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Influence of Seed Polymer Coating with Micronutrients and Foliar Spray on resultant Seed Quality Parameters of Pigeonpea (*Cajanus cajan* L.)

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ABSTRACT

The field and laboratory experiments were conducted at Main Agricultural Research Station, University of Agricultural Sciences, Raichur to study the influence of seed polymer coating with micronutrients and foliar spray on resultant seed quality parameters of pigeonpea. The experiment consisted of sixteen different seed polymer coating and foliar spray treatments with various combinations of potassium molybdate, $ZnSO_4$, boron including control. Among the different treatments imposed, seed polymer coating (@ 6 ml/kg) of pigeonpea seeds with the combination of 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 (75 and 85 DAS) recorded significantly higher germination , speed of germination , test weight (g), shoot length (cm), root length (cm) , seedling dry weight (mg/seedling) and seedling vigour index (SVI) as compared to control.

Key words: *Foliar spray, Micronutrients, Pigeonpea, Seed polymerization, Seed quality.*

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is a backbone of nutritional security of our country. India has virtual monopoly in its production by bagging 80 per cent of world's total production. Pigeonpea like other pulses is considered a subsidiary crop. It is often grown on marginal lands and is usually intercropped with crops as sorghum and cotton, etc. as a crop of secondary importance in many of these systems; it receives little or no purchased inputs. However, farmers in some red gram growing areas are growing more sole crops of pigeonpea and the crop is increasingly gaining status as a cash crop. Pigeonpea is mainly cultivated and consumed in developing countries of the world. This crop is widely grown in India. India is the largest producer of pigeonpea accounting for 3.90 million hectares of growing area with 2.71 million tonnes of production and 813 kg per hectares productivity.

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In Karnataka, it occupies an area of 0.71 million hectares and 0.50 million tonnes production with a productivity of 712 kg per hectare[1]. Kalaburgi is very potential district of the state for pigeonpea cultivation which is considered as '*Tur bowl*' of Karnataka.

Pigeonpea is a protein rich staple food. It contains about 22 percent protein, which is almost three times that of cereals. Pigeonpea supplies a major share of protein requirement of vegetarian population of the country. It is mainly consumed in the form of split pulse as Dal and particularly rich in lysine, riboflavin, thiamine, niacin and iron. Besides being a rich source of protein, it also maintains soil fertility by improving physical properties of soil through biological nitrogen fixation in 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 of crop 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 due to excess removal by high yielding varieties and hence their exogenous supplies are urgently required.

Seed quality enhancement techniques include three different aspects *viz.*, pre-sowing hydration treatment, coating techniques and seed pelleting. Seed polymer coating (polymerization) is a technique wherein, any substance applied to the seed does not obscure or change its shape. The film is readily water soluble (hydrophilic) so as not to impede seed germination. The major benefit of seed polymerization (polymer coating) is that the seed enhancement material *viz.*, fungicide, microbiological treatment, micronutrients *etc.*, can be placed directly on to the seed preventing dusting off and loss of added chemicals during handling[2]. In this method small quantity of chemicals or micronutrients are needed as compared to soil application or foliar spray. Seed polymerization is one of the most economical approaches for improving seed performance[2].

With this background, field and laboratory experiments were carried out at MARS, UAS, Raichur with an objective to study the ''Influence of Seed Polymer Coating with Micronutrients and Foliar Spray on resultant Seed Quality Parameters of Pigeonpea''.

MATERIALS AND METHODS

The experiment was conducted during *kharif* 2014 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 and 8.3 pH. The experiment consisted of 16 different treatments *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 laid out in randomized block design with three replications.

The seeds of pigeonpea variety TS 3R were sown with a spacing of 90 cm between rows and 30 cm between plants with the plot size was 9.0 x 4.8 m^2. The fresh seeds of pigeonpea were treated with different micronutrients as per above treatments through seed polymerization by coating 6 ml polymer per kg of seed which was standardized from laboratory experiment using rotary seed coating machine and the coated seeds were properly dried under shade. In addition to seed polymerization, 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 either individually or in combination as per the treatments.

The various observations of seed quality parameters *viz.,* germination percentage, speed of germination, test weight (g), shoot length (cm), root length (cm), seedling dry weight (mg/seedling), seedling vigour index I (SVI), seedling vigour index II (SVI) of resultant seeds were recorded at Main Agricultural Research Station, University of Agricultural Sciences, Raichur. The research data was statistically analysed by adopting the procedure prescribed by Panse and Sukhatme[3].

RESULTS AND DISCUSSION

The data on seed quality parameters *viz.*, germination percentage, speed of germination, test weight (g), shoot length (cm), root length (cm), seedling dry weight (mg/seedling), seedling vigour index I (SVI) and seedling vigour index II (SVI) of resultant seeds are presented in Table 1, 2 and 3. All the seed quality parameters of resultant seeds differed significantly due to seed polymerization (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 germination (96.20 %), speed of germination (29.47) (Table 1) as compared to control [(87.00 %, 20.00 respectively].

