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Polymer coating of cowpea seeds (*Vigna unguiculata*) for improving its storability and performance

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Abstract
An investigation was undertaken to study the effect of polymer coating of cowpea seeds in improving its storability and performance. Freshly harvested seed of cowpea cv. Utkal Manika (*Rabi* 2018-19 produced seed) was taken and assessment of germinability and vigour was done prior to polymer coating of the seeds. The experiment was laid out in RBD with three replications and twelve treatments, *viz.*, uncoated seeds stored in cloth bags (Control), uncoated seeds stored in 700 gauge polythene bags, and polymer seed coatings with Methyl cellulose, Ethyl cellulose, Polyvinyl pyrrolidone, Hydroxy propyl cellulose and Methyl vinyl acetate, each at 3 ml and 4 ml per kg seeds. Seeds were then dried to original moisture content and stored under ambient conditions from June 2019 to December 2019 in cloth bags, except T_2, which was stored in 700 gauge polythene bags. Observations on various seed physiological quality and seed health parameters were recorded at monthly intervals. After six months of storage, the seeds were used to study their field performance. Results revealed that there was gradual increase in moisture content over six months of storage under ambient condition in cloth bags, the increase being relatively higher in the uncoated seeds (Control), compared to all the coating treatments. Seed germination and vigour declined progressively over the period of storage, the rate of decline being faster in the uncoated Control, as compared to the uncoated seeds stored in 700 gauge polythene bags, as well as all polymer coating treatments. Seeds coated with Methyl cellulose @ 4 ml/kg seed recorded significantly higher seed germination (80.50%), while lowest germination was recorded in uncoated Control (72.00%) after six months of storage. Similar trend was observed with regards to the field emergence. Seed infection and infestation were highest in Control compared to seed coating with polymers, with Polyvinyl pyrollidone and Methyl vinyl acetate each at 4 ml/kg seeds proving to be the best. With regards to field performance, plant height, number of branches per plant, pod length, number of pods per plant, number of seeds per pod, seed yield and 100-seed weight were highest from coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds, followed by Methyl cellulose @ 4 ml/kg seeds. Highest seed yield of 22.59 q/ha was obtained from Polyvinyl pyrrolidone @ 4 ml/kg seeds (25.99% higher over Control), followed by Methyl cellulose @ 4 ml/kg seeds (22.52 q/ha). The uncoated seeds (Control) in cloth bag recorded least seed yield per hectare (17.93 q/ha). The polymer seed coatings did not have any significant influence on the quality of seed produced, viz., seed germination and vigour indices, or on the seed carbohydrate and protein contents. Thus, polymer seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds or Methyl cellulose @ 4 ml/kg seeds played important role in maintaining seed quality during storage, which was manifested in improved plant growth, seed yield attributing parameters and seed yield of cowpea.

Keywords: cowpea, polymer seed coating, seed storability, seed yield

Introduction
Cowpea (*Vigna unguiculata*) is an important and versatile crop cultivated in India. The seed is a good source of human protein while the haulms are valuable source of livestock protein. Being a drought tolerant crop with better growth in warm climate, cowpea is most popular in the semi-arid regions of the tropics, where other food legumes do not perform as well. Cowpea has the ability to fix nitrogen even in very poor soils with pH range 4.0 - 9.0, organic matter less than 0.2% and sand content of more than 85%. It is an ecologically and economically important leguminous plant and rich in protein (Goncalves *et al*., 2016) [6]. In India, cowpea is grown in almost 1.3 million ha area with an average productivity of 600-700 kg/ha, particularly in western, central and peninsular region. In India, Maharashtra is the leading producer of cowpea. Major states growing cowpea are Maharashtra, Karnataka, Tamil Nadu Madhya Pradesh, Rajasthan and Andhra Pradesh.

