Influence of macro and micronutrient priming on growth parameter, grain yield and seed quality of soybean

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Abstract
A field study was conducted two consecutive years to know the “Influence of macro and micronutrient priming on growth parameter, grain yield and seed quality of soybean” was carried out during kharif, 2018 and 2019 at research farm of Oilseed Research Station, Latur under VNMKV, Parbhani. The experiment was laid out in Randomized Block Design (RBD) with 12 treatments which were replicated thrice. The treatments comprises T1: absolute control, T2: Only RDF, T3: RDF + Zn@ 3g kg⁻¹ seed, T4: RDF + B @ 3g kg⁻¹ seed, T5: RDF + Fe @ 3g kg⁻¹ seed, T6: RDF + S @ 3g kg⁻¹ seed, T7: RDF + Zn + B each @ 3g kg⁻¹ seed, T8: RDF + Zn + B + Mo each @ 3g kg⁻¹ seed, T9: RDF + Zn + B + Mo + Fe each @ 3g kg⁻¹ seed, T10: Absolute control, T11: RDF + Zn + B + Mo + Fe + S each @ 3g kg⁻¹ seed, T12: Without RDF + Zn + B + Mo + Fe + S each @ 3g kg⁻¹ seed. To achieve the objectives the observations were recorded at various growth stages of soybean during 2018 and 2019. The result indicates that, the micronutrient priming treatment T10 receiving Zn + B + Mo + Fe + S each @ 3g kg⁻¹ seed application along with RDF found to be effective in improving growth and yield attributing characters like germination percentage, plant height, leaf area, root density, number of pods, final plant stand percentages, grain yield, dry matter yield and total biological yield. In grain quality the results revealed that test weight, protein and oil content percentage were significantly influenced with the application of treatment T10. On the other hand, in all the cases the lower response was found from the control treatment.

Keywords: Macronutrient, nutrient, priming, soybean yield, quality

Introduction
Soybeans [Glycine max (L.) Merill] are often called the “miracle crop.” of the 21st century and has witnessed phenomenal growth in production, processing and trade in last few years in India and has revolutionized the rural economy and improved socio economic status of the farmers. Soybean seed consists of 35 per cent carbohydrate, 5 per cent ash, 40 per cent protein and 20 per cent oil and is a major source of protein and oil for commercial products. In addition, it contains a good amount of minerals, salts and vitamins (thiamine and riboflavin). Soybean improve the soil health and fertility by fixing nitrogen through biological nitrogen fixation in soil which is carried out by symbiotic nitrogen fixing bacteria residing in the root nodule of soybeans (Javaid and Mahmood, 2010) [62]. Soybean also has the capacity to ameliorate the nutritional situation, enhance productivity of other crops. Soybean is the second largest oilseed in India after groundnut. In recent years, soybean has shown a rapid increase in area in southern parts of the country, particularly in the states of Maharashtra, Karnataka. Madya Pradesh since beginning has been the major contributor to the soybean area and production.

Micronutrients are known to play many complex roles in plant development and health. These include photosynthesis, chlorophyll synthesis, respiration, enzyme function, formation of hormones, metabolic processes, nitrogen fixation, reducing nitrates to usable forms, cell division, development and regulation of water uptake. Micronutrients promote the strong, steady growth of crops that produce higher yields and increase harvest quality maximizing a plant’s genetic potential. In particular, their presence can have a great impact on root development, fruit setting and grain filling, seed viability and plant vigor and health.
Normally micro nutrients are provided through different methods like, soil application and foliar spray. But these are expensive and sometime plant roots are unable to absorb. So it is necessary to develop an attractive and easy alternative method to increase the micronutrients availability. One of such method is “Seed nutri priming” The use of macro and micronutrient enriched seeds (seed priming) has been reported to be a better strategy in overcoming macro and micronutrient deficiency. It is one of the physiological methods, which improves seed performance and provide faster and synchronized germination and increase yield and quality improves the crop and increase yield and micronutrient grain contents (Farooq et al., 2012) [10]. Seed may be treated with micronutrients either by soaking in nutrient solution of a specific duration (seed priming) with micronutrients. In seed priming, seeds are partially hydrated to allow metabolic events to occur without actual germination and re-dries (near to their original weight) to permits routine handling (Bradford 1986) [10], (Farooq et al., 2008) [10]. Seed priming is employed for better crop stand and higher yields in a range of crops Harris et al. (2007) [10]. Small amount of nutrient is required for seed priming hence can be an economical approach as compared with other methods.