This is having a positive relation to seed development which is reflected through the size, test weight of seed and the micronutrients present in it. This in turn dependant on efficient synthesis, accumulation of food metabolites such as protein, carbohydrates and their translocation from source to the developing seed at greater ease. Seed with higher initial capital food reserves always showed higher and rapid germination which is also true in present study. Similarly, the micronutrients also participate in catalytic activity and breakdown of complex food source to simple form (glucose, amino acids and fatty acids). These in turn reflected on enhancing the rate of germination and elongation of root and shoot. Similar results were reported by Kavitha *et al.* (2002) in black gram as seeds hardened and pelleting with 40 g DAP + 100 mg $ZnSO_4$ + 100 mg $FeSO_4$ + 250 mg ammonium molybdate per kg of seed[4], Vijaya and Ponnuswamy (1998) in black gram with combined application of $ZnSO_4$ (0.2%) + $MnSO_4$ (0.2%) + Na_2MO_4 (0.1%) per kg of seed[5] and Masuthi *et al*. (2009) with Zinc+Boron+Arappu leaf powder in cowpea[6].

From the study, increased speed of germination could be ascribed to activation of cells, which results in the enhancement of mitochondrial activity leading to the formation of high energy compounds and vital biomolecules, which were made available during the early phase of germination (Dharmalingam *et al.* 1998)[7] and nitrogen containing compound that might have stimulated speed of germination with increase in seed cytokinin content, occurring naturally in seeds which interact with growth inhibitors and enhance metabolic process and finally, leading to higher speed of germination.

Significantly highest test weight of 13.78 g (Table 1) was recorded by T_{13} as compared to all other treatments and control (11.94 g) due to seed polymerization and foliar spray with micronutrients. This increase in test weight of seed might be due to combined effect of micronutrients which might have influenced pollen germination, seed development, cell division, translocation of sugar and starch from source to sink, thereby resulted in increased test weight. Similar results were reported by Pradeep and Elamathi (2007) in green gram due to foliar application of DAP (2%) + NAA (40 ppm) + B (0.2%) + Mo (0.05%)[8].

Significantly maximum shoot and root length (14.47 cm, 16.27 cm) (Table 2) were recorded by the treatment T_{13} as compared to control (12.25 cm, 13.90 cm) i.e., T_{16}. The increased shoot and root length might be due to seeds with higher test weight shall have higher germination potential and seedling growth, this intern might have increased the metabolic activity of indole acetic acid and auxin (Basaria Begam and Krishnasamy, 2003) through micronutrients and its translocation leading to early germination, cell division and elongation leading to increase in root and shoot length[9]. Similar results were reported by Srimathi *et al*. (2007) in green gram due to combined application of $MnSO_4$ hardening at the rate of 100 ppm and hardening with 1 per cent *Prosopis* leaf extract + pelleting with DAP (40 g) + $MnSO_4$ (100 mg) + $FeSO_4$ (100 mg) + ammonium molybdate (250 mg) per kg of seed[10] and Harish Babu *et al*. (2005) in green gram seeds pelleted with micronutrient mixture (2 % iron + 1% manganese + 3 % zinc + 0.5 % boron)[11].

Among the different treatments, significantly higher Seedling dry weight (90.33 mg) (Table 2) was recorded in T_{13}. While, the lower seedling dry weight **(**73.23 mg) was recorded in the control (T_{16}). This increase in seedling dry weight was due to better seedling length and also greater vigour reflected in early stage and higher percentage of germination of seeds that had reached autotrophic stage well in advance than others. Increase in dry weight might further be enhanced due to enhanced lipid utilisation through glyoxalate cycle, a primitive metabolic pathway thereby, facilitating the conversion of acetate into nucleic acid (Sherin Susan *et al*., 2005)[12]. As a result of improved germination percentage, seedling length and seedling dry weight due to imposed treatments the seedling vigour index I and II differed significantly. However, among the treatments significantly highest Seedling vigour index I and II were (2956 and 8690) (Table 3) recorded in the treatment $T_{13.}$ While, the lowest seedling vigour index I and II were (2275 and 6371) recorded in control (T_{16}).

The present study also revealed that seed polymerization with boron at the rate of 4g per kg of seed enhanced the seed germination percentage and seedling vigour compared to only polymer and control but the effect was comparatively less when compared to other treatments. It was due to the toxic effect of boron when used in excess affect the seed germination negatively. Similarly, Ajouri *et al.,* (2004) reported the negative effect of boron on seed germination of barley when the concentration of boric acid exceeded 0.04 M[13].

From the results of this investigation, it can be concluded that seed polymerization (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 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 germination and vigour of pigeonpea seeds.

