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Effect of Micronutrient Application through Seed Coating and Foliar Spraying on Growth and Seed Yield of Pigeonpea (*Cajanus cajan* L.)

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ABSTRACT: An experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Raichur to investigate the effect of micronutrient application as seed coating s and foliar spray, on growth and seed yield of pigeonpea during *kharif* 2014. The results revealed that among the different treatments seed polymer coating (6 ml/kg of seed) with potassium molybdate + $ZnSO_4$ + boron (each @ 2g / kg of seed) along with two foliar sprays of potassium molybdate (0.1 %) + zinc sulphate (0.5 %) in EDTA form + borax (0.2 %) at an interval of 10 days during flowering stage recorded significantly higher plant height, leaf area index, chlorophyll content, stomatal conductance and resistance, effective root nodules per plant, number of branches per plant, number of pods per plant, number of seeds per pod and seed yield as compared to control.

Key words: Foliar spray, micronutrients, pigeonpea, seed polymer coating, seed yield

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important protein rich legume of the semi-arid tropics grown predominantly under rainfed conditions of tropical and sub-tropical regions of the world. Globally it is grown in 5.2 million hectares with an annual production of 4.2 million tonnes [1]. India is the major pigeonpea growing country in the world, accounting for 3.88 million hectares with 3.29 million tonnes of production and 849 kg per hectares productivity with 18 per cent contribution to the total pulse production of the world [2]. In Karnataka, it occupies an area of 0.82 million hectares and 0.60 million tonnes production with a productivity of 733 kg per hectare [2]. Kalaburgi district of Karnataka is a favourable location for pigeonpea cultivation and is considered as *'Tur bowl'* of Karnataka.

Pigeonpea is cultivated for grain purpose as dhal which is a major source of protein for vegetarians. It has three times higher protein as compared to cereals. Besides being a rich source of protein, it also maintains soil fertility by improving physical properties of soil through biological nitrogen fixation in the soil and thus contributes significantly to sustainability of the farming systems. Despite the importance of pigeonpea in semi-arid regions of the world, the productivity is not at the desired level. A number of factors are responsible for the poor productivity among which, inadequate supply of micronutrients in addition to macronutrients is one of them. The deficiency of these micronutrients has been very pronounced under multiple cropping systems where high yielding varieties cause rapid depletion of soil nutrients and hence their exogenous supplies become essential.

Seed polymer coating is a sophisticated process of applying precise amount of active ingredients along with a liquid polymer directly on to the seed surface without obscuring its shape, seed size and weight. Thus, polymer forms a flexible film that adheres and protects the active ingredients,

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preventing the dusting off and loss of active ingredients during handling. This technology helps in precise and uniform application of fungicides, insecticides, bioagents, micronutrients, colours and other additives [3]. These micronutrients play an important role in increasing yield of pulses, oilseeds and legumes through their effects on the plant itself and on the nitrogen fixing symbiotic process.

With this background an experiment was carried out at MARS, UAS, Raichur with an objective to study the effect of seed polymer coating with micronutrients on growth and seed yield of pigeonpea. Foliar spray treatments were also applied for comparison.

MATERIALS AND METHODS

The experiment to study the influence of seed polymer coating along with foliar spray with micronutrients on growth and yield of pigeonpea variety TS-3R was conducted during *kharif* 2014-15 at Main Agricultural Research Station, College of Agriculture, University of Agricultural Sciences, Raichur. Geographically, the station is situated in the North-Eastern dry zone (Zone-2) of Karnataka State at 16° 15' North latitude and 77° 20' East longitude and at an altitude of 389 meter above mean sea level. The soil of the experimental site was deep black, clay in nature with 8.3 pH. The experiment consisted of sixteen treatments wherein three different micro nutrients namely potassium molybdate, $ZnSO_4$ and boron were used either individually or in combinations *viz.*, T_1: Potassium molybdate @ 2g per kg of seed, T_2: Potassium molybdate @ 4g per kg of seed, T_3: $ZnSO_4$ @ 2g per kg of seed, T_4: $ZnSO_4$ @ 4g per kg of seed, T_5: Boron @ 2g per kg of seed, T_6: Boron @ 4g per kg of seed, T_7: Potassium molybdate + $ZnSO_4$ (each @ 2g/kg of seed), T_8: Potassium molybdate + $ZnSO_4$ (each @ 4g/kg of seed), T_9: $ZnSO_4$ + Boron (each @ 2g/kg of seed), T_{10}: $ZnSO_4$ + Boron (each @ 4g/kg of seed), T_{11}: Potassium molybdate + Boron (each @ 2g/kg of seed), T_{12}: Potassium molybdate + Boron (each @ 4g/kg of seed), T_{13}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 2g/kg of seed), T_{14}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 4g/kg of seed), T_{15}: Only polymer and T_{16}: Absolute control. These micronutrients were coated to the seed by using 6 ml polymer (Disco Agro DC Red L-603 procured from Incotec Pvt. Ltd. Ahmedabad, Gujarat) after dissolving in 30 ml water per kg of seed (standardized in the preliminary experiment) in a rotary seed coating machine. The coated seeds were properly dried in shade and sown in three replications with randomized block design with spacing of 90 x 30 cm. In addition to seed polymer coating, two foliar sprays of micronutrients *viz.*, zinc sulphate (0.5%), potassium molybdate (0.1%) in EDTA form and borax (0.2%) in non EDTA form were given during flowering stage (75 and 85 DAS) at an interval of 10 days.

