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Extension of shelf life of cotton (*Gossypium hirsutum* L.) seeds through polymer coating under ambient storage condition

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ABSTRACT

Experiments conducted to elucidate the impact of polymer coating on viability of cotton seeds at Central Institute for Cotton Research, Regional Station, Coimbatore, India revealed that seeds coated with polymer "polycote" or " polyloc" @ 3 ml kg^{-1} + thiram @ 2.5 g kg^{-1}+ super red @ 5 ml kg^{-1} + cruiser @ 5 g kg^{-1} packed in polythene bag (700 gauge) and stored at ambient condition for 26 months was found superior in preserving seed quality *viz*., seed viability expressed in terms of germination and seedling vigour over untreated seeds. The percentage loss of viability was less rapid and at 26th month of storage it was 70% where as in control 56%. Less seed infection, high seedling vigour and field emergence was recorded in coated seeds.

Key words: Cotton seed, Polymer, Seed coating, Seed storage, Vigour.

INTRODUCTION

Cotton (*Gossypium* sp) is the king of fiber crops and the most important commercial crop of India, plays an important role in economy. In India, cotton contributes nearly one third of earnings through foreign exchange which accounts to nearly 11 billion dollars (Mayee and Rao, 2002). Large quantity of cotton seeds are produced and distributed among Indian farmers for cultivation. Carryover of unsold seeds stock prevails in the seed trade, therefore maintenance of viability till they are distributed for cultivation pose serious problem. Factors such as seed moisture content, storage environment, seed treatment methods are attributed for loss of viability during storage. In cotton seed deterioration takes place rapidly under ambient storage conditions. Use of newer molecules like Acrylic Polyvinyl Alcohol Copolymer through film coating techniques have paved the way for control of seed decay during storage. This polymer forms a flexible film that adheres and protects the fungicides, insecticides and nutrients included in the coatings (Sherin *et al*., 2005). Polyvinyl resin coating maintained the germination consistently after 18 months of storage (Sauve and Shiel, 1980). Maize seeds, film coated with polykote stored up to 10 months with 90 % under ambient storage conditions (Sherin, 2003). Information on the effect of film coating on cotton seed is scanty. Hence, the present investigation was carried out to explore the feasibility of utilizing polymer film coating of cotton seeds.

MATERIALS AND METHODS

The delinted cotton seed lot with initial viability of 89.5% was used for this experiment. The seeds were divided in to six equal portions and following treatments were applied. Polymer film coating @ 3 ml diluted with water @ 5 ml kg^{-1} (T_1). In another lot, thiram 75% WDP @ 2.5 g kg^{-1} was included in polymer and coated (T_2). Thiram @ 2 g kg^{-1} and super red @ 5 ml kg^{-1} was included in polymer and film coated (T_3). In T_4, vitavax 200 (Carboxin 37.5% + Thiram 37.5%) @ 2 g kg^{-1} was incorporated in polymer before coating, and in T_5, thiram, super red (colourant) and cruiser WP @ 5 g kg^{-1} was added to polymer before coating. Two set of treatments were imposed on cotton seeds, using polymers "Polykote" and "Polyloc". In all treatments polymers were diluted with 5 ml of water before coating. Treated seeds were packed in cloth bag (C_1) and polythene bag (700 gauge) (C_2) and kept under ambient storage along with untreated seeds (T_0). After coating of seeds, the percentage increase in seed weight was recorded. Samples seeds were drawn from all treatment at bimonthly interval for assessment of seed quality. Germination of seeds was evolved in sand medium (ISTA, 1999). Vigour index (Abdul – Baki and Anderson 1973) was computed using the seedling measurements of 12th day of germination. Seed moisture content by hot air oven and percentage seed infection using blotter paper were estimated (ISTA, 1999). The data recoded were statistically analyzed as per the procedures of Panse Sukhatme, (1985).