Material and Methods
The field experiment was conducted two consecutive years using Soybean crop (Var. MAUS 162) at research farm of Oilseed Research Station, Latur under VNMKV, Parbhani. To study the influence of macro and micronutrient priming on growth parameter, grain yield and seed quality of soybean. After completion of preparatory tillage operations, the experiment was laid out in randomized block design (RBD) with twelve (12) treatments of micro nutrient priming along with RDF replicated three (03) times as per fixed plan and site. Five micronutrient elements i.e. Zinc (ZnSO₄), Iron (FeSO₄) Boron (H₂BO₃) Elemental sulphur (S), and Ammonium molybdenum (Mo) were used for priming purpose @3g kg⁻¹ of seed and bio fertilizer Rhizobium + PSB 10 ml kg⁻¹ of seed. The treatments comprises T₁: absolute control, T₂: Only RDF, T₃: RDF + Zn @ 3 g kg⁻¹ seed, T₄: RDF + B @ 3 g kg⁻¹ seed, T₅: RDF+Fe @ 3 g kg⁻¹ seed, T₆: RDF + S @ 3g kg⁻¹ seed, T₇: RDF + Zn + B + each @ 3g/kg seed, T₈: RDF + Zn + B + Mo each @ 3g/kg seed, T₉: RDF + Zn + B + Mo + Fe each @ 3g/kg seed, T₁₀: RDF + Zn + B + Mo + Fe + S each @ 3g/kg seed, T₁₁: Without RDF + Zn + B + Mo + Fe + S each @ 3g/kg seed. One kg each treatment soybean seed taken added 10 to 15 ml of the solution with different concentrations of the micronutrients and micronutrients mixture (nutria priming) for same period of time. Then the seeds were surface washed with distilled spray of water and re-dried with forced air under shade near to original weight to original moisture content soybean

Soybean seed was sown on 24 June 2018 and 30 July 2019 by dibbling method as per randomly replicated plot having size 5.4x 4.5m² maintained row to row spacing 45 cm and plant to plant 5 cm and using a seed rate of 65 kg ha⁻¹. All the plots were fertilized with recommended dose of NPK (30:60:30 kg ha⁻¹) whole quantity of fertilizers was applied as a basal dose and micronutrients seed priming done at the time of sowing. After sowing, seed was covered with soil. Sowing depth was kept almost 5 cm. The crop was harvested at maturity stage on 3rd October, 2018 and 4th November 2019. The observation recorded viz. plant height, leaf area, root density at flowering, pod formation and at harvest stage The yield attributing parameters viz., no. of pods per plant seed yield, fodder yield, total biomass were recorded at harvest stage. Quality parameter like protein, oil content and test weight value were recorded. The data collected from the above observation were analysed statistically by the procedure prescribed by Panse and Sukhatme (1967) [10].

Table 1: Plant height (cm) at various growth stages of soybean as influenced by macronutrients treatments of and priming micronutrients