The various observations *viz.*, plant height, leaf area index, chlorophyll content, stomatal conductance and resistance, effective nodules per plant, number of branches per plant, number of pods per plant, number of seeds per pod, seed yield per plant and seed yield per hectare were recorded. For measurement of leaf area index, chlorophyll content, stomatal conductance and stomatal resistance AccuPAR 80 ceptometer, SPAD meter and leaf porometer (SC-1 porometer, Decagon Devices, Pullman, WA, USA), respectively were used. The research data was statistically analysed using standard procedure [4].

RESULTS AND DISCUSSION

The data on plant growth parameters *viz.*, plant height, leaf area index, chlorophyll content, stomatal conductance and resistance, effective nodules per plant and number of branches per plant are presented in Table 1. All the plant growth parameters differed significantly due to seed polymer coating with micronutrients and foliar spray. Among all the different treatments, T_{13} i.e. potassium molybdate + $ZnSO_4$ + boron (each @ 2g/kg of seed) along with two foliar sprays of potassium molybdate (0.1 %) + zinc sulphate (0.5 %) in EDTA form + borax (0.2 %) recorded significantly higher plant height (184.7 cm), leaf area index (2.91), chlorophyll content (71.47), stomatal conductance and resistance (860.7 M mol/m^2s and 2.21 m^2s/mol respectively) at 120 DAS, effective nodules per plant (10.15) at 60 DAS and number of branches per plant (58.20) at harvest as compared to the control (T_{16}).

This increase in plant growth parameters might be due to the effect of micronutrients present in the coating materials, which would have enhanced plant height, number of branches and higher number of effective nodules per plant as observed by Geeta Gowdar *et al.* [5] in soybean. Dinesh Chandra [6] also reported highest number of nodules in soybean due to the application of biofertilizer in conjunction with micronutrients *viz.*, (Zn+B+Mo). The activation of metabolic function of seed could also be due to hydrophilic polymer present in the coating material, which might have improved the rate of water uptake by the seeds leading to early germination and better seedling establishment as reported by Sherin *et al.* [7] in maize. The physiological functions of zinc and K^+ ion, in the opening and closing of the stomata, would have affected the CO_2 uptake and transpiration losses. Similarly, molybdenum in combination with Zinc also contributed to the higher stomatal conductance as reported earlier by Fois *et al.* [8] in wheat. The increase in chlorophyll content might be due to the enhanced production of phytochrome, which ultimately resulted in synthesis of chlorophyll by the additional supply of nutrients. Duyingqiong *et al.* [9] reported a similar increase in chlorophyll content and photosynthetic intensity in peanut leaves with the application of B or Mo or a combination of both.

The data on seed yield and its attributing characters *viz.*, number of pods per plant, number of seeds per pod, seed yield per plant and seed yield per hectare are presented in Table 2. Seed yield and its attributing characters were significantly influenced by seed polymer coating with micronutrients and foliar spray. Among all the treatments, T_{13} i.e. potassium molybdate + $ZnSO_4$ + boron (each @ 2g/kg of seed) along with two foliar sprays of potassium molybdate (0.1 %) + zinc sulphate (0.5 %) in EDTA form + borax (0.2 %) recorded significantly higher number of pods (193), number of seeds per pod (3.67), seed yield (62.80 g/plant and 16.30 q/ha) as compared to control (169, 2.93, 53.20 g, 13.86 q/ha respectively for above parameters). The increase in seed yield as a result of seed polymer coating with micronutrients and foliar spray might be attributed to the role played by micronutrients in activating dehydrogenase and other enzymes. These micronutrients are also necessary for the biosynthesis of IAA which is essential for normal enlargement of cells. It is also a constituent of amino acids, from which protein and enzymes are synthesised. The reason for the increased yield might also be due to the increased photosynthetic efficiency through stabilisation of chlorophyll, higher production of photosynthates resulting in increased translocation of nutrients from the source to sink in the treated plants. Similar findings were reported by Masuthi *et al.* [10] in cowpea and Dinesh Chandra [6] in soybean. Polymer present in the coating material might have also helped in higher rate of water uptake in turn resulted in the early germination with more seedling vigour and better stand establishment, which might have ultimately led to better growth, plant stand and productivity of pigeonpea and increase in plant height, number of pods per plant as a consequent of improvement in root growth and nodulation. Similar observations were reported by Sherin *et al.* [7] in maize.

From the results of this investigation, it can be concluded that seed polymer coating (6 ml per kg of seed) of pigeonpea seeds with the combination of micronutrients namely, potassium molybdate + $ZnSO_4$ + boron each at 2 g per kg of seed, along with two foliar sprays (0.1 % + 0.5 % + 0.2 % respectively, potassium molybdate and $ZnSO_4$ in EDTA form) at an interval of 10 days during flowering stage (75 and 85 DAS) could be advocated for better establishment of seedlings and higher seed yield.

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