Cowpea seeds are highly susceptible to insect-pests and seed borne diseases during storage and also in field condition. Cowpea seeds lose viability within 3-4 months if the storage arrangement and the condition of seeds are not proper. High levels of temperature and relative humidity in the storage environment as well as seed moisture content appears to be the main factors to hasten degenerating biochemical changes and insect-pathogen growth that eventually lead to deterioration in seed quality (Maity and Pramanik, 2013) [7]. Storage of seeds at least for next sowing season is an essential part of seed programme. It is of common knowledge that seed deterioration is an irreversible, inexorable and inevitable process. However, the rate of seed deterioration could be slowed down by any approach that maintains seed moisture content within safe limits. An effective approach to safeguard seeds by maintaining low moisture content of the seeds is by coating seeds with suitable polymers along with seed treating chemicals. Ideally, a seed coating polymer, to be effective, must restrict entry of moisture into seeds in vapour form but readily diffuse in soil upon contact with water to allow the seed to germinate. The polymer must be non-toxic to the seed or seedlings during germination, as well as eco-friendly so as to maintain soil health in the rhizosphere.

Though polymer seed coating is not new to the seed industry, only limited work has been done in cowpea, for which detailed information in this crop is lacking. Hence, the present investigation was conducted to study the role of polymer seed coating on the storability and subsequent field performance of cowpea seed.

Materials and Methods

The present investigation was undertaken in the Department of Seed Science and Technology, College of Agriculture, OUAT, Bhubaneswar. Freshly harvested seed of cowpea cv. Utkal Manika (*Rabi* 2018-19 produce) was collected from AICRP on Vegetable Crops, OUAT, Bhubaneswar. Assessment of germinability and vigour of seeds was done prior to polymer coating of the seeds. The experiment was laid out in Randomised Block Design with three replications and twelve treatments, *viz.*, uncoated seeds stored in cloth bags (Control) (T_1), uncoated seeds stored in 700 gauge polythene bags (T_2), Methyl cellulose @ 3 ml/kg seeds (T_3), Methyl cellulose @ 4 ml/kg seeds (T_4), Ethyl cellulose @ 3 ml/kg seeds (T_5), Ethyl cellulose @ 4 ml/kg seeds (T_6), Polyvinyl pyrrolidone @ 3 ml/kg seeds (T_7), Polyvinyl pyrrolidone @ 4 ml/kg seeds (T_8), Hydroxy propyl cellulose @ 3 ml/kg seeds (T_9), Hydroxy propyl cellulose @ 4 ml/kg seeds (T_{10}), Methyl vinyl acetate @ 3 ml/kg seeds (T_{11}) and Methyl vinyl acetate @ 4 ml/kg seeds (T_{12}). After polymer coating, the seeds were dried to original moisture content. The uncoated and coated seeds were stored under ambient conditions from June 2019 to December 2019 in cloth bags, except T_2, which was stored in 700 gauge polythene bags. Regular observations on various seed physiological quality and seed health parameters were recorded at monthly intervals. After six months of storage, the seeds were used to study their field performance. Various plant growth, yield attributing and seed yield and quality parameters were recorded.

Results and Discussion

There was gradual increase in moisture content over six months storage under ambient condition in cloth bags. The percentage increase in moisture content was relatively higher in the uncoated seeds (Control), compared to all the coating treatments. After six months of storage, the moisture content of the coated seeds ranged from 8.36 to 8.59%, while it was 9.17% in the uncoated Control and 7.52% in the uncoated seeds stored in polythene bags.