| Flowering stage | Pod development stage | Harvesting stage |
|-----------------|-----------------------|------------------|
| 2018 | 2019 | Pooled | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| T₁ | 49.30 | 29.93 | 39.62 | 65.73 | 48.73 | 57.23 | 73.33 | 54.40 | 63.87 |
| T₂ | 51.40 | 32.80 | 42.10 | 72.13 | 51.87 | 62.00 | 76.47 | 57.20 | 66.83 |
| T₃ | 52.93 | 33.40 | 43.17 | 71.60 | 50.20 | 60.90 | 76.47 | 58.20 | 67.33 |
| T₄ | 51.27 | 33.00 | 42.13 | 72.13 | 52.73 | 62.43 | 76.47 | 55.27 | 65.87 |
| T₅ | 51.00 | 32.60 | 41.80 | 69.87 | 51.80 | 60.83 | 72.93 | 62.93 | 67.93 |
| T₆ | 50.20 | 34.20 | 42.20 | 71.87 | 53.60 | 62.73 | 76.67 | 60.80 | 68.73 |
| T₇ | 54.53 | 33.53 | 44.03 | 71.80 | 55.73 | 63.77 | 77.60 | 61.40 | 69.50 |
| T₈ | 52.87 | 33.60 | 43.23 | 71.20 | 54.53 | 62.87 | 76.13 | 60.73 | 68.43 |
| T₉ | 54.07 | 33.60 | 43.83 | 72.20 | 57.40 | 64.80 | 76.28 | 61.20 | 68.74 |
| T₁₀ | 57.60 | 36.67 | 47.13 | 76.20 | 53.67 | 64.93 | 78.47 | 62.33 | 70.40 |
| T₁₁ | 50.33 | 34.33 | 42.33 | 74.27 | 50.87 | 62.57 | 76.00 | 60.00 | 68.00 |
| T₁₂ | 49.40 | 31.87 | 40.63 | 72.53 | 52.60 | 62.57 | 77.93 | 55.07 | 66.50 |
| SE ± | 1.398 | 1.019 | 0.814 | 1.607 | 1.44 | 1.268 | 1.087 | 1.496 | 0.836 |
| CD at 5% | 4.128 | 2.988 | 2.389 | 4.743 | 4.209 | 3.719 | 3.208 | 4.387 | 2.453 |
| GM | 52.08 | 33.29 | 42.68 | 71.79 | 52.81 | 62.30 | 76.23 | 59.13 | 67.68 |
Were at par with each other at pod development and harvest stage. Whereas, minimum value at recorded in T₁ absolute control treatment. It was found that T₁₀ had been superior rest of the treatments. However, in pooled mean increment in plant height of soybean was noted up to the extent of 19.86, 13.45 and 10.22 percent at flowering, pod development and harvest stage of soybean respectively in T₁₀ over T₁ absolute control. Increase in plant height might be due to cell elongation, cell enlargement and more chlorophyll synthesis resulting in better plant growth due to nutrient seed priming with micronutrients treatment similar findings have been reported by Heidarian et al. (2019) [11] and Mahmood, et al. (2019) [15].

Root density (g/cm³): Data in respect of root density at various growth stages of soybean presented in the table 2. There was continuous build up of a root density in soybean with advancing growth stages and found significantly maximum in seed priming treatment T₁₀ receiving Zn + B + Mo + Fe+ S each @ 3g kg⁻¹ seed along with RDF and significantly superior over T₁ absolute control and was found at par with treatments T₃, T₅, T₃, T₇ and T₉. The maximum root density at pod development was recorded in the seed priming treatment T₁₀ during the year 2018 and 2019 as well as pooled analysis. Micronutrient elements play a critical role in plants that lead to increase of leaf area. The increase in leaf area per plant in present investigation is in accordance with the finding of Dandoti et al. (2017) [13] showed coating of lineased seeds with the combination of Zn + B + Mo + Fe+ Ca recorded significantly higher leaf area compared to all other treatments and Badiri et al. (2014) [14] who reported priming the plantain seeds with Zn, Mn and Fe significantly increased leaf area.

Leaf area (sq. cm per plant): The data furnished in table 3 revealed that, significantly highest leaf area at flowering, pod development, harvesting stage of soybean was found in the seed priming treatment T₁₀ receiving Zn + B + Mo + Fe+ S each @ 3g kg⁻¹ seed along

| Table 2: Root density (g/cm³) at various growth stages of soybean as influenced by macronutrients and priming treatments of micronutrients |
|---------------------------------------------------------------|
| Flowering stage | Pod development stage | Harvesting stage |
|------------------|----------------------|------------------|
|                  | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| T₁               | 0.38 | 0.19 | 0.29 | 0.49 | 0.31 | 0.40 | 0.51 | 0.38 | 0.45 |
| T₂               | 0.39 | 0.23 | 0.31 | 0.53 | 0.34 | 0.44 | 0.58 | 0.42 | 0.50 |
| T₃               | 0.40 | 0.23 | 0.31 | 0.53 | 0.35 | 0.44 | 0.59 | 0.46 | 0.53 |
| T₄               | 0.41 | 0.21 | 0.31 | 0.54 | 0.37 | 0.46 | 0.62 | 0.43 | 0.52 |
| T₅               | 0.42 | 0.23 | 0.33 | 0.56 | 0.36 | 0.46 | 0.66 | 0.47 | 0.56 |
| T₆               | 0.41 | 0.25 | 0.33 | 0.56 | 0.36 | 0.46 | 0.60 | 0.46 | 0.53 |
| T₇               | 0.44 | 0.24 | 0.34 | 0.60 | 0.37 | 0.48 | 0.65 | 0.47 | 0.56 |
| T₈               | 0.47 | 0.26 | 0.36 | 0.58 | 0.38 | 0.48 | 0.66 | 0.49 | 0.58 |
| T₉               | 0.44 | 0.26 | 0.35 | 0.59 | 0.39 | 0.49 | 0.66 | 0.48 | 0.57 |
| T₁₀              | 0.51 | 0.27 | 0.39 | 0.67 | 0.41 | 0.54 | 0.66 | 0.51 | 0.58 |
| T₁₁              | 0.48 | 0.25 | 0.37 | 0.65 | 0.39 | 0.52 | 0.66 | 0.48 | 0.57 |
| T₁₂              | 0.44 | 0.22 | 0.33 | 0.55 | 0.35 | 0.45 | 0.61 | 0.41 | 0.51 |
| SE ±             | 0.025 | 0.013 | 0.013 | 0.025 | 0.016 | 0.017 | 0.024 | 0.022 | 0.018 |
| CD at 5%         | 0.075 | 0.037 | 0.038 | 0.075 | 0.047 | 0.049 | 0.070 | 0.064 | 0.054 |
| GM               | 0.43 | 0.24 | 0.34 | 0.57 | 0.36 | 0.47 | 0.62 | 0.46 | 0.67 |