RESULTS AND DISCUSSION

The mean data of the present investigation exhibited that the percentage increase in seed weight due to coating was more in seeds coated with polymer "polykote" or "polyloc" along with thiram, super red and cruiser than in polymer alone coated seeds (T_5) (Fig. 1). The percentage increase in T_5 due to "polykote" or "polyloc" was 3.09 and

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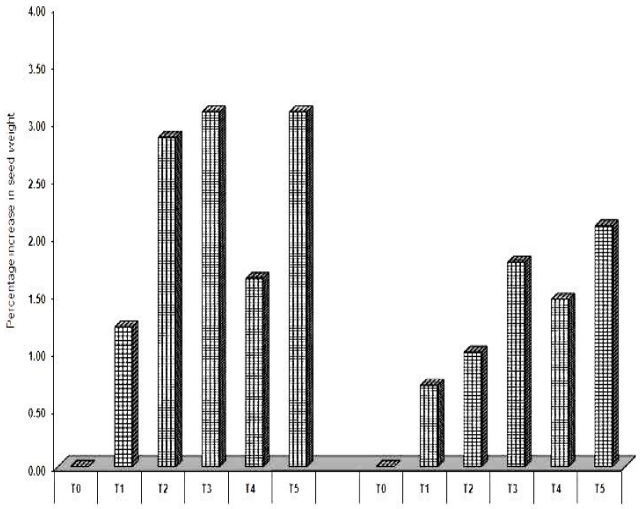

FIG.1: Effect of polymer coating on percentage increase in seed weight of cotton cv. Sumangala after treatment

2.09, respectively. Seed film coating acts as an efficient carrier of chemicals, which can be applied with a greater accuracy on the seed surface to protect the seed during conservation storage and to improve protection of seeds and young seedlings from diseases and pests (Abou, 1993). In conformity to this, the present study clearly revealed, that seeds coated with pink polykote @ 3 ml kg^{-1} combined with fungicide (thiram 75% WDP @ 2.5 g kg^{-1}) colourant (super red) and insecticide (cruiser WP @ 5 g kg^{-1}) (T5) was found to be the best and registered higher germination, seedling vigour and field emergence over a period of twenty six months of ambient storage than untreated seeds stored in cloth and polythene bags (Table1 and 2; Fig. 2). It may be noted that the same seed lot have maintained the germination of 65% as a statuary requirement of minimum seed certification standard even at twenty six months of storage extending the planting value. On the other hand the viability of untreated seeds retained up to eighteen months. Similar trend of observation was noted in seeds lots coated with Polyloc @ 3 ml kg^{-1} combined with thiram 75% WDP @ 2.5 g kg^{-1}, super red and cruiser WP @ 5 g kg^{-1} (Table 1 and 2; Fig. 2). Among the storage containers, polythene bag (700 gauge) was superior in maintaining higher germination and vigour, irrespective of treatments, for 26 months. It was observed, a reduction in germination and vigour with increase in period of storage, irrespective of treatments and storage containers; however, the rate of decline of viability was found rapid in untreated seeds (T0). The beneficial effect of film coating of seeds with polymer alone and or in combination with fungicide and insecticide during storage was reported in maize by Sherin (2003). Similar conclusions were drawn in polymer coated seeds which maintained physiological quality over the 12 months of storage; chemical treatment with the fungicide mixture (Carbendazim + Thiram) and insecticide Fipronil, either seed coated or non-coated, gives effective control of fungi and promotes better physiological performance during storage (Santos *et al.*,2010).