Table 1: Influence of seed polymer coating with micronutrients and foliar spray on germination percentage, speed of germination and test weight of resultant seeds of pigeonpea

Treatment	Germination (%)	Speed of germination	Test weight (g)
T_1: Potassium molybdate @ 2g per kg of seed	89.00 (70.63)	24.10	12.75
T_2: Potassium molybdate @ 4g per kg of seed	90.37 (71.93)	24.37	13.04
T_3: $ZnSO_4$ @ 2g per kg of seed	87.83 (69.60)	23.58	12.11
T_4: $ZnSO_4$ @ 4g per kg of seed	88.40 (70.09)	23.37	12.69
T_5: Boron @ 2g per kg of seed	85.00 (67.22)	23.00	12.23
T_6: Boron @ 4g per kg of seed	84.00 (66.45)	23.13	12.64
T_7: Potassium molybdate + $ZnSO_4$ (each @ 2g / kg of seed)	91.50 (73.05)	26.33	13.21
T_8: Potassium molybdate + $ZnSO_4$ (each @ 4g / kg of seed)	91.33 (72.88)	26.45	13.25
T_9: $ZnSO_4$ + Boron (each @ 2g / kg of seed)	91.17 (72.72)	26.13	13.20
T_{10}: $ZnSO_4$ + Boron (each @ 4g / kg of seed)	90.83 (72.52)	25.48	12.96
T_{11}: Potassium molybdate + Boron (each @ 2g / kg of seed)	92.00 (73.59)	27.08	13.21
T_{12}: Potassium molybdate + Boron (each @ 4g / kg of seed)	91.83 (73.44)	27.10	13.23
T_{13}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 2g / kg of seed)	96.20 (78.79)	29.47	13.78
T_{14}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 4g / kg of seed)	92.00 (73.59)	27.14	13.24
T_{15}: Only polymer	89.43 (71.03)	22.10	12.05
T_{16}: Absolute Control	87.00 (68.87)	20.00	11.94
Mean	**89.87 (71.65)**	**24.93**	**12.84**
S.Em.±	0.65	0.63	0.16
CD (P = 0.05)	1.87	1.82	0.46

Figures in the parenthesis indicate arcsine transformed values

Table 2: Influence of seed polymer coating with micronutrients and foliar spray on shoot length, root length and seedling dry weight of resultant seeds of pigeonpea

Treatment	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)
T_1: Potassium molybdate @ 2g per kg of seed	12.51	14.64	76.90
T_2: Potassium molybdate @ 4g per kg of seed	12.57	14.91	79.37
T_3: $ZnSO_4$ @ 2g per kg of seed	12.39	14.33	76.60
T_4: $ZnSO_4$ @ 4g per kg of seed	12.47	14.87	78.67
T_5: Boron @ 2g per kg of seed	12.37	14.21	75.97
T_6: Boron @ 4g per kg of seed	12.32	14.18	75.45
T_7: Potassium molybdate + $ZnSO_4$ (each @ 2g / kg of seed)	13.23	15.20	84.32
T_8: Potassium molybdate + $ZnSO_4$ (each @ 4g / kg of seed)	13.17	15.16	82.00
T_9: $ZnSO_4$ + Boron (each @ 2g / kg of seed)	13.10	15.04	83.30
T_{10}: $ZnSO_4$ + Boron (each @ 4g / kg of seed)	12.90	14.95	80.20
T_{11}: Potassium molybdate + Boron (each @ 2g / kg of seed)	13.63	15.46	86.60
T_{12}: Potassium molybdate + Boron (each @ 4g / kg of seed)	13.53	15.22	84.57
T_{13}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 2g / kg of seed)	14.47	16.27	90.33
T_{14}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 4g / kg of seed)	13.33	15.42	84.90
T_{15}: Only polymer	12.28	15.00	73.60
T_{16}: Absolute Control	12.25	13.90	73.23
Mean	**12.91**	**14.92**	**80.38**
S.Em.±	0.19	0.16	0.68
CD (P = 0.05)	0.55	0.45	1.95

Table 3: Influence of seed polymer coating with micronutrients and foliar spray on seedling vigour index of resultant seeds of pigeonpea

Treatment	SVI-I	SVI-II
T_1: Potassium molybdate @ 2g per kg of seed	2416	6844
T_2: Potassium molybdate @ 4g per kg of seed	2483	7172
T_3: $ZnSO_4$ @ 2g per kg of seed	2347	6729
T_4: $ZnSO_4$ @ 4g per kg of seed	2417	6954
T_5: Boron @ 2g per kg of seed	2259	6457
T_6: Boron @ 4g per kg of seed	2226	6338
T_7: Potassium molybdate + $ZnSO_4$ (each @ 2g / kg of seed)	2601	7715
T_8: Potassium molybdate + $ZnSO_4$ (each @ 4g / kg of seed)	2587	7490
T_9: $ZnSO_4$ + Boron (each @ 2g / kg of seed)	2566	7595
T_{10}: $ZnSO_4$ + Boron (each @ 4g / kg of seed)	2530	7284
T_{11}: Potassium molybdate + Boron (each @ 2g / kg of seed)	2676	7967
T_{12}: Potassium molybdate + Boron (each @ 4g / kg of seed)	2641	7766
T_{13}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 2g / kg of seed)	2956	8690
T_{14}: Potassium molybdate + $ZnSO_4$ + Boron (each @ 4g / kg of seed)	2645	7811
T_{15}: Only polymer	2440	6582
T_{16}: Absolute Control	2275	6371
Mean	**2504**	**7235**
S.Em.±	28.93	80.94
CD (P = 0.05)	83.34	233.1

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