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Effects of polymer seed coating and seed treatment on plant growth, seed yield and quality of Cowpea (*Vigna unguiculata)*

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Abstract
The experiment was conducted to study the Effects of polymer seed coating and seed treatment on plant growth, seed yield and quality of Cowpea (*Vigna unguiculata)*. Field experiment was conducted at Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Uttar Pradesh during kharif 2016-17. The experiment consisting of 9 treatments, 3 replications with 2 cowpea varieties (Kashi Kanchana and Kashi Unnati) were laid out in randomized block design. The results of the present investigation revealed that T7 (imidachloprid 17.8% SL @ 3ml /kg of seeds + mancozeb @ 3 g/kg of seed + PSB @ 4g/kg seeds + polymer coat @ 5ml/kg of seeds) was found to be Significantly superior in growth, seed yield and quality parameters *viz.*, No. of primary branches, number of pods per plant, number of seeds per pod, seed yield per plant and seed yield per hectare as compare to control (T0). The laboratory experiment was conducted on Department of Genetics and Plant Breeding, SHUATS, to studies on seed quality parameters *viz.*, 100 seed weight, germination percentage, root length, shoot length, seedling length, seed vigour Index-I, protein content and carbohydrate content were found to higher in seeds obtained from T7 compared to control (T0) in both the varieties of cowpea.

Keywords: Calcarea phosphorica 6x, Cowpea varieties, Imidacloprid, Moncozeb, Polymer coat, PSB, Seed yield, Seed quality

Introduction
Cowpea (*Vigna unguiculata*) is an important and versatile crop cultivated in India, being a drought tolerant crop with better growth in warm climate, cowpea is most popular in the semi-arid region of the tropic where other food legume does not perform as well. Cowpea has the ability to fix nitrogen even in a very poor soil with pH range 4 - 9.0, Organic matter < 0.2% and a Sand content of > 85%. It is the most important grain legume grown, Cowpea is an important grain legume for over 50 million people.

The largest production of cowpea is with over 4.3 million metric tons of annual production while the grain is a good source of human protein while the haulms are valuable source of livestock protein. It is also source of income for many small farmers as it contributes to the sustainability of cropping system and soil fertility improvement in marginal land through provision of ground cover and plant residue, like leaves and roots (Tripathi and Singh 2001). All part of cowpea is useful for food and is nutritious, providing protein, vitamin and mineral. The protein in cowpea seed is richer in amino acid (lysine) compared to other legumes (Anonymous, 2010). The cowpea haulm is also of great value to farmers as it is used as cover crop for soil erosion control, green manure crop, and for feeding Animals. Weeds cause the low yield, poor quality of crop and also low income to the farmers. Pulses occupy an indispensable place in our daily diet as a source of protein. Cowpea is valuable warm season grain legume in tropical and sub-tropical zones of Africa, Asia and U.S.A, it is widely adopted and capable of producing seeds even in lowland. However, grain yield of this legume varies widely when grown at different locations.

The world's total production of cowpea covers around 3 million tons, of which Nigeria is the leading producer contributing 2.1 million tons. Highest cowpea production nations are Nigeria, India and Brazil. Annual global production is 2 million tons from an area of 5 million ha. In India, cowpea is grown in almost 1.3 million ha area with an average productivity of 600-700 Kg grains/ha, particularly in western, central and peninsular region. In India, Maharashtra is the leading producer of cowpea (FAO, 2012). Major states grown cowpea are Maharashtra, Karnataka, Tamil Nadu Madhya Pradesh, Rajasthan and Andhra Pradesh. It is an annual multipurpose grain legume. Seed treatment is a process of applying useful materials to form a continuous layer of thin coating over the seed without altering the shape or size, by employing

water as the solvent. Currently seed coating polymers are being used by seed companies along with active ingredients such as insecticides and fungicides. This helps in improving the resistance of seeds towards pest and diseases in the much warranted juvenile stage, besides improves the seedling vigour (Vanangamudi *et al.*, 2003) [8].

