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Standardize the optimum dosage of polymer for soybean (*Glycine max* L. Merril) seed quality

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Abstract
An experiment was undertaken to standardize the optimum dosage of polymer (L-200 red) for seed coating in soybean cv. JS 335 with 11 treatments (1 to 10 ml) including control. The coated seeds were then used for analysis various seed quality parameters. From the present study it was observed that soybean seeds coated with red polymer at 5 ml per kg of seeds recorded significantly higher germination percentage (90.67 %), speed of germination (42.33), peak value germination (37.47), shoot length (16.73 cm), root length (16.67 cm), seedling dry weight (415.0 mg), speed of germination (42.33) seedling vigour index-I (3027) and seedling vigour index-II (37618) compared to all other treatments and control (79.33 %, 31.97, 30.50, 12.10, 12.98, 324.67, 1989 and 25753, respectively).

Keywords: polymer, soybean, dosage, seed quality

Introduction
Soybean (*Glycine max*. L) is an important oil seed crop in the world contributing 25 per cent to the global vegetable oil production and also serving as a major source of protein (40%) and oil (20%) for both human and animal consumption. Globally, it is grown in an area of about 78.6 m. ha with a production of 181 m. tones and productivity of 2297 kg per ha. Though it is comparatively new crop to India, it occupies an area of 10.80 m. ha with a production of 14.66 m. A seed coating with polymer is the substance applied to the seed that does not obscure its shape. Seed coating can be done along with fungicides. The major benefit of seed coating is that the seed enhancement material is placed directly on to the seed. Smaller amount of chemicals are needed as compared to broadcasting or surface dressing onto the growing medium. Seed coating is one of the most economical approach for improving crop performance. Polymer products can be added to the standard slurry treatment. They are compatible with the fungicides and insecticides commonly used in seed treatment. The polymer products can be used at near full strength or can be diluted with 1-4 parts water plus seed treatment chemicals. They contain excellent surfactants and spreaders and have a very quick drying time.

Seed coats encompassing surface film, colouring, pelleting and invigoration have been accepted as an important quality enhancing input. Field crops, including maize (*Zea mays* L.), oilseed rape (*Brassica* sp) and sunflower (*Helianthus annuus* L.) are now being treated with film coatings in Europe and there is much interest in its application to these crops in USA and several other countries. Pandey *et al.* (2005) [9] reported the effects of polymer coating on soybean (*Glycine max* L. Merrl.) and maize seed for seed quality enhancement. A reduced rate of water uptake and controlled water vapour movement into the seeds during storage could be achieved by coating the seeds with hydrophobic polymers. Therefore polymeric coatings allow the storage of the seeds required from harvest to sowing or planting (Kavak and Benian 2004) [7].

The poor storability of soybean seeds is accounted for high oil content, physiological fragility and thin seed coat, which leads to rapid loss of viability and vigour in storage. This in turn results in poor establishment of the crop in the field and low productivity. Seed deterioration is an irreversible, inexorable and inevitable process. But the rate of seed deterioration could be slowed down either by storing the seeds under controlled conditions or by imposing seed treatment with polymer coating along with seed treatment chemicals (Duan and Burris 1997) [3]. As the controlled condition involves the huge cost, seed treatment remains the best alternative approach to maintain seed quality. Hence the present investigation was undertaken standardize the optimise the polymer dose for seed coating of soybean.

Material and Methods
Certified seeds of soybean cv. JS 335 produced during *kharif* 2016-17 at Seed Unit, Bidar, University of Agricultural Sciences, Raichur, were size graded and utilised for the present study. The seeds were coated with red polymer (L-200) at various dosages 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 ml per kg of seed were dissolves in 10 ml of water and seed in a rotary seed treatment. Utmost care was taken during mixing to have uniformity in coating and the seeds were air dried under shade for 24 h to bring back to its original moisture content. The experiment was designed in a completely randomized design with three replications. The polymer coated seeds were used for assessing various seed quality parameters.
The germination test was conducted as per ISTA (Anon., 2014) [2] using between paper method. The number of normal seedlings counted at the end of eight day of and expressed as seed germination in percentage (%). The speed of germination was worked out by the following formula suggested by (Maguire, 1962) [8].

Speed of germination= $[G_1/D_1 + G_2/D_2 + \ldots\ldots + Gn/Dn]$

Where, n= number of seeds germinated on day (d). D= serial number of days
G_1: Germination percentage × 100 on 1st day
G_n: Germination percentage × 100 on the nth day

The peak value of germination was taken from numbers of seeds germinated were recorded on daily basis up to the day of final count (8th day). The peak value is the cumulative germination percentage for each unit on its peak day divided by the number of days to reach that percentage. It was calculated by the formula proposed by Gairola *et al.* (2011) [4].

$$\text{Peak value of germination} = \frac{\text{Highest number of seeds germinated}}{\text{Number of days}}$$

Number of days
Ten normal seedlings were selected at random on eight day of germination test and the root and shoot lengths were measured and mean was calculated and expressed in centimetres (cm). The same ten seedlings were dried in hot air oven at 80 ^{0}C for 24 hours and cooled in desiccators for 30 min and weight of the dry seedlings was recorded using electronic balance and was expressed in gram (g) per seedling. The vigour index I was calculated using the formula VI I = (Mean root length + Mean shoot length) (cm) x Germination (%) was suggested by Abdul-Baki and Anderson (1973) [1]. The vigour index II was calculated using the formula VI II = Seedling dry weight (mg) x Germination (%).

