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Effect of seed polymer coating with micronutrients and foliar spray on seed quality parameters of resultant seed in chickpea (*Cicer arietinum* L.)

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Abstract: A laboratory experiment was carried out in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur to study the effect of seed polymer coating with micronutrients and foliar spray on the resultant seed quality parameters of chickpea. Among the seventeen different treatments, resultant chickpea seeds obtained from treatment polymer coated seeds (each@ 6 ml/kg of seed) along with the combination of micronutrients *viz.*,$ZnSO_4$ + Boron + Ammonium molybdate + $FeSO_4$ (each @ 2 g/kg of seed) and two foliar sprays (0.5 % + 0.2 % + 0.1% + 0.5 %, respectively, except $ZnSO_4$ and $FeSO_4$ in EDTA form) at an interval of 10 days during flowering stage (50 and 60 days after sowing) recorded significantly highest hundred seed weight (25.9 g), germination (97.00 %), speed of germination (18.50), shoot length (8.43 cm), root length (19.80 cm), seedling dry weight (43.30 mg) and seedling vigour index (2738) compared to all other treatments and control (23.6 g, 92.05 %, 13.74, 5.48 cm, 16.30 cm, 34.00 mg and 2004, respectively) and hence above treatment combinations can be used in order to produce good quality seeds.

Keywords: Chickpea, Micronutrients, Polymer coating, Seed quality parameters

INTRODUCTION

Among the pulses, chickpea (*Cicer arietinum* L.) is a major crop, which is highly nutritious grain legume and one of the cheapest sources of energy and protein. But, the slow growth in pulse production compared to enormous increase in human population led to the progressive decline in the per capita availability of pulses. (Anonumous, 2010). In India, chickpea is grown in an area of 10.22 million hectares with a production of 9.88 million tonnes and an average productivity of 967 kg per hectare (Anon., 2014) which is far less to the world average productivity. In order to improve the productivity, it is necessary to supply the good quality seed to the farmers, as it is a proven fact that the productivity of many crops can be increased by 20-25 percent by mear use of high quality seed.

For optimum growth and development of crop plants, 17 elements are very much essential. These minerals, when required in relatively high amounts are called macronutrients or in trace amounts, micronutrients. Since, micronutrients are required in relatively smaller quantities for plant growth, they are as important as macronutrients (Farooq *et al*.,2012). They often act as co-factors in enzyme systems and participate in redox reactions and having several other vital functions in plants (Mengel *et al.*, 2001). Among the micronutrients, zinc, boron, ferrous sulphate and ammonium molybdate are very important for pulses as zinc is involved in biosynthesis of plant hormone and is a component of variety of enzymes like, carbonic anhydrase, alcohol dehydrogenase, glutamic dehydrogenase. It also plays an important role in nucleic acid and protein synthesis and helps in utilization of phosphorus and nitrogen in seed formation and development. Ferrous sulphate is another important micronutrient which is a constituent of chlorophyll biosynthesis, regulates respiration, photosynthesis, reduction of nitrates and sulphates and also activates several enzymes involved in respiration (Kaleeswari *et al*., 2013). While, boron plays an important role in flower retention, pollen tube growth, seed formation and seed setting and mainly involved in translocation of metabolites from source to sink (Tanaka and Fujiwar, 2008). While, molybdenum involved in nitrogen assimilation and helps root nodule bacteria to fix atmospheric nitrogen (Campo *et al.*, 2000).

These micronutrients may be supplied to the plants through soil application, foliar spray or seed treatment. Micronutrient application through seed treatments improves the stand establishment, advances phonological events and increases yield and micronutrient grain contents in many crops (Farooq *et al*, 2012). In many cases, micronutrient application through seed treatment performed better or similar to other application methods (Singh *et al.*, 2003). Being an easy and cost effective method, seed treatment by polymer coating along with foliar spray offer an attractive option for resource poor farmers through its pronounced effect during the early stage of seedling establishment (Johnson *et al.*, 2005) and seedling growth (Singh *et al.,* 2003). Keeping in view the above facts, the present investigation was carried with an objective to study the influence of seed coating with micronutrients and foliar spray on seed quality of the resultant seed of chickpea.