The higher germination and vigour observed in seeds coated with polymer, fungicide, insecticide and colourant was possibly due to less seed infection of storage fungi and low seed moisture content maintained throughout

TABLE 1: Effect of polymer coating on viability (%) of cotton seeds cv. Sumangala under ambient storage

Treatment	"Polykote"									"Polyloc"								
	Months after storage (P)									Months after storage (P)								
	Initial	2	6	10	14	18	22	26	Mean	Initial	2	6	10	14	18	22	26	Mean
C1T0	92	88	88	86	81	68	62	56	77	92	88	88	85	82	72	66	58	78
C1T1	95	92	89	88	82	78	70	65	82	94	93	92	87	83	78	70	62	82
C1T2	94	94	92	91	89	81	72	67	84	95	94	92	87	86	78	74	65	83
C1T3	95	91	91	89	85	84	76	68	85	95	92	88	87	87	82	78	72	84
C1T4	94	89	89	86	81	77	72	65	81	95	94	90	86	83	78	70	64	82
C1T5	93	94	92	89	87	83	75	68	85	96	94	93	90	88	81	76	68	85
Mean	94	91	90	88	84	79	71	65	82	95	93	91	87	85	78	72	65	83
C2T0	92	88	89	87	79	69	64	58	78	92	88	89	87	83	76	68	60	80
C2T1	95	93	92	90	86	84	74	67	85	94	95	93	89	83	78	71	64	83
C2T2	95	93	92	91	85	84	76	69	85	95	94	92	90	81	82	76	68	85
C2T3	95	91	93	91	84	83	78	71	85	95	93	93	87	81	81	79	74	85
C2T4	94	91	93	89	87	83	73	66	84	95	96	90	88	81	80	71	68	83
C2T5	93	93	93	93	89	85	78	70	87	96	96	94	92	87	84	78	70	87
Mean	94	92	92	90	85	81	74	67	84	95	94	92	89	83	80	74	67	84
P. Mean	94	91	92	90	85	81	74	67	83	95	94	92	89	83	80	74	67	84
	T0	T1	T2	T3	T4	T5				T0	T1	T2	T3	T4	T5			
T. Mean	77	83	85	85	83	86				79	82	84	85	83	86			
CD(0.05)	C	T	P	CT	TP	CP	CTP		C	T	P	CT	TP	CP	CTP			
	0.6	1	1.6	NS	NS	NS	NS		0.7	1.2	1.8	NS	4.5	NS	NS			

C1-gada cloth bag, C2-polythene bag(700 gauge)

TABLE 2: Effect of polymer coating on field emergence (%) of cotton seeds cv. Sumangala under ambient storage

Treatment	"Polykote"									"Polyloc"								
	Months after storage (P)									Months after storage (P)								
	Initial	2	6	10	14	18	22	26	Mean	Initial	2	6	10	14	18	22	26	Mean
C1T0	93	90	84	84	63	62	58	54	72	93	90	84	84	80	68	62	56	77
C1T1	95	93	87	84	71	68	64	62	76	94	92	91	87	78	74	68	60	80
C1T2	96	93	88	87	87	80	72	64	83	96	93	90	86	85	78	70	62	82
C1T3	96	92	89	86	82	80	74	67	82	93	93	87	85	82	80	74	68	82
C1T4	96	90	87	83	78	77	70	62	79	95	93	88	86	81	74	68	62	80
C1T5	97	93	91	86	85	82	72	64	83	97	92	89	87	84	79	72	64	83
Mean	96	92	88	85	78	75	68	62	79	95	92	88	86	82	76	69	62	80
C2T0	93	89	86	81	75	68	62	56	75	93	89	86	81	77	70	64	59	77
C2T1	95	93	91	89	88	82	72	64	84	94	95	89	87	71	76	68	62	80
C2T2	96	89	90	88	86	82	74	65	83	96	93	89	86	84	78	72	64	82
C2T3	96	91	88	85	83	82	76	69	83	93	92	91	84	72	80	75	69	81
C2T4	93	92	88	89	87	80	71	62	83	96	95	89	87	76	76	68	64	80
C2T5	95	93	92	89	86	83	74	66	85	96	95	91	89	87	80	73	66	84
Mean	95	91	89	87	84	80	72	64	82	95	93	89	86	78	77	70	64	81
P. Mean	95	91	89	87	83	79	71	63	81	95	93	89	86	78	77	70	64	81
	T0	T1	T2	T3	T4	T5				T0	T1	T2	T3	T4	T5			
T. Mean	73	80	83	83	81	84				77	80	82	82	80	83			
CD(0.05)	C	T		CT	TP	CP	CTP		C	T	P	CT	TP	CP		CTP		
	0.7	1.3		1.8	4.8	2.8	NS		NS	1.4	2.1	NS	5.1	NS		NS		