The polymer coat provides protection from the stress imposed by accelerated ageing, which includes fungal invasion. The coat is thin (8 µm), simple to apply, diffuses rapidly and non-toxic to the seedling during germination. It improves plant stand and emergence of seeds, accurate application of the chemical reduces chemical wastage, helps to make room for including all required ingredients, protectants, nutrients, plant growth promoters, hydrophobic / hydrophilic substance, oxygen suppliers etc. By encasing the seed within a thin film of biodegradable polymer, the adherence of seed treatment to the seed is improved, ensures dust free handling, make treated seed both useful and environment friendly. Polymer coating makes sowing operation easier due to the smooth flow of seeds. Addition of colorant helps in visual monitoring of placement accuracy, enhance the appearance, marketability and consumer preference. The polymer film may act as physical barrier, which has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo (Vanangamudi *et al.*, 2003) [8].

Materials and Methods

The present investigation was carried out at during kharif 2016-17 in the field of Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Uttar Pradesh. The experiment was laid out in randomized block design with 2 cowpea varieties (Kashi Kanchana and Kashi Unnati), 3 replications consisted of 9 treatments combinations. Seeds were sown with spacing of 30 cm between rows and 10 cm between plants. The treatment combinations are control(T0), T1 (imidachloprid 17.8% SL @ 3ml /kg of seeds), T2(PSB @ 4g/kg seeds), T3(mancozeb @ 3 g/kg of seed), T4(Imidachloprid +PSB+ polymer coating@ 5ml/kg of seeds) T5(Imidachloprid + moncozeb + polymer coating@ 5ml/kg of seeds), T6(PSB + moncozeb + polymer coating@ 5ml/kg of seeds), T7 (imidachloprid 17.8% SL @ 3ml /kg of seeds + mancozeb @ 3 g/kg of seed + PSB @ 4g/kg seeds + polymer coat @ 5ml/kg of seeds), T8 (Calcarea phasphorica 6x @ 2g/kg seeds). The plot size was 1.0 × 1.0 m.

The liquid polymer used for seed coating was polykote manufactured by Little's Oriental Balm and PHS Ltd., Chennai. One hundred gram of seeds were taken in a polythene bag, initially they were treated with fungicide moncozeb @ 3 g per kg of seeds and added the polymer coating @ 5 ml per kg of seeds in the polythene bag. The polythene bag was closed tightly trapping air in it to form a balloon, then polybag was vigorously shaken till all the seeds are uniformly coated, later the treated seeds were spread on a sheet under shade and dried completely. The dried seeds were used for sowing. The same procedure was used for the other seed treatments also. Cultural operations, application of fertilizer, method of sowing, plant protection, harvesting, threshing and cleaning was carried out as per the package of practice. Five plants were selected randomly and tagged in each treatment for recording plant growth and yield parameters *viz.*, plant height @20, 30, 40 days after sowing, No. of primary branches, number of pods per plant, number of seeds per pod, seed yield per plant and seed yield per hectare. The laboratory studies on seed quality parameters *viz.*, 100 seed weight, germination percentage, root length, shoot length, seedling length, seed vigour Index-I, protein content by Lowry *et al.* method and carbohydrate content by Anthrone method.

Results and Discussion

The data on plant growth and yield parameters *viz.*, plant height, number of primary branches, number of pods per plant, number of seeds per pod, seed yield per plot, seed yield/hectare are presented in Table 1 and 2. All the Plant growth parameters differed significantly except plant height. Among all the treatments T7 was significantly differed in No. of primary branches V1(5.53) and V2(5.40), No. of pods per plant V1(15.40), V2(15.20), no. of seeds per pod V1(12.87), V2(12.47),100 seed weight V1(14.18 g), V2(13.86 g), seed yield per plot V1(28.09 g), V2(26.34 g), seed yield per ha V1(84.27 q/ha), V2(79.03 q/ha) as compared to control T0No. of primary branches V1(4.07) and V2(3.47), No. of pods per plant V1(13.27), V2(13.13), no. of seeds per pod V1(11.07), V2(10.33),100 seed weight V1(12.28 g), V2(12.44 g), seed yield per plot V1(17.27 g), V2(16.28 g), seed yield per ha V1(51.82 q/ha), V2(50.68 q/ha), where there was no significant difference between the treatments on plant height at 20, 30,40 days after sowing. This increase in the yield parameters may be attributed to higher no. of pods, seed filling percentage and 100 seed weight. Similar results were also observed in chickpea (2), groundnut (3) and pigeon pea (9).

