Response of greengram to soil and foliar application of micronutrients mixture in southern dry zone of Karnataka

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DOI: https://doi.org/10.22271/chemi.2020.v8.i1q.8418

Abstract

The productivity of pulses are declining year by year due to many reasons. The major one is as they are grown in rainfed areas with low moisture availability combined with low fertile soils and another important physiological constraint which limit the productivity is flower drop. Experiment was laid out in RCBD with fourteen treatments including control, RDF + FYM, foliar application of MM at 20 DAS (MMF1 and MMF2), 40 DAS (MMF1 and MMF2) along with RDF+FYM, Foliar spray at 20 and 40 DAS along with FYM+RDF and soil application of MMS1, MMS2, MMS3 and MMS4 along with RDF+FYM. These treatments were replicated thrice. Micronutrients mixture comprising Fe (20.10 g), Mn (18.20 g), Zn (160 g), Cu (12.73 g), with B (43.70 g)/without B, Mo(2.33 g) was prepared using appropriate micronutrients salts for foliar application per acre and Fe (80.4g), Mn(72.8g), Zn (640 g), Cu (50.92 g), with B (174.8 g)/without B, Mo (9.32 g) for MMS1 and two, three and four times that of MMS1 for other mixture (MMS2, MMS3 and MMS4, respectively) per acre for soil application. Results revealed that foliar application of MMF1 at 20 days after sowing and MMF2 at 40 days after sowing along + RDF+FYM recorded significantly higher plant height (28.35 cm), number of leaves per plant (6.87) number of branches per plant (4.13), number of pods per plant (26.10), number of seeds per pod (12.28) and seed yield (1030.70 kg ha$^{-1}$) and dry matter (15.61 g plant$^{-1}$) of blackgram. While higher haulm yield (1873.75 kg ha$^{-1}$) and was observed with MMS2 + RDF+FYM.

Keywords: Greengram, soil, foliar application, micronutrients mixture

Introduction

Agriculture still remains the backbone of Indian economy in spite of various technological advancements and industrial development with 70 % of people dependent on agriculture and 25 % of country's Gross Domestic Product coming from agricultural sector. Among the various inputs in agriculture, fertilizer is a vital input since it replenishes the nutrients removed from the soil by crops and also boosts the yield of crops. Pulses play an important role in Indian agriculture. In India, pulses are being cultivated over an area of 23.6 million hectares with an annual production of 17.2 million tonnes and productivity of 728 kg per hectare. Greengram [Vigna radiata (L.) Wilczek] also known as mungbean is an important pulse crop of India. It is also considered as “Golden Bean” because of its nutritional value (Its seed contains 24.2% protein, 1.3% fat and 60.4% carbohydrate) and suitability for increasing the soil fertility by way of addition of nitrogen (30 kg ha$^{-1}$ annum$^{-1}$). Among all pulses grown in India, greengram ranks third after chickpea and pigeon pea, with a production of 1.49 mt from 3.53 m ha area (Anon., 2012) [1]. Foliar feeding of nutrients has become an established procedure in crop production to increase yield and quality of crop products and it also minimizes environmental pollution and improves nutrient utilization through reducing the amounts of fertilizers added to the soil.

Material and methods

Field experiment was conducted during early Kharif 2017 on sandy loam soil at College of Agriculture, V.C. Farm, Mandya, University of Agricultural Sciences, Bengaluru, Karnataka to study the effect of micronutrients mixture application on growth and yield of greengram in Southern Dry Zone (Zone 6) of Karnataka.
The experiment was laid out in RCBD with fourteen treatments including control, RDF + FYM, foliar application of MMF1 and MMF2 at 20 DAS, MMF1 and MMF2 at 40 DAS along with RDF+FYM and their combinations and soil application of MMS1, MMS2, MMS3 and MMS4 along with RDF+FYM. Initial soil properties of the experimental site during 2017 was presented in the Table 1.

Table 1: Initial Physico-chemical properties of the soil

| Sl. No | Parameter                  | Site 1 (2017) |
|--------|----------------------------|---------------|
|        | I. Physical properties     |               |
|        | Coarse sand (%)            | 55.70         |
|        | Fine sand (%)              | 25.87         |
|        | Silt (%)                   | 14.9          |
|        | Clay (%)                   | 3.53          |
|        | Textural Class             | Sandy loam    |
|        | II. Chemical properties    |               |
| 1      | pH (1:2.5)                 | 7.39          |
| 2      | EC (dS m⁻¹)                | 0.13          |
| 3      | Organic carbon (g kg⁻¹)    | 1.53          |
| 4      | Available N (kg ha⁻¹)      | 252.97        |
| 5      | Avail. P₂O₅ (kg ha⁻¹)      | 45.8          |
| 6      | Avail. K₂O (kg ha⁻¹)       | 345.96        |
| 7      | Exch. Ca (cmol ha⁻¹)       | 3.24          |
| 8      | Exch. Mg (cmol ha⁻¹)       | 1.89          |
| 9      | Available S (mg kg⁻¹)      | 15.67         |
| 10     | DTPA Fe (mg kg⁻¹)          | 17.82         |
| 11     | DTPA Zn (mg kg⁻¹)          | 0.52          |
| 12     | DTPA Mn (mg kg⁻¹)          | 8.78          |
| 13     | DTPA Cu (mg kg⁻¹)          | 0.53          |
| 14     | Hot water soluble Boron (mg kg⁻¹) | 0.46        |