MATERIALS AND METHODS

An experiment was conducted in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur during the year 2014 to study the effect of seed polymer coating with micronutrients and foliar spray on seed quality parameters of the resultant seed of chickpea cultivar JG-11. The experiment consisted of seventeen different treatments which were imposed with different micronutrients either individually or in combination along with polymer (Disco Agro DC Red L-603 procured from Incotec Pvt. Ltd. Ahmedabad, Gujarat) @ 6 ml per kg of seed dissolved in 45 ml water in a rotary seed coating machine except control *viz.*,T_1: $ZnSO_4$ @ 2 g per kg of seed, T_2: $ZnSO_4$ @ 4 g per kg of seed, T_3: Boron @ 2 g per kg of seed, T_4: Boron @ 4 g per kg of seed, T_5: Ammonium molybdate @ 2 g per kg of seed, T_6: Ammonium molybdate @ 4 g per kg of seed, T_7: $FeSO_4$ @ 2 g per kg of seed, T_8: $FeSO_4$ @ 4 g per kg of seed, T_9: T_1 + T_3, T_{10}: T_1 + T_5, T_{11}: T_1 + T_7, T_{12}: T_3 + T_5, T_{13}: T_3 + T_7, T_{14}: T_5 + T_7, T_{15}: T_1 + T_3 + T_5 + T_7, T_{16}: Only polymer, T_{17}: Absolute control.The coated seeds were properly dried in shade to bring back their original moisture content and sown in the field following standard agronomic practices in a randomised bock design. During flowering stage (50 and 60 DAS) two foliar sprays at an interval of 10 days were given either individually or in combination as per the treatments ($ZnSO_4$ @ 0.5 % + Boron @ 0.2 % + Ammonium molybdate @ 0.1% + $FeSO_4$ @ 0.5 %, respectively, $ZnSO_4$ and $FeSO_4$ in EDTA form). At physiological maturity the seeds were harvested followed by proper threshing and drying and subjected for assessing various seed quality parameters *viz.*, seed germination percentage was worked out by putting 100 seeds each in four replications by following between paper method and the rolled towels were incubated in the walk in seed germinator maintained at 25 degree celcius with 90 percent relative humidity (ISTA, 1999), speed of germination was worked out (Maguire, 1962) by counting the number of seeds that geminated on daily basis up to the day of final count, shoot length, root length, seedling dry weight and vigour index was calculated as per the formula suggested (Abdul-Baki and Anderson, 1973). The data of the laboratory experiment were statistically analyzed by adopting completely randomized design as outlined by Sundararaj *et al*. (1972). The critical difference were calculated at one per cent level of probability, Wherever 'F' test was found significant for various seed quality parameter under study.

RESULTS AND DISCUSSION

The results obtained on various resultant seed quality parameters of chickpea obtained from seed polymer coated with micronutrients and foliar sprays after their harvest from the field are presented below:

100 seed weight (g): In the present study, significantly higher hundred seed weight (25.9 g) was recorded by the seed harvested from T_{15} treatment (seed polymer coating with 6 ml/kg along with combination of micronutrients namely, $ZnSO_4$ + Boron + Ammonium molybdate + $FeSO_4$ each at 2 g per kg of seed) along with two foliar sprays (0.5 % + 0.2 % + 0.1% + 0.5 %, respectively, except $ZnSO_4$ and $FeSO_4$ in EDTA form) at an interval of 10 days during flowering stage (50 and 60 DAS)) compared to all other treatments and control (23.6 g) (Table 1). This increase in hundred seed weight might be due to better seed filling as the micronutrients play an important role in pollen germination, seed development, cell division, translocation of sugar and starch from source to sink (Masuthi *et al.,* 2009). Similar results were reported by Umarani *et al.* (2003) in black gram by seed pelleting with DAP (40 g) + $ZnSO_4$ (100 mg) + $FeSO_4$ (100 mg) + ammonium molybdate (250 mg) using 10 per cent maida as an adhesive and Dixit and Elamathi (2007) in green gram due to foliar application of DAP (2%) + Napthelene acetic acid (40 ppm) + B (0.2%) + Mo (0.05%).

