J. Farm Sci., 34(4): (401-403) 2021

RESEARCH PAPER

Effect of foliar nutrition and bio-inoculants on growth and yield of black gram (*Vigna mungo* L.) under rainfed condition

ABDUL MAJEED, H. T. CHANDRANATH , P. JONES NIRMALNATH AND SANGSHETTY

Department of Agronomy, College of Agriculture, Dharwad, 586 101
University of Agricultural Sciences, Dharwad - 580 005 (Karnataka), India
E-mails: tarakiabdulmajeed@gmail.com, htcnath@rediffmail.com

(*Received: November, 2021 ; Accepted: December, 2021*)

Abstract:A field experiment was conducted to assess the effect of foliar nutrition and bio-inoculants on growth and yield of black gram under Northern Transition Zone of Karnataka during *kharif,* 2020 at Main Agricultural Research Station, UAS, Dharwad with 11 treatments, which includes foliar spray of Dharwad nutrient mixture (DNM), Water soluble all 19 (19:19:19), Di-ammonium Phosphate (DAP), Urea and Pink Pigmented Facultative Methylotrophs (PPFM) with and without soil application of mycorrhizal consortium and their combinations. The treatments were replicated thrice in a randomized block design. Among the treatments, soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows and spraying of Dharwad nutrient mixture (DNM) @ 2 per cent at flowering and pod formation stage improved the growth parameters such as plant height (85.0 cm), stem girth (0.72 cm), plant spread (39.1 cm), dry matter production (32.65 g plant^{-1}) and seed yield (1,180 kg ha^{-1}) over the recommended production practice alone (25:50 N, P kg ha^{-1} + seed treatment with *Rhizobium* @ 200 g + PSB @ 200 g).

Key words: Black gram, Mycorrhizal consortium, Nutrients

Introduction

In India, blackgram occupies an area of about 2.70 million hectares with a production of 0.94 million tonnes (Anon., 2019). In Karnataka, it is grown on an area of 0.89 lakh hectares with a production of 0.41 lakh tonnes (Anon., 2019). The present productivity of the crop is below the potential yield over years due to several reasons. Among all the yield limiting factors, fertility management is one of the important factors to ensure better crop production on exhausted soils. Supplemental nutrition plays a crucial role in increasing grain yield of pulses (Chandrashekar and Bangarusamy, 2003).Foliar feeding is most effective and economical way to improve plant nutrient deficiency (Dixit and Elamathi, 2007). Foliar nutrients usually penetrate the leaf cuticle or stomata and enter the cells facilitating easy and rapid utilization of nutrients (Latha *et al*., 2003).

Microbial inoculants also known as soil inoculants or bio-inoculants are agricultural amendments that use beneficial rhizosphericic or endophytic microbes to promote plant health. Many of the microbes involved form symbiotic relationships with the target crops where both parties benefit (mutualism). While microbial inoculants are applied to improve plant nutrition, they can also be used to promote plant growth by stimulating plant hormone production (Bashan *et al.,* 1997).Mycorrhizal fungi associated with plant roots increase the absorption of nutrients, particularly phosphorus and thus enhance the growth of crop plants and trees.Thus, from the foregoing points it is clear that the productivity of blackgram, with foliar spray of water-soluble fertilizers or mixture of fertilizer along with bio-inoculants *viz.,* Mycorrhizal consortium and PPFM, the productivity could enhanced. Hence, the trial was conducted with an objective to know the combined use of foliar nutrients and bio-inoculants on the growth parameters of blackgram under rainfed conditions.

Material and methods

A field experiment was conducted to assess the effect of foliar nutrition and bio-inoculants on growth and yield of black gram under Northern Transition Zone of Karnataka during *kharif* 2020 at Main Agricultural Research Station, UAS, Dharwad. The soil of the experimental site was medium deep black with a depth of 2-3 m and is well drained. The climatic conditions were favourable for the crop growth and development during the crop growth. The treatments comprised of T_1: Spraying of Dharwad nutrient mixture (DNM) @ 2 per cent at flowering and pod formation stage, T_2: Spraying of DAP @ 2 per cent at flowering and pod formation stage, T_3: Spraying of PPFM @ 2.5 liter ha^{-1} at flowering stage, T_4: Spraying of 19:19:19 NPK @ 2 per cent at flowering and pod formation stage,T5: Spraying of urea @ 2 per cent at flowering and pod formation stage, T_6: T_1 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows, T_7: T_2 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows, T_8: T_3 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows, T_9:T_4 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows, T_{10}:T_5 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows, T_{11}: RPP (RDF 25:50 NP kg ha^{-1} + seed treatment with *Rhizobium* @ 200 g + PSB @ 200 g). The experiment was laid out in a Randomized Complete Block Design having three replications. After the layout and before 2 weeks of sowing, FYM at 5 tonnes per hectare was applied for all the treatments. The seeds were sown @ 15 kg per hectare on 3rd July 2020 by maintaining the 30 cm row to row spacing and plant to plant spacing of 10 cm. Mycorrhizal consortium was applied to the soil @ 15 kg ha^{-1} at the time of sowing in the furrows. Recommended dose of fertilizer (25:50 of N, P_2O_5 kg ha^{-1}) was applied at the time of sowing through urea and diammonium phosphate for all the

treatments. Foliar application of DNM (10 per cent N, 35 per cent P, 3.5 per cent micronutrients and 35 ppm PGR), DAP, PPFM, 19:19:19 and urea were undertaken at flowering stage and at pod formation stage as per the treatments and 500 lit of spray mixture per hectare was used.