Results and Discussion
The present study clearly revealed that seeds coated with red polymer @ 5 ml kg^{-1} as slurry coating improved the seed quality compared to control. In terms of uniformity in coating, the physical appearance of slurry coated seeds was found to be better. When the seeds were coated with polykote as slurry coating, the seed moisture content was increased with quantity of water used to dissolve the polykote.
The results showed that the germination (%), shoot length (cm), root length (cm), total seedling length (cm), seedling dry weight (mg), seedling vigour index, and germination rate index were significantly influenced by polymer coating.
All the seed quality parameters showed a significant variation due to seed coating with polymer. Among the different polymer dosages, the seeds coated with polymer at (5 ml polymer kg^{-1} of seed) (P_5) recorded significantly highest seed germination (90.67 %) followed by P_6 (6 ml polymer kg^{-1} of seed) (85.33 %) treatment, whereas, lowest germination was recorded in control (79.33 %) (P_0) (Table 1). Other quality parameters like highest peak value (37.47) and speed of germination (42.33) were recorded with P_5 treatment (5 ml kg^{-1} of seeds) compared to control (30.50 and 31.97 respectively) and it was followed by P_6 treatment (6 ml kg^{-1} of seeds), which recorded (34.33 and 37.87, respectively). The increase in germination percentage might be due to the hydrophilic nature of the polymer that has increased the imbibition rate which led to faster activation of cells and resulted in enhancement of mitochondrial activity leading to the formation of more high energy compounds and vital bio molecules, which were made available during the early phase of germination and reduced imbibitional damage by regulating the water uptake. These findings are in agreement with those of earlier researchers in soybean (Imran Baig, 2005) [6]. Similarly, the seedling length differed significantly due to polymer coating. Among the polymer coating, the seeds coated with polymer @ 5 ml per kg of seed (P_5) recorded significantly higher shoot length (16.73 cm) and root length (16.67 cm) as compared to control (12.98 cm and 12.10 cm) (Table 1). This increase in total seedling length may be due to increase in shoot length and root length. This might be due to the beneficial effect of polymer which enhanced metabolic activities in early phase of germination and thereby better seedling growth was observed. These findings were in line with the reports of Suma and Srimathi (2014) [11] in sesamum with polymer @ 4 g per kg of seed and Sherin *et al.* (2005) [10] in maize with polymer @ 3 g per kg of seed. The seedling dry weight differed significantly due to seed coating with polymer. The seedling dry weight which is directly dependent on the total seedling length (shoot and root length) and significantly higher seedling dry weight was noticed with the seeds treated with polymer @ 5 ml per kg of seed (P_5) (415.00 mg) and was superior over control (P_0) which recorded the minimum seedling dry weight (324.67 mg) as indicated in Table 1. The possible reason may be the influence of polymer on seed germination and seedling length. The results are in agreement with the findings of Vijaykumar *et al.* (2007) [13] in cotton.
The seedling vigour index is the most important aspect of seed quality as it decides the vigour level or performance of a seed. Significantly highest seedling vigour index I (3027) and seedling vigour index II (37618) was recorded in P_5 (5 ml polymer kg^{-1} of seed). While, the lowest seedling vigour index I (1989) and II (25753) were observed in control (P_0). The beneficial effect of polymer coating might be the reason for better seedling growth and vigour. It might be also due to enhanced metabolic activities in early phases of germination. Similar results were also obtained by Geetharani (2006) [6] in chilli, Vinodkumar *et al.* (2013) [14] in pigeon pea, Suma and Srimathi (2014) [11] in sesame and Verma and Verma (2014) [12] in soybean.

Table 1: Standardization of seed film coating polymer in soybean.

Treatments	Germination (%)	Speed of germination	Peak value of germination	Root length (cm)	Shoot length (cm)	Seedling dry weight (mg)	Seedling vigour index-I	Seedling vigour index-II
P_0 (Control)	79.33 (62.97)*	31.97	30.50	12.10	12.98	324.67	1989	25753
P_1 (Polymer @ 1ml)	82.67 (65.42)*	32.89	31.17	12.53	13.89	354.67	2183	29298
P_2 (Polymer @ 2ml)	83.00 (65.66)*	33.81	31.83	12.93	13.93	364.33	2229	30234
P_3 (Polymer @ 3ml)	83.33 (65.99)*	36.48	33.67	14.23	15.02	376.67	2439	31379
P_4 (Polymer @ 4ml)	85.00 (67.28)*	37.58	34.00	14.67	15.23	381.00	2543	32386
P_5 (Polymer @ 5ml)	90.67 (72.23)*	42.33	37.47	16.67	16.73	415.00	3027	37618
P_6 (Polymer @ 6ml)	85.33 (67.53)*	37.87	34.33	15.32	15.56	392.33	2634	33463
P_7 (Polymer @ 7ml)	85.00 (67.31)*	37.22	33.83	14.60	15.34	387.67	2544	32930
P_8 (Polymer @ 8ml)	84.00 (66.53)*	36.64	33.33	14.07	14.90	374.67	2430	31463
P_9 (Polymer @ 9ml)	82.00 (64.91)*	35.86	32.83	13.87	14.38	371.00	2316	30419
P_{10} (Polymer @ 10ml)	81.00 (64.16)*	35.78	32.17	13.87	14.16	363.67	2270	29457
Mean	83.76 (66.36)*	36.22	33.19	14.08	14.74	373.24	2419	31309
S.Em ±	1.14	0.78	0.72	0.32	0.29	6.26	52.32	541.14
CD at 1%	4.56	3.11	2.86	1.29	1.15	24.95	208.56	2157.16

Conclusion

The present investigation revealed that the seed coated with red polymer (L-200) @ 5 ml per kg seed is found more ideal and effective dosage for getting better germination and vigour index in soybean.

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