Seed germination (%): The seed germination (97.00 %) was significantly higher in the seeds harvested from T_{15} treatment compared to all other treatments and control (92.05 %) (Table 1) as it had supplied the required micronutrients for better seed development which in turn might have influenced the seed germination. Similarly, Harris *et al.,* (2008) demonstrated that the chick pea seed Zinc content was increased by 29 per cent through seed priming with Zinc sulphate over the control. Priming seeds in Zn solution increased grain Zn contents in , chickpea, lentil, rice and wheat (Johnson *et al.,* 2005). This is in turn dependent on the efficient synthesis, accumulation of food metabolites such as protein, carbohydrates and their translocation from source to the developing seed (sink) at greater ease (Shkolnik and Abdurashitov, 1958). Seed priming with Zn improved germination and seedling development in barely (Ajouri *et al.,* 2004). Similarly, Ozturk *et al.* (2006) studied the effect of foliar Zn application on the concentration of Zn in seeds of a bread wheat cultivar and found that after 36 hours of germination , the coleoptile and roots that emerged showed very intensive red colour formation and had Zn concentration up to 200 mg/kg indicating substantial remobilization of Zn from seed pools into the developing roots (radical) and coleoptile thus highlighting the involvement of Zn in physiological processes during early

Table 1. Influence of seed polymer coating with micronutrients and foliar spray on resultant seed quality parameters.

Treatments	100 seed weight (g)	Germination (%)	Speed of germination	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)	Seedling vigour index
T_1	24.5	93.30	15.80	6.40	17.50	35.30	2228
T_2	25.1	94.80	16.55	6.60	17.98	38.00	2330
T_3	24.5	93.05	15.61	6.23	16.93	35.00	2154
T_4	25.1	94.30	16.47	6.53	18.03	37.80	2315
T_5	23.8	93.05	15.08	6.10	16.70	34.50	2121
T_6	24.8	94.30	16.27	6.48	17.78	37.50	2287
T_7	23.6	93.30	14.70	5.60	16.63	34.30	2072
T_8	24.5	94.05	16.02	6.48	17.60	36.80	2265
T_9	25.8	96.05	17.36	7.55	19.13	41.00	2562
T_{10}	25.8	95.80	17.29	7.40	18.60	40.80	2489
T_{11}	25.5	95.50	16.70	7.18	18.30	40.00	2432
T_{12}	25.7	95.55	16.84	7.33	18.50	40.50	2468
T_{13}	25.4	94.80	16.56	7.00	18.25	39.00	2394
T_{14}	25.3	95.05	16.55	6.75	18.27	38.00	2375
T_{15}	25.9	97.00	18.50	8.43	19.80	43.30	2738
T_{16}	24.2	93.30	15.61	6.18	16.70	34.80	2133
T_{17}	23.6	92.05	13.74	5.48	16.30	34.00	2004
Mean	24.9	94.43	16.22	6.69	17.82	37.70	2316
S.Em.±	0.1	0.50	0.38	0.20	0.42	12.00	50
CD @ 1 %	0.4	1.50	1.09	0.58	1.19	33.00	142

Control (T_{17})

Micronutrient treatment (T_{15})

Plate 1. *Influence of micronutrients on seedling vigour of the resultant seed in chickpea.*

seedling development, possibly in protein synthesis, cell elongation membrane function and resistance to abiotic stresses (Cakmak, 2000). In addition, higher seed Zn contents may better resist invasion of soil-borne pathogens during germination and seedling development thus ensuring good crop stand (Marschner, 1995). Kaur *et al.* (2009) also reported improved germination of *Chlorophytum borivilianum* (L.) from seeds soaked in Zn ($ZnSO_4$) for 12 h. Substantial improvement in germination and early seedling growth was observed when seeds of papaya were primed in 2 mg per litre B solution for 6 h (Deb *et al.,* 2010). However, Rahman *et al.,* (2014) did not find any significant variation in seed germination due to seed treatment with boron (2 g/kg of seed) and molybdenum (1 g/kg seed) in chickpea.