| Micronutrients salts used Form | MMF1 (g ha⁻¹) | MMF2 (g ha⁻¹) | MMS1 (g ha⁻¹) | MMS2 (g ha⁻¹) | MMS3 (g ha⁻¹) | MMS4 (g ha⁻¹) |
|-------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Fe₂SO₄·7H₂O Fe                | 50.25         | 50.25         | 100.5         | 201           | 100.5         | 201           |
| MnSO₄·5H₂O Mn                 | 45.5          | 45.5          | 91            | 182           | 91            | 182           |
| ZnSO₄·7H₂O Zn                 | 400           | 400           | 800           | 1600          | 800           | 1600          |
| CaSO₄·2H₂O Cu                 | 31.82         | 31.82         | 63.64         | 127.28        | 63.64         | 127.28        |
| Sodium molybdate Mo           | 5.82          | 5.82          | 11.64         | 23.28         | 11.64         | 23.28         |
| Boric acid B                  | 109.25        | 218.5         | 437           | -             | -             | -             |

*MMS-micronutrients mixture for soil application, MMF-micronutrients mixture for foliar application

Recommended dose of NPK (25:50:50 kg ha⁻¹) for greengram was supplied with urea, single super phosphate and murate of potash, respectively and micronutrient mixture (MMS1 and MMS2) comprising Fe, Mn, Zn, Cu, B and Mo (Table 2) was applied at the time of sowing in the form of iron sulphate, manganese sulphate, zinc sulphate, copper sulphate, borax and sodium molybdate, respectively. Micronutrient mixture containing the amount as indicated in Table 2 for foliar spray was prepared by dissolving the appropriate quantity of all the micronutrient salts in distilled water. Then the pH of the solution was adjusted to 6.5 using 1% KOH solution. This solution was used for foliar spraying (@ 500 l/ha) at 20 and 40 DAS as per the treatment plan. Crop was harvested at proper maturity. Periodical and quantitative observations were taken in order to assess the effect of micronutrients mixture on growth, yield and yield parameters. Mature pods were harvested manually by hand picking. The seed was separated by manual threshing. Seed and haulm yield was recorded separately treatment wise.

Results and Discussion

Table 3: Effect of micronutrients mixture application on growth parameters of greengram

| Treatments | Plant height (cm) | Number of leaves per plant | Number of branches per plant | Dry matter production per plant (g plant⁻¹) |
|------------|------------------|----------------------------|-----------------------------|---------------------------------------------|
| T₀         | 18.20            | 4.80                       | 2.47                        | 14.03                                       |
| T₁         | 25.07            | 5.65                       | 2.87                        | 15.03                                       |
| T₂         | 25.40            | 5.73                       | 2.93                        | 15.90                                       |
| T₃         | 24.41            | 5.33                       | 3.20                        | 15.46                                       |
| T₄         | 21.23            | 5.35                       | 3.46                        | 13.68                                       |
| T₅         | 25.89            | 5.40                       | 3.58                        | 15.66                                       |
| T₆         | 28.35            | 6.87                       | 4.13                        | 15.61                                       |
| T₇         | 22.46            | 5.73                       | 3.07                        | 14.99                                       |
| T₈         | 25.44            | 6.51                       | 2.99                        | 14.78                                       |
| T₉         | 24.73            | 6.20                       | 3.28                        | 16.34                                       |
| T₁₀        | 21.13            | 5.27                       | 3.08                        | 14.61                                       |
| T₁₁        | 24.67            | 6.53                       | 3.67                        | 16.21                                       |
| T₁₂        | 22.84            | 6.53                       | 3.24                        | 14.69                                       |

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Effect of application of micronutrients mixture on growth and yield of greengram was significant (Table 3). Significantly higher plant height was noticed in T1 (28.35 cm) with the application of RDF + FYM + MMF1 at 20 DAS+ MMF2 at 40 DAS and it was on par with T3 and T9 and significantly differed from other treatments. Highest number of leaves (6.87) and branches (4.13) per plant recorded with the application of RDF + FYM + MMF1 at 20 DAS+ MMF2 at 40 DAS and these treatments were on par with T12 (6.53 and 3.67 respectively) with RDF + FYM + MMS2 and lowest was recorded in control (4.80 and 2.47 respectively). Significantly higher dry matter production per plant (16.21 g) was observed with RDF + FYM + MMS2 application.