Results and discussions

The variation in the growth components due to various foliar nutrition treatments could be due to variation in total dry matter production in plants. The dry matter production (g plant^{-1}) varied significantly due to foliar nutrition plus soil application of mycorrhizal consortium at the time of sowing at 60 DAS and at harvest. The maximum dry matter production (16.31 g plant^{-1} and 32.65 g plant^{-1} at 60 and at harvest stage, respectively) was recorded in the treatment which received soil application of mycorrhizal consortium @ 15 kg ha^{-1} plus foliar application of Dharwad nutrient mixture @ 2 per cent at flowering and pod formation stage over rest of the treatments including application of recommended dose of fertilizers alone (Table 1). Dharwad nutrient mixture composed of macro nutrients, micro nutrient and plant growth promoter. Foliar application of Dharwad nutrient mixture at flowering and pod formation stage might have resulted in better growth, development of growth parameters and metabolism of black gram. This might be due to better absorption of nutrients through leaves which played a role in cell division, cell differentiation and development, translocation of photosynthates and growth regulators from source to sink as reported by Karthikeyan *et al.* (2020).

Improvement in dry matter production could be due to improvement in leaf area index. Leaf area index is one of the important growth parameters. In the present study, significantly higher leaf area index at 60 DAS (3.60) was recorded in the treatment which received soil application of mycorrhizal consortium @ 15 kg ha^{-1} plus foliar application of Dharwad nutrient mixture @ 2 per cent at flowering and pod formation stage over application of recommended dose of fertilizer only. However, foliar spray of Dharwad nutrient mixture @ 2 per cent, DAP @ 2 per cent, PPFM @ 2.5lit ha^{-1}, 19:19:19 NPK @ 2 per cent also realised higher leaf area index over recommended dose of fertilizer alone (Table 1). Thus, foliar application of nutrients and plant growth promoters throughout the flowering and pod formation stages increased the accumulation and transport of food assimilates, possibly leading to increased photosynthetic capability of the plant. Such increased leaf area index in black gram was also authenticated by Patil *et al.* (2015) who reported that foliar spraying of nutrients increased the leaf area index in black gram. The increase in leaf area index may be ascribed to increase in plant spread with more number of branches and leaves plant^{-1} and more plant height at harvesting stage as compared to the application of recommended dose of fertilizer alone. These morphological parameters differed significantly due to foliar application of nutrients, bio-inoculants and soil application of mycorrhizal consortium. The treatment which received soil application of mycorrhizal consortium @ 15 kg ha^{-1} along with foliar application of Dharwad nutrient

Table 1. Growth parameters of black gram at harvest as influenced by foliar nutrition and bio-inoculants.

Treatments	Plant height (cm)	Number of branches plant^{-1}	Plant spread (cm)	LAI (60 DAS)	Dry matter production (g plant^{-1})
T_1: Spraying of Dharwad nutrient mixture (DNM) @ 2 per cent at flowering and pod formation stage	83.6	10.40	38.6	3.35	31.40
T_2: Spraying of DAP @ 2 per cent at flowering and pod formation stage	79.4	9.00	36.3	3.04	27.84
T_3: Spraying of PPFM @ 2.5 liter ha^{-1} at flowering	80.6	9.05	36.1	3.05	27.67
T_4: Spraying of 19:19:19 NPK @ 2 per cent at flowering and pod formation stage	80.0	8.96	36.3	3.09	27.68
T_5: Spraying of Urea @ 2 per cent at flowering and pod formation stage	79.6	8.23	35.1	2.95	25.86
T_6: T_1 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	85.0	11.15	39.1	3.60	32.65
T_7: T_2 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	84.4	10.38	38.0	3.41	30.95
T_8: T_3 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	84.8	10.69	38.5	3.54	31.68
T_9: T_4 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	85.6	10.65	38.3	3.42	31.24
T_{10}: T_5 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	84.8	10.11	38.2	3.41	30.21
T_{11}: RPP = RDF (25:50 NP kg ha^{-1}) + *Rhizobium* @ 200 g + PSB @ 200 g (Seed treatment)	78.1	6.85	34.1	2.70	24.05
S. Em. ±	1.4	0.3	0.3	0.12	1.1
C. D. (p=0.05)	4.1	0.8	1.0	0.3	3.3

Note: FYM @ 5 tons ha^{-1} + 100 per cent RDF (25:50 NP kg ha^{-1}) commonly applied to all the treatments

Table 2. Seed yield and haulm yield of black gram as influenced by foliar nutrition and bio-inoculants