Seed germination declined progressively over the period of storage due to seed coating with the polymers. However, the rate of decline was faster in case of the uncoated Control, as compared to the uncoated seeds stored in 700 gauge polythene bags, as well as all the polymer coating treatments. Among the various treatments, the seeds coated with Methyl cellulose @ 4 ml/kg seed recorded significantly higher seed germination (80.50%), while lowest germination was recorded in uncoated Control (72.00%) after six months of storage. Such research results are consistent with the findings of Susmitha and Rai (2017) [14] in cowpea. They noticed that seed coating with polymer coat and neem oil was found to be most successful, which recorded (95.53%) of germination in 6 months of storage. Dadlani and Vashisht (2006) [5] investigated the storability of soybean seed by polymer coating with polykote @ 4 ml per kg of seed stored in Superbag, which recorded highest germination (88.0%) compared to 70.0% in Control. Badiger *et al*. (2014) [1] noticed that cotton seed coated with chemical treatment polykote @ 3 ml/kg + vitavax 200 @ 2 ml/kg of seeds and stored in polythene bag (400 gauge) maintained germination (73.67%) after ten months of storage compared to Control in cloth bag, giving germination of 60.00%. The decline in seed vigour over six months of storage followed similar pattern to that of seed germination. After six months, significantly higher seed vigour indices (SVI-I and SVI-II) were recorded in the polymer coating treatments as compared to the uncoated seeds (1949.2 and 1.88, respectively). These findings are in conformity with Maruthi (2008) [9] in soybean. They revealed that seeds coated with polykote after treating with captan + Thiram @ 3 g per kg seeds maintained higher vigour index (2638) in storage. In cowpea, Susmitha and Rai (2017) [14] noticed that seed coating with polymer coat and neem oil recorded higher seedling vigour index (SVI 3573.95). Venkatesh *et al*. (2018) [15] investigated that soybean seeds treated with various fungicides along with polymer (5 ml kg^{-1}) had a significantly higher seedling vigour index-I (1524) and seed vigor index-II (7747) at the end of nine months of storage. Roopashree *et al*. (2018) [11] reported that kabuli chickpea seeds treated with polymer (20 ml/kg of seed) + vitavax (3 g/kg of seed) had a considerably higher vigour index of seed (2736) up to nine months of storage.

The per cent seed infection increased with increase in storage period in the uncoated Control and seed coating with polymers, though the rate of increase was much higher in the Control. Among the treatments, both Polyvinyl pyrrolidone and Methyl vinyl acetate @ 4 ml/kg of seed recorded lowest percentage of infected seed (1.20%) after six months of storage, while maximum seed borne infection was 10.71% in uncoated Control. The occurrence of storage fungi coupled with higher moisture content in Control seed leads to loss of seed quality parameters during storage. Such results are consistent with the results obtained in cotton by Badiger *et al*. (2011). Similarly, the seed infestation per cent increased with increase in storage period in all treatment combinations. Among the treatments, Polyvinyl pyrrolidone @ 4 ml/kg of seeds recorded minimum infestation of 0.80%, while maximum seed infestation was 2.50% in uncoated Control.

Field emergence decreased progressively with advancement of storage period. All the seed coating treatments showed significant variation and field emergence ranged between 65.75% - 68.75%, which was higher compared to uncoated seeds (61.00%). Manjunatha *et al*. (2008) [8] found in chilli that seeds coated with polymer @ 7.0 g/kg and Thiram @ 2.0 g/kg of seed recorded significantly higher field emergence

(66.14%) at the end of 12 months of storage. Chandravathi *et al.* (2008) [3] concluded that in pearl millet, among the seed treatments, hydropriming + polymer coating + Thiram 2.5 g/kg seed recorded significantly higher field emergence (81.39%) as compared to untreated seeds at the end of six months storage period.