Flowering, pod development and at harvest stage of soybean. In present investigation smaller results line with Gandhi et al. (2017) [9] found maximum root length where boron was used at the lowest concentration Munawar et al. (2013) [17] found seed priming with Zn (1.5%) solution. Mn (1.5%) and Mn (2%) solution showed highest mean shoot length and root length in carrot respectively.

| Table 3: Leaf area (sq. cm per plant) at various growth stages of soybean as influenced by macronutrients and priming treatments of micronutrients |
|---------------------------------------------------------------|
| Tr. | Flowering stage | Pod development stage | Harvesting stage |
|-----|----------------|----------------------|------------------|
|     | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| T₁  | 361.60 | 244.67 | 303.13 | 539.53 | 388.00 | 463.67 | 269.47 | 145.00 | 207.23 |
| T₂  | 469.93 | 307.33 | 388.63 | 640.53 | 416.67 | 528.60 | 306.07 | 166.00 | 236.03 |
| T₃  | 531.00 | 354.67 | 442.83 | 694.60 | 441.67 | 568.13 | 375.07 | 219.00 | 297.03 |
| T₄  | 503.47 | 318.00 | 410.73 | 684.80 | 413.33 | 549.07 | 347.47 | 210.67 | 279.07 |
| T₅  | 524.67 | 327.67 | 426.17 | 693.67 | 420.00 | 556.83 | 391.20 | 214.33 | 302.77 |
| T₆  | 537.60 | 353.67 | 445.63 | 730.67 | 473.67 | 602.17 | 395.87 | 244.67 | 320.27 |
| T₇  | 534.53 | 348.33 | 441.43 | 701.87 | 453.67 | 577.77 | 379.67 | 241.00 | 310.33 |
| T₈  | 551.67 | 410.33 | 481.00 | 742.67 | 494.33 | 618.50 | 405.47 | 245.00 | 325.23 |
| T₉  | 665.73 | 387.33 | 476.53 | 810.53 | 512.67 | 661.60 | 495.87 | 251.67 | 323.77 |
| T₁₀ | 651.47 | 440.67 | 546.07 | 923.67 | 521.00 | 722.33 | 427.60 | 258.33 | 342.97 |
| T₁₁ | 526.80 | 410.67 | 468.73 | 714.67 | 485.33 | 600.00 | 349.60 | 235.67 | 292.63 |
| T₁₂ | 481.53 | 295.33 | 388.43 | 624.60 | 401.33 | 512.97 | 338.13 | 158.67 | 248.40 |
| SE ± | 10.48 | 23.880 | 14.651 | 19.387 | 23.158 | 16.875 | 19.783 | 18.505 | 14.110 |
| CD at 5% | 30.961 | 70.036 | 42.969 | 57.227 | 67.921 | 49.491 | 58.397 | 54.272 | 41.384 |
| GM | 520.00 | 349.89 | 434.94 | 708.47 | 451.81 | 580.14 | 365.12 | 215.83 | 290.48 |
No. of pods per plant
It is evidenced from the data presented in table 4. Among the various treatments seed priming with micronutrients treatment T10 (57.73, 32.87 and 45.20) receiving Zn + B + Mo + Fe + S each @ 3 g kg⁻¹ seed along with RDF registered the more number of pods per plant at harvest stages of soybean and found significantly superior over rest of all treatment and at par with treatments. T8, T9, T7, T6, and T11. Whereas less number of pods per plant was noticed in treatment T1 (38.80, 18.60 and 28.70) receiving absolute control respectively in both years and pooled analysis. However, increment was noted up to the extent of 57.49 percent with regards to number of pods per plant in T10. During the growth stage, plants were highly affected by micronutrient applications which directly become visible at pods initiation and forming. Our result corresponds to the findings of Harris et al., (2008) [10] Ali et al. (2018) [18] Barangule et al. (2018) [4].