Treatments	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1: Spraying of Dharwad nutrient mixture (DNM) @ 2 per cent at flowering and pod formation stage	1136	2868
T_2: Spraying of DAP @ 2 per cent at flowering and pod formation stage	1012	2632
T_3: Spraying of PPFM @ 2.5 liter ha^{-1} at flowering	1006	2558
T_4: Spraying of 19:19:19 NPK @ 2 per cent at flowering and pod formation stage	1010	2542
T_5: Spraying of Urea @ 2 per cent at flowering and pod formation stage	940	2454
T_6: T_1 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	1180	2964
T_7: T_2 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	1125	2782
T_8: T_3 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	1146	2844
T_9: T_4 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	1130	2851
T_{10}: T_5 + Soil application of mycorrhizal consortium @ 15 kg ha^{-1} at the time of sowing in the furrows	1101	2748
T_{11}: RPP = RDF (25:50 NP kg ha^{-1}) + *Rhizobium* @ 200 g + PSB @ 200 g (Seed treatment)	890	2391
S. Em. ±	39.3	60.5
C. D. (p=0.05)	115.9	178

Note: FYM @ 5 tons ha^{-1} + 100 per cent RDF (25:50 NP kg ha^{-1}) commonly applied to all the treatments

mixture @ 2 per cent recorded significantly higher plant spread (39.1 cm), plant height (85.0 cm) at harvesting stage over recommended dose of fertilizer alone (Table 1). These findings were in line with the findings of Basavarajappa *et al.* (2013).

The seed yield and haulm yield of blackgram was significantly increased due to foliar application of nutrients and bio-inoculants when compared to application of only recommended dose of fertilizers (Table 2). The treatment which received soil application of mycorrhizal consortium at the time of sowing and foliar application of Dharwad nutrient mixture @ 2 per cent at flowering and pod formation stage realised 24 per cent higher seed yield (1,180 kg ha^{-1}) and 19 per cent higher haulm yield (2,964 kg ha^{-1}) over application of recommended dose of fertilizers alone (890 kg ha^{-1}) (Table 2). The treatments *viz.,* spraying of DAP @ 2 per cent at flowering and pod formation stage, spraying of PPFM @ 2.5 liter ha^{-1} at flowering, spraying of 19:19:19 NPK @ 2 per cent at flowering and pod formation stage in addition to RDF also recorded significantly higher seed yield over application of recommended dose of fertilizers alone. However, these treatments recorded significantly lower seed yield over treatments which received foliar nutrients with soil application of mycorrhizal consortium at the time of sowing. The increased yield might be due to better absorption of nutrients, synthesis of food assimilates and translocation of photosynthesis towards reproductive parts as the Dharwad nutrient mixture composed of nitrogen, phosphorus, micronutrients and plant growth promoting substances. Increased yield of black gram due to application of foliar nutrition is also reported by Mandre *et al*. (2020).

Conclusion

From the study it could be inferred that soil application of mycorrhizal consortium @ 15 kg ha^{-1} and foliar application of Dharwad nutrient mixture (DNM) @ 2 per cent at flowering and pod formation stage found optimum to improve the growth parameters of black gram leading to higher grain yield under rainfed conditions.

References

Basavarajappa R, Salakinkop S R, Hebbar M, Basavarajappa M P and Patil H Y, 2013, Influence of foliar nutrition on performance of blackgram (*Vigna mungo* L.), nutrient uptake and economics under dry land ecosystems. *Legume Research International Journal,* 36 (5): 422-428.

Bashan Y, Holguin G and De-Bashan L E, 2004, Azospirillum-plant relationships: physiological, molecular, agricultural, and environmental advances (1997-2003). *Canadian Journal of Microbiology*, 50 (8): 521-577.

Chandrasekhar C N and Bangarusamy U, 2003, Maximizing the yield of mungbean by foliar application of growth regulating chemicals and nutrients. *Madras Agriculture Journal,* 90 (1): 142-145.

Dixit P M and Elamathi S, 2007, Effect of foliar application of DAP, micronutrients and NAA on growth and yield of greengram. *Journal of Legume Research,* 30 (4): 305-307.

Karthikeyan A, Vanathi J, Babu S and Ravikumar C, 2020, Studies on the effect of foliar application of organic and inorganic nutrients on the phenotypic enhancement of blackgram. *Plant Archives,* 20 (2): 1161-1164.

Latha M R and Nadanassababady T, 2003, Foliar nutrition in crops– A review. *Agricultural Reviews*, 24 (3): 229-234.

Mandre R P, Singh M D, Usha W and Vinod B, 2020, Effect of foliar application of nutrients on growth and yield attributing characters of blackgram. *International Journal of Current Microbiology and Applied Sciences*, 2: 419-428.

Patil A S, Nawalagatti C M, Channappagoudar B B and Kubsad V S, 2015, Influence of nutrients on growth, morpho-physiological traits in blackgram. Univ. Agric. Sci., Dharwad, Karnataka (India). *Global Journal of Biology, Agriculture and Health Sciences,* 4 (1): 248-250.