Table 1: Plant height at 20, 30, 40 days after sowing and number of primary branches shows as effects of polymer seed coating and seed treatment on cowpea varieties

Treatments	Plant height at 20 DAS		Plant height at 30 DAS		Plant height at 40DAS		No. of primary branches	
	V1	V2	V1	V2	V1	V2	V1	V2
T0	35.10	33.15	35.64	36.47	43.49	45.41	4.07	3.47
T1	33.13	40.56	35.29	41.80	45.36	62.45	4.40	4.60
T2	32.24	42.39	35.75	45.89	41.93	59.25	4.60	4.07
T3	36.60	38.02	36.93	39.64	44.94	49.90	4.40	4.40
T4	40.62	38.11	42.72	39.97	59.98	48.19	4.47	4.00
T5	36.15	40.24	36.80	40.37	46.51	47.27	4.33	4.53
T6	34.86	36.68	36.69	39.22	44.79	45.31	5.07	4.87
T7	37.81	36.71	39.86	41.01	47.01	45.95	5.53	5.40
T8	35.81	38.94	37.89	38.97	45.39	50.73	4.47	4.67
SEd ±	2.79	1.96	2.05	1.79	4.91	3.18	0.26	0.42
CD(P=0.05)	NS	NS	NS	NS	NS	NS	0.54	0.89

NS – Non significant

T_0: Control, **T_1**: Imidachloprid @ 3ml/kg seeds, **T_2**: PSB @ 4g/ kg seeds, **T_3**: Moncozeb @ 3g/kg seeds, **T_4**: T1+T2 + polymer coating @ 5ml/kg seeds, **T_5**: T1+T3 + polymer coating, **T_6**: T2+T3 + polymer coating, **T_7**: T1+T2+T3 + polymer coating, **T_8**: Calcarea phosphorica 6x @ 2g/kg

seeds.

Table 2: No. of pods per plant, No. of seeds per plant, seed weight per plot, test weight and seed yield per hectare shows as effects of polymer seed coating and seed treatment on cowpea varieties.

Treatments	No. of pods/plant		No. of seeds/pod		Seed yield/plant(g)		100 seed weight(g)		Seed yield(q/ha)	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
T0	13.27	13.13	11.07	10.33	17.27	16.89	12.28	12.44	51.82	50.68
T1	13.53	13.40	10.60	11.20	18.84	18.03	12.29	12.01	56.53	54.10
T2	14.27	14.27	11.20	11.40	19.43	22.22	12.16	13.63	58.30	66.67
T3	13.60	13.93	11.67	12.00	20.84	22.07	13.14	13.16	62.52	66.21
T4	14.60	14.07	11.33	11.33	21.93	20.15	13.27	12.66	65.80	60.45
T5	13.93	14.40	12.07	11.67	21.20	22.93	12.49	13.65	63.61	68.78
T6	14.40	14.27	12.40	11.60	23.96	20.93	13.27	12.64	71.06	62.78
T7	15.40	15.20	12.87	12.47	28.09	26.34	14.18	13.86	84.27	79.03
T8	13.80	13.53	11.73	10.67	21.12	19.79	13.04	13.71	63.37	59.37
SEd±	0.40	0.42	0.50	0.45	1.07	1.44	0.12	0.48	3.20	4.33
CD(P=0.05)	0.84	0.89	1.06	0.96	2.26	3.06	0.25	1.02	6.79	9.18

NS – Non significant

T_0: Control, **T_1**: Imidachloprid @ 3ml/kg seeds, **T_2**: PSB @ 4g/ kg seeds, **T_3**: Moncozeb @ 3g/kg seeds, **T_4**: T1+T2 + polymer coating @ 5ml/kg seeds, **T_5**: T1+T3 + polymer coating, **T_6**: T2+T3 + polymer coating, **T_7**: T1+T2+T3 + polymer coating, **T_8**: Calcarea phosphorica 6x @ 2g/kg seeds.

The data on seed quality parameters on germination per cent, root length, shoot length, seedling length, seed vigour Index-I, protein content and carbohydrate content are presented on table 3 and 4. Among all the seed treatments the T7 is significantly differed for germination 97% in both V1 and V2, root length V1(20.43 cm), V2(20.13 cm), shoot length V1(32.77 cm), V2(30.22 cm), seedling length V1(53.20cm), V2(50.35cm), seed vigour Index-I V1(5161), V2(4074), protein content V1(24.49%), V2(24.85%), and carbohydrate content T2 in V1(78.29), T7 in V2(81.71) as compare to control T0.