Table 4: No of pods, Weight of pods per plant (gm) and final plant stand percentage at harvest stages of soybean as influenced macronutrients and priming treatments of micronutrients

| Tr. | No of pods | Weight of pods | Final plant stand (%) |
|-----|------------|---------------|-----------------------|
|     | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| T1  | 38.80 | 18.60 | 28.70 | 13.00 | 9.67 | 11.33 | 79.55 | 79.32 | 79.43 |
| T2  | 45.80 | 20.40 | 33.10 | 13.53 | 11.20 | 12.37 | 84.28 | 85.95 | 85.11 |
| T3  | 47.87 | 24.20 | 36.03 | 15.87 | 11.67 | 13.77 | 89.51 | 88.14 | 88.83 |
| T4  | 49.47 | 23.67 | 36.57 | 15.80 | 12.13 | 13.97 | 86.48 | 87.65 | 87.06 |
| T5  | 48.67 | 25.80 | 37.23 | 16.53 | 13.40 | 14.97 | 90.30 | 92.77 | 91.53 |
| T6  | 54.73 | 26.67 | 40.70 | 15.80 | 13.93 | 14.87 | 88.67 | 92.42 | 90.55 |
| T7  | 51.27 | 29.53 | 40.40 | 16.13 | 14.07 | 15.10 | 87.99 | 91.36 | 89.68 |
| T8  | 54.33 | 28.60 | 41.47 | 17.00 | 13.33 | 15.17 | 88.98 | 92.20 | 90.59 |
| T9  | 55.13 | 29.13 | 42.13 | 17.27 | 14.53 | 15.90 | 87.95 | 91.33 | 89.64 |
| T10 | 57.73 | 32.67 | 45.20 | 18.20 | 15.13 | 16.67 | 90.64 | 93.90 | 92.27 |
| T11 | 50.73 | 27.67 | 39.20 | 15.33 | 13.80 | 14.57 | 86.97 | 92.80 | 89.89 |
| T12 | 44.82 | 22.40 | 33.60 | 13.20 | 10.93 | 12.07 | 82.87 | 84.17 | 83.52 |
| SE ± | 2.702 | 2.199 | 1.665 | 0.947 | 0.914 | 0.662 | 1.894 | 1.492 | 1.289 |
| CD at 5% | 7.976 | 6.450 | 4.885 | 2.794 | 2.681 | 1.941 | 5.555 | 4.377 | 3.780 |
| GM  | 49.94 | 25.78 | 37.86 | 15.64 | 12.82 | 14.23 | 87.02 | 89.33 | 88.18 |

Weight of pods per plant (gm)
The data pertaining to weight of pods per plant at harvest stages of soybean presented in table 4. It was observed that in the year 2018 and 2019 and in pooled analysis weight of pods per plant at harvest stages of soybean was found significantly highest in treatment T10 (18.20, 15.13 and 16.67 gm) receiving RDF + Zn + B + Mo + Fe + S each @ 3 g kg⁻¹ seed priming and followed by treatments T8, T9, T7, T6, and T5 and at par with each other. While lowest value of weight of pods per plant was recorded in treatment T1 (13.00, 9.67 and 11.33 gm) absolute control respectively. This might be due to fact that the combined application of micronutrients along with RDF in primed manner had increased weight of pods per plant at harvest stage. Similar results were also observed by Kalpana et al. (2013) [14] Dandoti et al. (2017) [13].