Significant variation in plant height was observed in different seed coating treatments, Among the various treatments Polyvinyl pyrrolidone @ 4 ml/kg seeds produced the tallest plants (46.55 cm), followed by seed coating with Methyl cellulose @ 4 ml/kg seeds with plant height of 46.41 cm, The uncoated seeds (Control) in cloth bag recorded lowest plant height (41.30 cm). The findings are in accordance with Ovalesha *et al*. (2017) [10] in cowpea, who reported that seed coating with Imidacloprid 17.8 percent SL @ 3 ml/kg of seeds + Mancozeb @ 3 g/kg of seed + PSB @ 4 g/kg of seeds + polymer coat @ 5 ml/kg of seeds recorded significantly highest plant height (47.27 cm) compared to uncoated seeds (43.49 cm). Similarly, Bony *et al*. (2017) [2] in soybean confirmed that seed treated with polymer @ 2 ml kg^{-1} seed, Thiram @ 3 g kg^{-1}, recorded highest plant height (35.65) compared to uncoated seeds. Sharma (2014) [12] in French bean noticed that seeds treated with polymer (20 g/kg) + Imidacloprid (5 ml/kg) + Bavistin (3 g/kg) recorded highest plant height (47.68 cm) compared to uncoated seeds (Control) (46.12 cm). With regards to days to flower initiation in 50% plants, uncoated seeds in cloth bags (Control) took least number of days (41.2 days) to flower initiation in 50% plants, followed by uncoated seeds in 700-gauge polythene bag (43.3 days). Maximum number of days (45.6) to flower initiation in 50% plants was recorded in case of seed polymer coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds, followed by Methyl cellulose @ 4 ml/kg seeds (45.5 days). Similarly, in chickpea, Sushma *et al*. (2018) [13] reported that days to 50 per cent flowering due to seed treatments did not differ significantly. Similarly, with regards to days to harvestable maturity, uncoated seeds (Control) in cloth bags took least number of days (63.4) followed by uncoated seeds in 700-gauge polythene bag (68.1) days. Maximum number of days (71.3) to harvestable maturity was recorded in case of seed polymer coating with Methyl vinyl acetate @ 3 ml/kg seeds, followed by Methyl cellulose @ 4 ml/kg seeds (71.1 days). Similarly, in chickpea, Sushma *et al*. (2018) [13] observed that a minimum number of days (96.00) had been observed in deltamethrin 2.8 EC @ 0.4 ml/kg seed + vitavax power @ 2 g/kg seed + polymer seed coating @ 10 ml/kg seed, while a maximum number of days (94.33) had been recorded in uncoated seeds (Control).

Significant variation in the primary branches was observed in different seed coating treatments. Among the various treatments Polyvinyl pyrrolidone @ 4 ml/kg seeds recorded maximum number of primary branches per plant (4.66), followed by Methyl cellulose @ 4 ml/kg seeds, i.e., 4.65 branches. The uncoated seeds (Control) in cloth bag recorded minimum number of primary branches per plant (4.14). These results are in agreement with the findings of Ovalesha *et al.* (2017) [10] in cowpea, who reported that seed coating with Imidacloprid 17.8% SL @ 3 ml/kg of seeds + PSB @ 4 g/kg seeds + polymer coat @ 5 ml/kg of seeds recorded significantly higher number of primary branches (5.53) compared to uncoated seeds (Control) (4.07). Similar results were reported by Vinod Kumar *et al.* (2012) [16] in pigeon pea, wherein seed treated with Deltamethrin 2.8 EC @ 0.3 ml/kg of seed + Vitavax power @ 3 g/kg of seed + Polymer seed coating @ 5 ml/kg of seed recorded more number of primary branches (18.12) compared to uncoated seeds (16.31). Maximum pod length (19.19 cm) was recorded in seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds, followed by Methyl cellulose @ 4 ml/kg seeds with pod length of 19.13 cm compared to the uncoated seeds (Control) in cloth bag which recorded minimum pod length of 17.03 cm. Similarly, regarding number of pods per plant, seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds resulted in production of maximum number of pods per plant (14.57), followed by seed coating with Methyl cellulose @ 4 ml/kg seeds (14.56), compared to the uncoated seeds (Control) in cloth bag which recorded minimum number of pods per plant (12.87). Investigation of Ovalesha *et al*. (2017) [10] in cowpea reported that seed coating with Imidacloprid 17.8% SL @ 3 ml/kg of seeds + PSB @ 4 g/kg of seeds + Moncozeb @ 3 g/kg of seeds + polymer coat @ 5 ml/kg of seeds produced highest number of pods per plant (15.40) than uncoated seeds in Control (13.27). Similarly, Bony *et al*. (2017) [2] in soyabean confirmed that seed coating with polymer + Thiram + Imidacloprid + *T. viride* produced significantly higher number of pods per plant (66) compared to uncoated seeds in Control, which produced minimum number of pods per plant (60). Seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds resulted in production of maximum number of seeds per pod (10.53), followed by seed coating with Methyl cellulose @ 4 ml/kg seeds with number of seeds per pod (10.50) compared to uncoated seeds (Control) in cloth bag which recorded minimum number of seeds per pod (9.42). These results are in line with the work of Ovalesha *et al.* (2017) [10] in cowpea, which revealed that seed coating with Imidacloprid 17.8 per cent SL @ 3 ml/kg of seeds + PSB @ 4 g/kg of seeds + Moncozeb @ 3 g/kg of seeds + polymer coat @ 5 ml/kg of seeds seemed to have a significant increase in the number of seeds per pod (12.87) compared to uncoated seeds (Control) which recorded 11.07 seeds per pod.

Seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds resulted in highest seed yield of 19.06 g/plant, followed by seed coating with Methyl cellulose @ 4 ml/kg seeds with seed yield of 19.00 g/plant compared to the uncoated seeds (Control) in cloth bags which recorded seed yield of 15.00 g/plant. Regarding seed yield per hectare, seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds resulted in highest seed yield (22.59 q/ha), followed by seed coating with Methyl cellulose @ 4 ml/kg seeds (22.52 q/ha). The uncoated seeds (Control) in cloth bag recorded least seed yield per hectare (17.93 q/ha). The seed yield per hectare from seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds was 25.99% higher over uncoated Control. These results are in accordance with the findings of Ovalesha *et al*. (2017) [10] in cowpea, which concluded that seed coating with Imidacloprid 17.8 percent SL @ 3 ml/kg seeds + PSB @ 4 g/kg seeds + Moncozeb @ 3 g/kg seeds + polymer coat @ 5 ml/kg seeds resulted in highest seed yield of 84.27 q/ha compared to uncoated Control seeds that recorded seed yield of 51.82 q/ha. This increase in the yield parameters may be attributed to higher number of pods, number of seeds per pod, better seed filling and higher 100-seed weight. Similar findings were also reported by Chaurasia *et al*. (2015) [4] in chickpea. Vinod Kumar *et al.* (2012) [16] in pigeon pea reported that seed treated with Deltamethrin 2.8 EC @ 0.3 ml/kg of seed + Vitavax power @ 3 g/kg of seed + polymer seed coating @ 5 ml/kg of seed recorded highest seed yield of 84.27 q/ha compared to uncoated seeds (Control), which attained the lowest seed yield of 51.82 q/ha.

Maximum 100-seed weight of 12.95 g was recorded from seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds, followed by seed coating with Methyl cellulose @ 4 ml/kg seeds with 12.91 g. The uncoated seeds (Control) in cloth bag recorded least 100-seed weight (11.49 g). Such results are in accordance with findings of Ovalesha *et al.* (2017) [10] in cowpea, where seed coating with Imidacloprid 17.8 percent SL @ 3 ml/kg seeds + PSB @ 4 g/kg seeds + Moncozeb @ 3 g/kg seeds + polymer coat @ 5 ml/kg seeds gave significantly higher 100-seed weight than uncoated seed, i.e., Control (12.28 g). Vinod Kumar *et al.* (2012) [16] found that seed treated with Deltamethrin 2.8 EC @ 0.3 ml/kg seed + Vitavax power @ 3 g/kg seed + Polymer seed coating @ 5 ml/kg seed recorded considerably higher seed weight (11.05 g) than uncoated seed (10.21 g). In the present investigation, even though polymer seed coatings had a positive influence on growth, yield attributing characters and seed yield of cowpea, the treatments had no significant influence on the quality of seed produced, viz., seed germination and vigour indices. Seed germination of the treatments varied in the range of 92.25 to 94.00%. These results are in agreement with Sushma *et al.* (2018) [13] who reported the non-significant difference in chickpea with respect to germination percentage and vigour indices. Seed carbohydrate and protein contents were not influenced by any of the polymer coating seed treatments. The seed carbohydrate content of the treatments ranged between 59.37% and 58.37%, while the seed protein content ranged between 24.63% and 24.22%.

