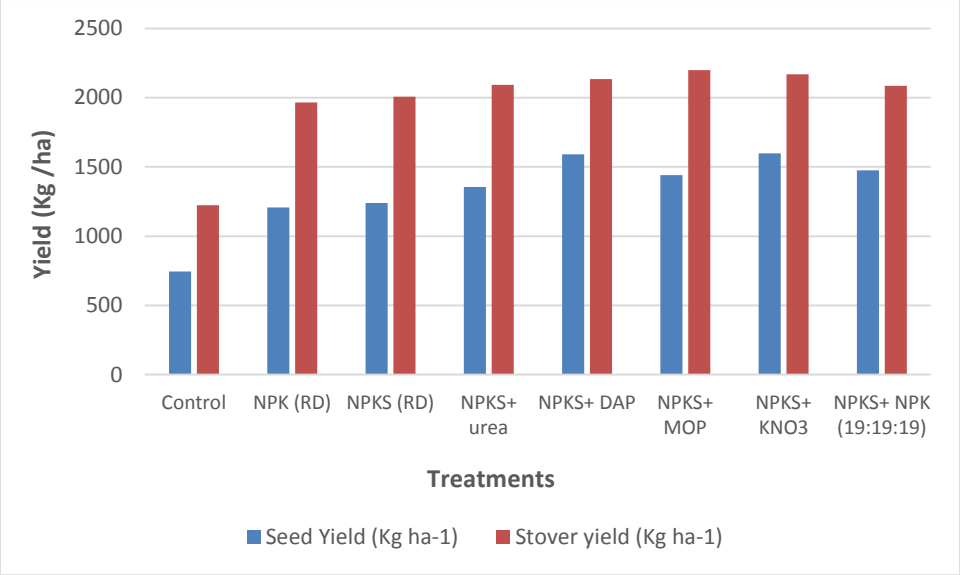

Figure 1: Effect of combined soil and foliar application of fertilizers on yield of green gram

Number of nodules

The data regarding number of nodules, effective nodules and effective nodule percentage recorded at 45 DAS is presented in Table 1. The pooled analysis of the results also showed that significantly lowest number of nodules was registered in control (34) whereas the highest number of nodules was found in T_8 (70) closely followed by treatment receiving 2% DAP foliar spray (67) and 2% KNO_3 foliar spray (63).

Effective Nodules and Effective Nodule Percentage

The data regarding number of nodules, effective nodules and effective nodule percentage recorded at 45 DAS is presented in Table 1.

The pooled analysis of results showed the similar trend of highest number of effective nodules in T_8 (56) followed by (2% DAP foliar spray)T_5 (50), (2% urea foliar spray)T_4 (43) and lowest in the absolute control (14). Effective nodules percentage at 45 DAS was found significantly lowest in T_1 (41%) as compared to rest of the treatments whereas the highest effective nodules percentage of 81% was found in T_8 followed by (2% DAP foliar spray)T_5 (78) and (2% urea foliar spray) T_4 (72).

The enhanced nodulation at 45 DAS might be due to the application of additional nitrogen and phosphorus which had attributed to better root development of the plant leading to profuse nodulation as a result of increased rhizobia activity under the influence of foliar nutrition of 2% NPK(19:19:19), urea and DAP at 30 and 45 DAS which in turn resulted in the formation of active and a greater number of nodules. These results are in accordance with the findings of Hiwale (2015), Kachlam, (2017) and Bhavya, *et al.*, (2020). In addition, enhanced nodulation can also be ascribed to the application of Rhizobium and sulphur in the experiment (Gorade, *et al.*, 2014).

Table 1: Effect of combined soil and foliar application of fertilizers on number of nodules, effective nodules and effective nodule percentage of green gram

Treatments	Number of nodules	Number of effective nodules	Effective nodule percentage
T_1 Control	34	14	41
T_2 NPK (RD)	50	31	61
T_3 NPKS (RD)	54	35	66
T_4 NPKS+ Urea	59	43	72

T_5 NPKS+ DAP	64	50	78
T_6 NPKS+ MOP	56	36	65
T_7NPKS+ KNO_3	60	41	68
T_8 NPKS+ NPK (19:19:19)	70	56	81
CD (0.05)	7	7	6.35
CV(%)	11	10	11

Conclusion

The results obtained in the study indicated that integrated soil and foliar application of fertilizer is better than soil application alone. Potassic fertilizers especially KNO_3 is highly beneficial for increasing yield of crop. There was enhanced nodulation at 45 DAS as a result of increased rhizobial activity under the influence of foliar nutrition at 30 and 45 DAS. Enhanced nodulation can also be ascribed to the application of Rhizobium and sulphur in the experiment.

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