The growth parameters and dry matter production in both greengram and blackgram recorded with the application of micronutrients mixture along with RDF + FYM can significantly enhance the chlorophyll content ultimately photosynthesis. Thus the total effect of application micronutrients mixture resulted in higher yield attributes and yield in greengram. The similar beneficial effect of multi micronutrients mixture application have been reported by Kaman et al., (2014) [4] and Poongothai and Chideshwari (2003) [5] in blackgram, by Henn (2013) [3] in cowpea, by Valenciano et al. (2010) [6] in chickpea and by Quddus et al. (2011) [6] in mungbean.

The data on the effect of application of FYM + RDF and micronutrients mixture on yield attributes and yield of greengram are presented in Table 4. Yield and yield attributes were differed significantly with the application of micronutrients mixture along with RDF + FYM. Significantly higher pod length (7.99 cm), number of pods per plant (26.42), number of seeds per pod (13.15), Test weight (4.26 g) were recorded with the application of RDF + FYM + MMF1 at 20 DAS + MMF2 at 40 DAS and lowest was observed with control, RDF + FYM. Superior yield of 1030.70 kg ha⁻¹ was observed in T7 significantly and it was on par with other treatments except T1, T2, T5, T11 and T14. Significantly higher haulm yield was observed in T12 (1873.75 kg ha⁻¹) compare to all other treatments.

Foliar application of micronutrients (Fe, Mn, Zn, Mo, Cu, with/without B) resulted in effective absorption of the nutrients during critical stages of growth and in turn contributed to increased pod length. This result was in accordance with the earlier findings of Sarkar and Malik (2001) [1]. Foliar application of nutrients enhanced the number of floral buds, prevented the floral shedding by maintaining optimum bio - physiological conditions and also these micronutrients such as Fe, Zn and Mn have a structural role in chlorophyll. Consequently supply of these micronutrients enhances the chlorophyll content ultimately photosynthesis. This in turn, leads to an increase in yield attributes in the treatment that received micronutrients mixture (Farag et al., 2014) [2] and B in the mixture might have improved flower retention, pollination and sugar transportation. Thus the total effect of application micronutrients mixture resulted in higher yield attributes and yield in greengram.

### Conclusion
The results indicated that soil or foliar application of micronutrients mixture along with RDF+FYM can significantly enhance the growth, yield and nutrient content of greengram. Application of micronutrients mixture ensures the balanced supply of nutrients which in turn helps in improving the nutritional quality of crops.

### Acknowledgement
Department of science and Technology, Ministry of Science and Technology Government of India for awarding INSPIRE fellowship to carry out the research as part of Doctoral Degree program of corresponding author.

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| Treatments | Pod length (cm) | Number of pods per plant | Number of seeds per pod | Test weight (g) | Seed yield (kg ha⁻¹) | Haulm yield (kg ha⁻¹) |
|------------|----------------|--------------------------|-------------------------|-----------------|---------------------|----------------------|
| T1         | 6.31           | 17.61                    | 9.87                    | 4.01            | 680.43              | 765.93               |
| T2         | 7.53           | 21.49                    | 11.26                   | 4.17            | 895.75              | 1271.07              |
| T3         | 7.60           | 20.97                    | 11.55                   | 4.17            | 846.52              | 1609.34              |
| T4         | 7.32           | 20.88                    | 11.87                   | 4.10            | 920.15              | 1581.09              |
| T5         | 7.35           | 19.42                    | 10.73                   | 4.14            | 921.04              | 1592.13              |
| T6         | 7.39           | 24.11                    | 12.87                   | 4.15            | 915.36              | 1643.11              |
| T7         | 7.99           | 26.42                    | 13.15                   | 4.26            | 1030.70             | 1656.47              |
| T8         | 7.66           | 24.05                    | 12.17                   | 4.10            | 921.65              | 1347.83              |
| T9         | 7.73           | 20.66                    | 12.21                   | 4.11            | 939.33              | 1510.44              |
| T10        | 7.21           | 20.14                    | 10.96                   | 4.08            | 983.16              | 1518.51              |
| T11        | 7.68           | 22.23                    | 11.67                   | 4.11            | 809.69              | 1559.96              |
| T12        | 7.88           | 21.09                    | 11.69                   | 4.07            | 927.49              | 1873.75              |
| T13        | 6.74           | 21.72                    | 11.08                   | 4.25            | 912.04              | 1631.78              |
| T14        | 7.28           | 20.88                    | 11.91                   | 4.04            | 902.99              | 1486.38              |

The results indicated that soil or foliar application of micronutrients mixture along with FYM + RDF were significantly higher than that recorded with only FYM+RDF. Micronutrients play an important role as these are involved in metabolic functions, translocation, enzyme activation, cell multiplication, photosynthesis etc., thus application of micronutrients mixture either through soil or foliage enhanced the growth parameters and dry matter production in greengram. The similar beneficial effect of multi micronutrients mixture application have been reported by Kaman et al., (2014) [4] and Poongothai and Chideshwari (2003) [5] in blackgram, by Henn (2013) [3] in cowpea, by Valenciano et al. (2010) [6] in chickpea and by Quddus et al. (2011) [6] in mungbean.

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**Table 4:** Effect of micronutrients mixture application on yield and yield attributes of greengram
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