Table 1: Seed quality parameters of polymer coated cowpea seeds during storage under ambient conditions

Treatments	Seed moisture content (%)		Seed germination (%)		Seed vigour index – I		Seed vigour index – II		Seed infection (%)		Seed infestation (%)		Field emergence (%)	
	After coating	After 6 months	After coating*	After 6 months*	After coating	After 6 months	After coating	After 6 months	After coating*	After 6 months*	After coating*	After 6 months*	After coating*	After 6 months**
T_{1}	7.14	9.17	91.00 (9.54)	72.00 (8.49)	2943.4	1949.2	2.82	1.88	2.40 (1.55)	10.71 (3.27)	1.20 (1.10)	7.14 (2.67)	81.75 (9.04)	61.00 (51.35)
T_{2}	7.21	7.52	93.00 (9.64)	78.50 (8.86)	3133.8	2559.5	2.62	1.86	1.19 (1.09)	3.92 (1.98)	0.59 (0.77)	2.62 (2.15)	83.75 (9.15)	66.75 (54.79)
T_{3}	7.18	8.58	93.75 (9.68)	79.25 (8.90)	3176.4	2422.4	1.97	1.50	1.20 (1.10)	2.85 (1.69)	0.60 (0.77)	1.90 (1.38)	84.50 (9.19)	67.75 (55.40)
T_{4}	7.09	8.44	95.00 (9.75)	80.50 (8.97)	3169.9	2445.1	2.00	1.53	0.60 (0.77)	1.38 (1.17)	0.30 (0.55)	0.92 (0.96)	85.50 (9.25)	68.75 (56.01)
T_{5}	7.18	8.53	92.00 (9.59)	77.50 (8.80)	3029.7	2329.9	2.61	2.02	1.20 (1.10)	2.85 (1.69)	0.60 (0.77)	1.90 (1.38)	82.75 (9.10)	66.25 (54.48)
T_{6}	7.13	8.37	91.75 (9.58)	77.25 (8.79)	3076.2	2428.1	1.97	1.56	2.40 (1.55)	5.40 (2.32)	1.20 (1.10)	3.60 (1.90)	81.75 (9.04)	65.75 (54.18)
T_{7}	7.12	8.52	93.25 (9.66)	78.75 (8.87)	2730.0	2104.9	2.33	1.80	1.20 (1.10)	2.70 (1.64)	0.60 (0.77)	1.80 (1.34)	84.00 (9.17)	67.25 (55.09)
T_{8}	7.15	8.50	94.00 (9.70)	80.50 (8.97)	2938.0	2292.2	1.77	1.35	0.60 (0.77)	1.20 (1.10)	0.30 (0.55)	0.80 (0.89)	84.50 (9.19)	68.75 (56.01)
T_{9}	7.15	8.50	93.25 (9.66)	78.75 (8.87)	2915.3	2221.5	1.47	1.10	1.18 (1.09)	2.70 (1.64)	0.59 (0.77)	1.80 (1.34)	83.75 (9.15)	67.25 (55.09)
T_{10}	7.29	8.59	92.75 (9.63)	79.25 (8.90)	2886.5	2225.8	2.91	2.24	1.22 (1.10)	2.55 (1.60)	0.61 (0.78)	1.70 (1.30)	83.75 (9.15)	67.75 (55.40)
T_{11}	7.19	8.54	94.75 (9.73)	80.50 (8.97)	2963.9	2285.3	2.85	2.19	0.60 (0.77)	1.38 (1.17)	0.30 (0.55)	0.92 (0.96)	85.50 (9.25)	68.75 (56.01)
T_{12}	7.11	8.36	93.00 (9.64)	79.75 (8.93)	3289.6	2596.6	2.33	1.84	0.60 (0.77)	1.20 (1.10)	0.30 (0.55)	0.80 (0.89)	83.75 (9.15)	68.00 (55.55)
Mean	7.16	8.47	93.13 (9.65)	78.54 (8.86)	3021.1	2271.7	2.30	1.71	1.20 (1.06)	3.49 (1.75)	0.60 (0.75)	2.33 (1.43)	83.77 (9.15)	66.50 (54.65)
S.E.m(±)	0.107	0.122	0.064	0.584	80.79	53.93	0.061	0.045	0.029	0.055	0.020	0.045	0.061	0.499
C.D.$_{0.05}$	NS	0.357	NS	1.712	236.94	158.18	0.179	0.133	0.084	0.162	0.060	0.132	NS	1.464

Figures in the parenthesis are *square root / ** arc sine transformed values.