Speed of germination: Among the treatments, significantly higher speed of germination (18.50) was recorded by T_{15} compared to all other treatments and control (13.74) (Table 1). This could be due to the activation of cells, which might have resulted in the enhancement of mitochondrial activity leading to the formation of high energy compounds and vital biomolecules, which were made available during early phase of germination (Dharmalingam *et al.,* 1998) and also due to nitrogen containing compound that might have stimulated the speed of germination with the increase in the seed cytokine content, which interact with growth inhibitors and enhance metabolic process leading to higher speed of germination. Similarly, Kavitha (2002) also reported that, seed with higher initial capital food reserve (test weight) always showed rapid and faster germination.

Shoot and root length (cm): Similarly, significantly higher shoot and root length (8.43 cm and 19.80 cm, respectively) were recorded from the seeds that were harvested from T_{15} treatment compared to all other treatments and control (5.48 cm and 16.30 cm, respectively) (Table 1). This might be due to increased metabolic activity of indole acetic acid and auxin (Krishnasamy, 2003) through the micronutrients and its translocation leading to faster cell division and elongation leading to increase in root and shoot length. Similar results were also reported by Srimathi *et al.* (2007) in green gram due to hardening with $MnSO_4$ (100 ppm) and *prosopis* leaf extract (1%) + pelleting with DAP (40 g) + $MnSO_4$ (100 mg) + $FeSO_4$ (100 mg) + ammonium molybdate (250 mg) per kg of seed and Harish Babu *et al.,* (2005) by pelleting green gram seeds with micronutrient mixture (2 % iron + 1% manganese + 3 % zinc + 0.5 % boron).

Seedling dry weight (mg) and seedling vigour index: Among the different treatments, significantly higher seedling dry weight (43.3 mg) was recorded by T_{15} as compared to all other treatments and control (34.0 mg). This could be due to better seedling length (root + shoot) as well as enhanced lipid utilization through glyoxylate cycle, a primitive pathway leading to faster growth and development of seedling to reach autotrophic stage well in advance of others and enabling them to produce relatively more quantity of dry matter (Jayaraj, 1997) and finally resulted in significantly higher seedling vigour index (2738) compared to other treatments (Table 1 and Plate 1) and untreated control (2004). Similar results were reported by Harish Babu *et al.,* (2005) by pelleting green gram seeds with micronutrient mixture (2 % Fe+ 1% Mn + 3 % Zn + 0.5 % B) and Srimathi *et al.* (2007) by hardening green gram seeds with $MnSO_4$ (100 ppm) and *prosopis* leaf extract (1%) + pelleting with DAP (40 g) + $MnSO_4$ (100 mg) + $FeSO_4$ (100 mg) + ammonium molybdate (250 mg) per kg seeds, Kavitha (2002) in blackgram seeds hardened with *prosopis* leaf extract (1%) followed by pelleting with 40 g DAP + 100 mg $ZnSO_4$ + 100 mg $FeSO_4$ + 250 mg ammonium molybdate per kg of seed. Similarly, Deepika and Pitagi (2015) reported higher seedling dry weight (5.07 mg) of the resultant seed with the combination of RDF + $ZnSO_4$ @ 10 kg per ha + Borax @ 0.1% spray at bud initiation stage in radish. However, Rahman *et al.*, (2014) did not find any significant variation in seedling dry weight and vigour index due to seed treatment with boron (2 g/kg seed) and molybdenum (1 g/kg seed) in chickpea.

Conclusion

Polymer coating (@ 6 ml/kg) of chickpea seeds along with $ZnSO_4$ + Boron + Ammonium molybdate + $FeSO_4$ (each @ 2 g/kg of seeds) with two foliar sprays (0.5 % + 0.2 % + 0.1% + 0.5 %, respectively, except $ZnSO_4$ and $FeSO_4$ in EDTA form) at an interval of 10 days during flowering stage (50 and 60 days after sowing) resulted in significant increase in hundred seed weight (25.9 g), germination (97.00 %), speed of germination (18.50), shoot length (8.43 cm), root length (19.80 cm), seedling dry weight (43.30 mg) and seedling vigour index (2738) compared to other treatments and control (23.6 g, 92.05 %, 13.74, 5.48 cm, 16.30 cm, 34.00 mg and 2004, respectively). Hence, the seed producing organizations can use this technology for suppling the micronutirnets to the seed during early seed germination which helps in better germination with high vigour.

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