Final plant stands percentage
It is evidenced from the data two consecutive years and pooled data expressed in table 4. The treatment T10 (90.64, 93.90 and 92.27 per cent) receiving RDF + Zn + B + Mo + Fe + S each @ 3 g kg⁻¹ seed priming recorded maximum final plant stand percentage and was significantly superior over rest of all treatment and it was found at par with treatments T8, T9, T7, T6, T5, T4 and T3. Whereas minimum value of final plant stand percentage was recorded in treatment T1 (79.55, 79.32 and 79.43 per cent) absolute control respectively. The increase in final plant stand percentage with nutrient seed dressing with micronutrients observed in the present study was in the accordance with the findings reported by Farooq et al. (2012) [8] Dandoti et al. (2017) [13] Sale and Nazirkar (2013) [22].

Grain yield (q ha⁻¹)
The data related to grain yield at harvest stage of soybean narrated in table no. 5. During the year 2018, 2019 and pooled analysis the grain yield of soybean significantly influenced by various treatments. Among the treatments evaluated, the seed priming with combined micronutrient along with RDF (30:60:30 NPK kg ha⁻¹) treatment T10 receiving Zn + B + Mo + Fe + S each @ 3 g kg⁻¹ seed, produced maximum grain yield (21.21, 12.07 and 16.64 q ha⁻¹) which was significantly superior over T5 (19.68,10.78 and 15.23 q ha⁻¹), T9 (19.62,10.99 and 15.31 q ha⁻¹), T2 (19.42,10.89 and 15.15 q ha⁻¹) and T1 (19.74, 10.56 and 15.15 q ha⁻¹) further it was observed that the seed treatment T10 recorded at par yield with T8, T9, T7, T6 and T5 and found significantly superior over T1 (16.44, 8.87 and 12.66 q ha⁻¹) and noticed lowest seed yield of soybean in T1 absolute control. Per cent increase in grain yield of soybean due to the micronutrient priming Zn + B + Mo + Fe + S each @ 3 g kg⁻¹ seed along with RDF was noted up to 29.01 per cent in the year 2018, 2019 and pooled data respectively. Combination of micronutrients like Iron, zinc, boron sulphur and molybdenum gives maximum seed

Table 5: Grain yield, dry matter yield and total biological yield (q ha⁻¹) at harvest stages of soybean as influenced macronutrients and priming treatments of micronutrients

| Tr. | Grain yield | Dry matter yield | Total biological yield |
|-----|-------------|------------------|------------------------|
|     | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| T1  | 16.44 | 8.87 | 12.66 | 15.45 | 8.38 | 11.92 | 31.89 | 17.25 | 24.57 |
| T2  | 17.88 | 9.40 | 13.64 | 16.75 | 9.17 | 12.96 | 34.63 | 18.57 | 26.60 |
| T3  | 19.74 | 10.56 | 15.15 | 17.17 | 9.86 | 13.51 | 36.91 | 20.41 | 28.66 |
| T4  | 18.68 | 9.60 | 14.14 | 16.47 | 9.00 | 12.74 | 35.16 | 18.60 | 26.88 |
Yield as compared to all other treatments due to synergistic effect of these micronutrients. Which are the metallic components of one or more enzymes which are involved in various physiological functions, growth, development and crop productivity. These results are also in accordance with Pawel (2013) [20] in soybean, Baranule et al. (2018) [4] in sorghum, Muhammad Imran (2015) [12] in maize.

**Dry matter yield (q ha⁻¹)**

The data expressed in table 5. The dry matter yield of soybean significantly influenced and the highest value of dry matter yield was recorded in treatment T₁₀ receiving RDF + Zn + B + Mo + Fe+ S each @ 3 kg kg⁻¹ seed (20.10, 11.29 and 15.69 q ha⁻¹) seed priming and found significantly superior over rest of all treatment respectively and also found at par with treatments T₆, T₈, and T₁₁ in year 2019 whereas T₉ was found superior all over treatment in 2019 whereas T₈, T₉, and T₁₀ in the year 2018 as well as T₈, T₉, and T₁₁ treatment in the year 2019 and pooled data. However the lowest test weight of seed was observed in treatment T₂ absolute control (120.00, 118.33 and 119.17 gm) respectively and the magnitude of increase in test weight 1000 seeds (gm) of soybean with T₁₀ was increased to the tune of 10.02 per cent. These results are in conformity with the findings of Arif et al. (2007) [1] who reported that seed priming increased thousand grain weights in chickpea. Greater mobilisation of photosynthesis to the developing seeds by application of micronutrients might be the reason for increase in seed weight.