Table 2: Field performance of polymer coated cowpea seeds after storage for six months under ambient conditions

Treatments	Plant height at maturity (cm)	Days to initiation of flowering in 50% plants	Number of primary branches per plant	Days to harvestable maturity	Pod length (cm)	Number of pods per plant	Number of seeds per pod	Seed yield per plant (g)	Seed yield per hectare (q)
T_{1}	41.30	41.2	4.14	63.4	17.03	12.87	9.42	15.00	17.93
T_{2}	44.09	43.3	4.31	68.1	18.94	13.80	9.88	16.87	20.62
T_{3}	45.82	44.9	4.59	70.2	18.89	14.23	10.37	18.49	21.91
T_{4}	46.41	45.5	4.65	71.1	19.13	14.56	10.50	19.00	22.52
T_{5}	44.67	43.8	4.47	69.2	18.42	13.82	10.11	17.63	20.89
T_{6}	44.47	43.6	4.45	68.9	18.33	13.91	10.06	17.41	20.64
T_{7}	45.35	44.4	4.54	69.2	18.70	14.21	10.26	18.16	21.52
T_{8}	46.55	45.6	4.66	70.0	19.19	14.57	10.53	19.06	22.59
T_{9}	45.39	44.5	4.55	69.9	18.71	14.19	10.27	18.18	21.55
T_{10}	45.82	44.9	4.59	70.6	18.89	14.31	10.37	18.49	21.91
T_{11}	46.36	45.4	4.64	71.3	19.11	14.48	10.49	18.98	22.50
T_{12}	46.04	45.1	4.61	70.9	18.98	14.39	10.42	18.64	22.10

Mean	44.94	44.4	4.50	69.4	18.53	14.11	10.22	17.83	21.39
S.E.m(±)	0.911	0.62	0.075	1.06	0.293	0.396	0.218	0.637	0.506
$C.D._{0.05}$	2.673	1.80	0.219	3.11	0.858	1.162	0.639	1.867	1.483

Table 3: Seed quality and chemical composition of cowpea seed produced after seed polymer coating and storage for six months under ambient conditions

Treatments	100-seed weight (g)	Seed germination (%)*	Seed vigour index – I	Seed vigour index - II	Carbohydrate content of seed (%)	Protein content of seed (%)
T_1	11.49	92.75 (9.63)	3083.4	2.30	59.21	24.57
T_2	12.43	93.25 (9.66)	3112.9	2.32	59.32	24.61
T_3	12.75	93.75 (9.68)	3128.5	2.33	58.84	24.41
T_4	12.91	94.00 (9.70)	3093.4	2.31	59.01	24.49
T_5	12.43	92.50 (9.62)	3052.2	2.28	58.88	24.43
T_6	12.37	92.25 (9.60)	3086.0	2.30	59.32	24.61
T_7	12.62	93.25 (9.66)	3049.6	2.27	58.37	24.22
T_8	12.95	94.00 (9.70)	3042.2	2.27	59.21	24.57
T_9	12.63	93.25 (9.66)	3071.9	2.29	58.89	24.44
T_{10}	12.75	92.75 (9.63)	3089.6	2.30	59.37	24.63
T_{11}	12.90	93.75 (9.68)	3057.8	2.28	58.85	24.42
T_{12}	12.81	93.00 (9.64)	3095.8	2.31	58.99	24.48
Mean	12.50	93.21 (9.65)	3080.3	2.30	59.02	24.49
S.E.m(±)	0.157	0.075	64.71	0.034	0.372	0.333
$C.D._{0.05}$	0.460	NS	NS	NS	NS	NS

Figures in the parenthesis are *square root transformed values.