These results are agreement with finding of Vanangamudi *et al*. (8) in maize, Chandravathi in (1) pearlmillet and shakunthala in (7) sunflower. Polymer coat acts as a temperature switch and protective coating by regulating the seed uptake of water, until the soil wormed to predominant temperature. It improves plant stand and emergence of seeds, accurate application of the chemical reduces chemical wastage, helps to make room for including all required ingredients, protectants, nutrients, plant growth promoters, hydrophobic / hydrophilic substance, oxygen suppliers etc. It acts provides resistance against mechanical damage in the seed drill. Thus improves the appearance and quality of polymer coated seeds.

Table 3: Germination %, Root length(g), Shoot length(g), Seedling length(g), Seed vigour index I shows the effects of polymer seed coating and seed treatment on cowpea varieties.

Treatments	Germination%		Root length(g)		Shoot length(g)		Seedling length(g)		Seed vigour index I	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
T0	87	86	17.30	16.39	24.92	17.47	42.22	33.86	3673	2509
T1	94	93	18.04	17.08	30.09	21.39	48.13	38.47	4524	3035
T2	96	93	19.10	15.43	29.01	28.02	48.11	43.45	4622	3435
T3	94	95	15.21	16.04	28.28	25.79	43.48	41.83	4088	3386
T4	95	95	16.65	17.40	28.45	29.06	45.10	46.46	4282	4138
T5	93	93	20.22	17.38	30.40	26.26	50.62	43.64	4708	3625
T6	94	95	16.88	19.15	30.54	29.44	47.42	48.58	4452	3975
T7	97	97	20.43	20.13	32.77	30.22	53.20	50.35	5161	4074
T8	94	94	17.77	18.45	27.59	28.33	45.36	46.77	4261	3458
SEd±	2.00	2.25	1.26	0.48	1.58	2.90	1.35	2.48	117	346
CD(P=0.05)	4.16	5.18	2.91	1.10	3.65	6.69	3.11	5.73	269	798

NS – Non significant

T_0: Control, **T_1**: Imidachloprid @ 3ml/kg seeds, **T_2**: PSB @ 4g/ kg seeds, **T_3**: Moncozeb @ 3g/kg seeds, **T_4**: T1+T2 + polymer coating @ 5ml/kg seeds, **T_5**: T1+T3 + polymer coating, **T_6**: T2+T3 + polymer coating, **T_7**: T1+T2+T3 + polymer coating, **T_8**: Calcarea phosphorica 6x @ 2g/kg seeds.

Table 4: Protein content and carbohydrate content shows the effects of polymer seed, coating and seed treatment on cowpea varieties

Treatments	Protein content (%)		Starch content (%)	
	V1	V2	V1	V2
T0	20.12	22.74	60.27	57.21
T1	23.83	21.85	61.10	67.99
T2	20.39	16.86	78.29	77.31
T3	18.95	22.30	72.37	77.35
T4	22.19	24.80	50.05	74.74
T5	20.17	21.61	72.32	75.80
T6	13.67	22.35	58.54	71.29
T7	24.49	24.85	60.77	81.71
T8	20.67	19.59	62.67	69.56

SEd±	2.35	1.80	5.33	5.36
CD(P=0.05)	5.42	4.15	12.30	13.36

NS – Non significant

T_0: Control, **T_1**: Imidachloprid @ 3ml/kg seeds, **T_2**: PSB @ 4g/ kg seeds, **T_3**: Moncozeb @ 3g/kg seeds, **T_4**: T1+T2 + polymer coating @ 5ml/kg seeds, **T_5**: T1+T3 + polymer coating, **T_6**: T2+T3 + polymer coating, **T_7**: T1+T2+T3 + polymer coating, **T_8**: Calcarea phosphorica 6x @ 2g/kg seeds.

Conclusion

Thus the present study revealed that seeds are treated with T7 (imidachloprid 17.8% SL @ 3ml /kg of seeds + mancozeb @ 3 g/kg of seed + PSB @ 4g/kg seeds + polymer coat @ 5ml/kg of seeds) has shown better field performance and seed quality parameter. So to get higher seed yield with good quality seeds can be treated with combination of insecticide, fungicide, bio agent and polymer coating.

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