**Total biological yield (q ha⁻¹)**

Total biological yield of soybean was tabulated in table 5. Total biological yield of soybean obtained with the application of the treatment T₁₀ receiving RDF + Zn + B + Mo + Fe+ S each @ 3 kg kg⁻¹ seed (41.31, 23.56 and 32.33 q ha⁻¹) and at par with the treatment T₆, T₈, T₁₀, T₆, T₈, T₁₀, and T₁₁ in year 2018 and the treatment T₁₀ was found superior all over rest of all treatment in 2019 whereas T₁ absolute control was recorded lowest value (31.89, 17.25 and 24.57 q ha⁻¹) during both years and pooled analysis. The magnitude of increase dry matter yield of soybean with T₁₀ was improved to the tune of 31.62 per cent over absolute control T₁.

**Protein content (per cent)**

The data on protein content percentage of soybean grain recorded statistically significant expressed in table 6. In both the years and pooled data percentage protein content in soybean significantly observed highest due to application RDF and Zn + B + Mo + Fe+ S each @ 3 kg kg⁻¹ seed priming (38.73, 38.49 and 38.61%) and significantly superior over rest of all treatment and at par with all treatment except T₁ and T₁₂ and lowest was noticed in treatment T₁ absolute control (27.91, 30.90 and 29.14 per cent) respectively and magnitude of increase in protein content of soybean with T₁₀ was increased to the tune of 31.28 per cent over absolute control. Increase in protein content might be due to combined priming of micronutrients which involved protein synthesis and there by increased protein content. Our results corresponds to the findings of Sarker et al. (2002) [23] Mirshekari et al. (2012) [16] and Rehman et al. (2012) [21] who reported priming enhanced buildup of nucleic acid, enhanced synthesis of protein.

### Table 6: Test weight (1000 seeds), protein content (percent) and oil content (per cent) at harvest stages of soybean as influenced macronutrients and priming treatments of micronutrients

| Tr. | Test weight (1000 seeds) | Protein content (percent) | Oil content (per cent) |
|-----|--------------------------|----------------------------|------------------------|
|     | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled | 2018 | 2019 | Pooled |
| T₁  | 120.00 | 118.33 | 119.17 | 27.91 | 30.90 | 29.41 | 15.76 | 14.92 | 15.34 |
| T₂  | 120.33 | 122.67 | 121.50 | 35.36 | 33.85 | 34.61 | 14.25 | 14.51 | 14.38 |
| T₃  | 126.00 | 123.67 | 124.83 | 38.73 | 36.37 | 37.55 | 15.22 | 15.50 | 15.21 |
| T₄  | 126.33 | 124.67 | 125.50 | 33.83 | 32.42 | 33.13 | 15.51 | 15.45 | 15.48 |
| T₅  | 125.33 | 124.33 | 124.83 | 37.71 | 36.30 | 37.01 | 14.84 | 15.10 | 14.97 |
| T₆  | 126.33 | 124.67 | 125.50 | 36.69 | 37.80 | 37.25 | 15.55 | 15.87 | 15.71 |
| T₇  | 131.33 | 124.00 | 127.67 | 37.92 | 37.93 | 37.92 | 15.64 | 15.75 | 15.70 |
| T₈  | 128.33 | 125.67 | 127.00 | 38.63 | 36.95 | 37.79 | 15.50 | 15.74 | 15.52 |
| T₉  | 130.67 | 127.67 | 129.17 | 37.81 | 33.51 | 35.66 | 15.62 | 15.77 | 15.70 |
| T₁₀ | 133.67 | 130.33 | 132.00 | 38.73 | 38.49 | 38.61 | 16.02 | 16.38 | 16.20 |
Oil content (per cent)
It is evidenced from the data presented in table 6. Oil content (per cent) soybean grain was found maximum in the seed priming treatment T₁₀ (16.02,16.38 and 16.20 per cent) receiving RDF + Zn + B + Mo + Fe+ S each @ 3g kg⁻¹ seed application was significantly superior over rest of all treatment and at par with treatments T₂, T₅, T₆, and T₇. While oil content (per cent) soybean grain was recorded lowest in treatment T₂ (14.25,14.51 and 14.38 per cent) receiving only RDF respectively in both year as well as pooled analysis. Due to dilution effect treatment T₁ absolute control higher value than T₂ receiving only RDF. However, increment was noted up to the extent of 12.65 percent with regards to oil content (per cent) in soybean grain in T₁₀ over T₁ absolute control. The increase in oil content with sulphur application might be due to the fact that sulphur helped in oil synthesis by enhancing the level of thiglugcosides Dwivedi and Bapat, (1998) [8]. The results are in conformity with the findings of Tahir et al. (2014) [20] these results are also in accordance with Pawel (2013) [20] in soybean.