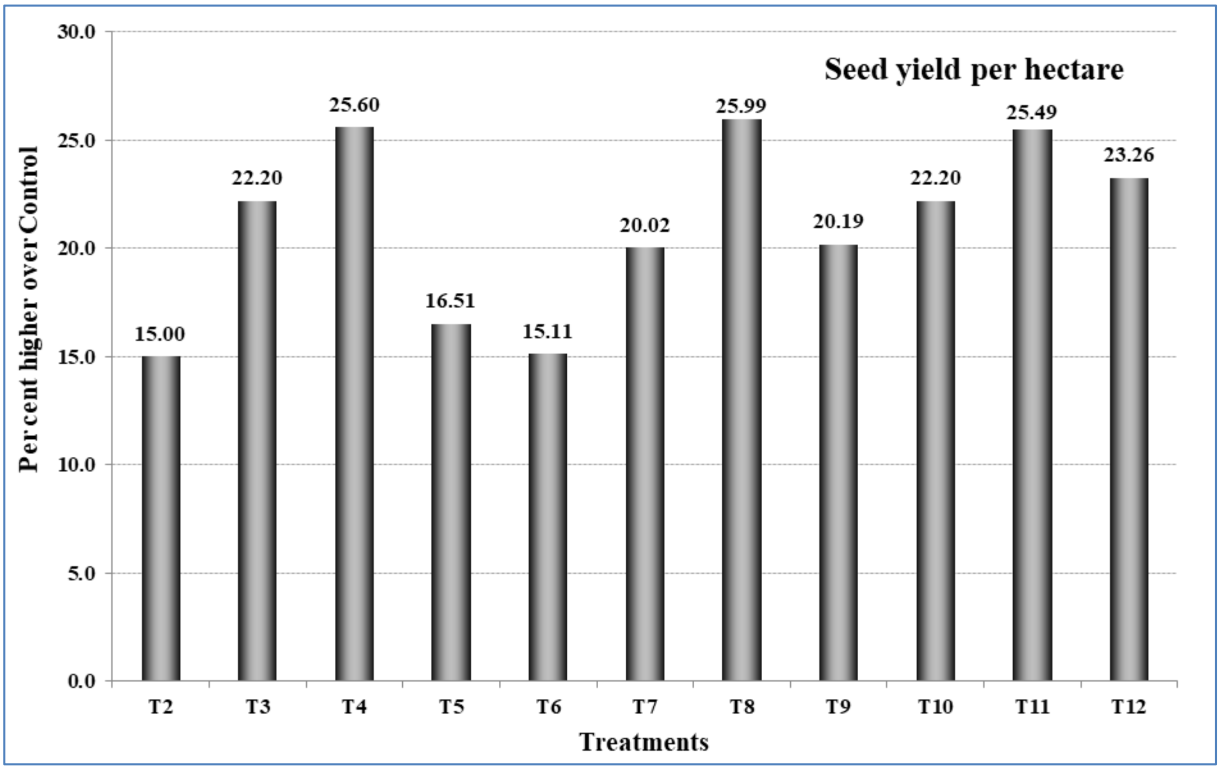

Fig 1: Percent increase in seed yield per hectare of polymer coated cowpea seeds compared to Control

Conclusion

From the investigation, it may be concluded that, in general, seed polymer coating treatments proved to be more effective in maintaining seed quality during storage up to 6 months, as compared to storage in moisture impervious container (700-gauge polythene bag) or moisture pervious container (cloth bag). Polymer seed coating with Polyvinyl pyrrolidone @ 4 ml/kg seeds played an important role in maintaining seed quality during storage, which was manifested in improved plant growth, seed yield attributing parameters and seed yield of cowpea. This was followed by seed coating with Methyl cellulose @ 4 ml/kg seeds. The additional cost involved in polymer seed coating is quite less, compared to the returns obtained from it. Since cowpea is a high volume seed (seed rate is 20-25 kg per hectare), its packing in moisture impervious containers is difficult. Seed coating with suitable polymers can be considered as a suitable cost-effective technique for reducing storage losses, maintaining seed quality during storage, improving field performance and increasing seed yield to a considerable extent, thus, benefiting the farmers and seed producers.

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