Conclusion
It can be inferred and concluded that seed nutrient priming of micronutrient Zn + B + Mo + Fe+ S each @ 3g kg⁻¹seed with recommended dose of NPK (30:60:30 kg ha⁻¹) to soybean improved growth attributes, yield attributes and quality. So, seed nutrient priming is an attractive and easy alternative in supplying the micronutrient requirement to crops in time.

References
1. Arif M, Waqas M, Nawab K, Shahid M. Effect of seed priming in Zn solutions on chickpea and wheat African Crop Science Conference Proceedings 2007;8:237-240.
2. Arshad Javaid, Nasir M. Growth, nodulation and yield response of soybean to biofertilizer and organic manures. P. J Bot 2010;42(2):863-871.
3. Aylar Badiri, Bahram Mirshekari, Ebrahim Hadavi, Aidin Hamidi. Effect of seed priming with micronutrient on growth, seed yield and mucilage of plantain (Musa paradisiaca L) Intl J Agri Crop Sci 2013;5(5):1879-1883.
4. Kalpana Khan AH, Singh AK, Maurya KN, Mubeen R, Yadava K, Uma Singh AR et al. Effect of different seed priming treatments on germination, growth, biochemical changes and yield of Wheat varieties under sodic soil International Journal of Science and Research (IJSR) 2013;4(7):306-310.
5. Mahmood A, Kanwal H, Kausar A, Ilyas A, Akhter N, Ilyas M et al. Seed priming with zinc modulate growth, pigments and yield of chickpea (Cicer arietinum L.) under water deficit conditions. Applied ecology and Environmental Research 2019;17(1):147-160.
6. Mirshekari B, Sahar Baser, Shirin Allahyari, Nayer Hamedanlu. On farm seed priming with Zn+ Mn is an effective way to improve germination and yield of marigold African Journal of Microbiology Research 2012;6(28):5796-5800.
7. Monawar M, Ikram M, Iqbal M, MuzaffarRaza M, Habib S, Hammad Najeebullah M et al. Effect of seed priming with zinc, boron and manganese on seedling health in carrot (Daucus carota L.) Intl J Agri Crop Sci 2013;5(22):2697-2702.
8. Nauman Ali, Farooq M, Hassan MA, Arshad MS, Saleem MK, Faran M. Micronutrient seed priming improves stand establishment, grain yield and bio fortification of bread wheat Crop and Pasture Science 2018;69(5):479-487.
9. Pandey VG, Sukhatme PK. Statistical methods for agriculture workers, (IV Edn.) ICAR, New Delhi 1985, 145-156.
10. Pakkiran V, Talwar. Influence of seed coating with micronutrients on growth and yield of winter wheat in southeastern coastal plains. American Journal of Agricultural and Biological Sciences 2013;8(3):230-238.
11. Rehman A, Farooq M, Ahmad R, Basra SMA. Seed priming with zinc improves the germination and early seedling growth of wheat Seed Sci. & Technol 2015;43:262-268.
12. Reshma B, Sale, Nazirkar RB. Effect of micronutrients application on the growth traits and yield of soybean

| Treatment | Oil Content (per cent) |
|-----------|------------------------|
| T1        | 125.67                 |
| T2        | 123.33                 |
| T10       | 120.67                 |
| SE ±      | 2.705                  |
| CD at5%   | 7.985                  |
| GM        | 126.44                 |
|           | 128.00                 |
|           | 128.36                 |
|           | 126.83                 |
|           | 36.39                  |
|           | 35.32                  |
|           | 35.85                  |
|           | 14.35                  |
|           | 14.67                  |
|           | 14.51                  |

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[Glycine max (L.) Merill.] Under rainfed condition in Vertisol An Asian Journal of Soil Science 2013;8:422-425.

23. Sarker SK, Chaudhary MAH, Zakir HM. Sulphur and Boron fertilization on yield quality and nutrient uptake by Bangladesh Soybean-4. Online Journal of Biological Sciences 2002;2(11):729-733.

24. Tahir M, Irfan M, Rehman A. Effect of foliar application of zinc on yield and oil content of flax Pakistan J Agric. Res 2014;27(4):2014.