C1-gada cloth bag, C2-polythene bag(700 gauge)

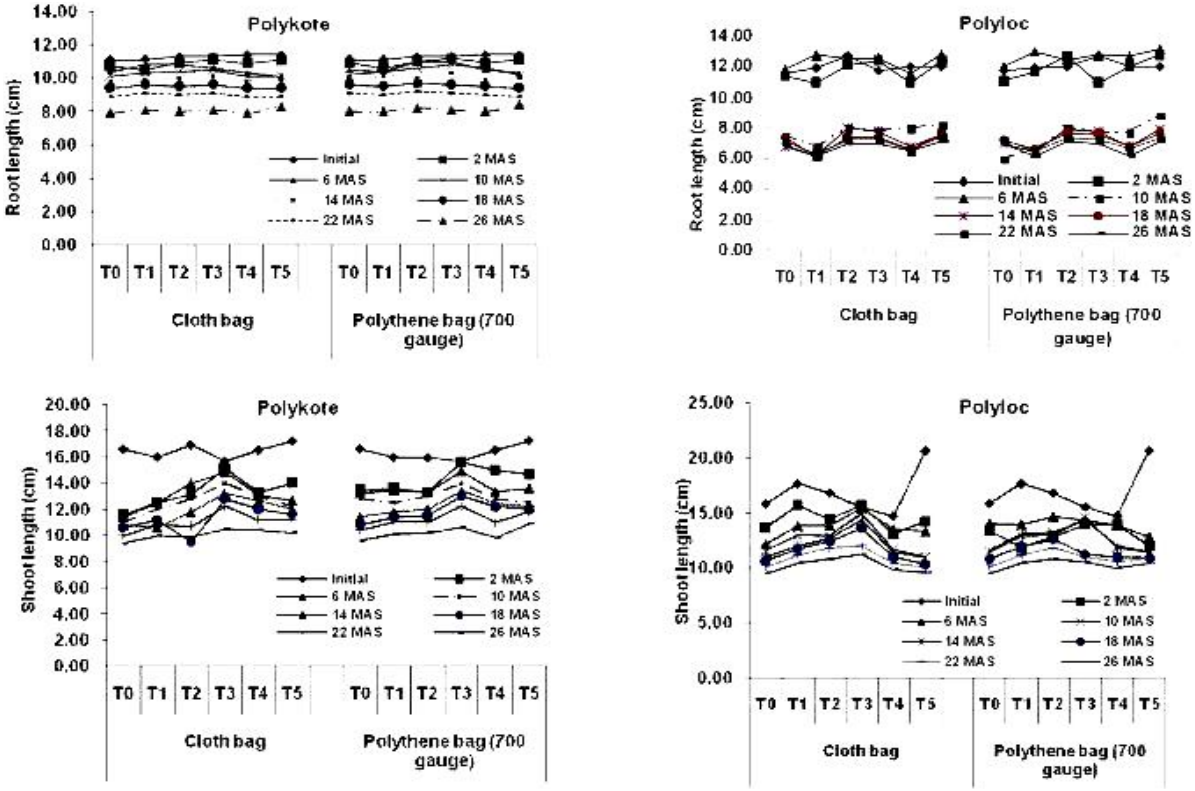

FIG. 2: Effect of polymer coating on root and shoot length (cm) of cotton cv. Sumangala under ambient storage

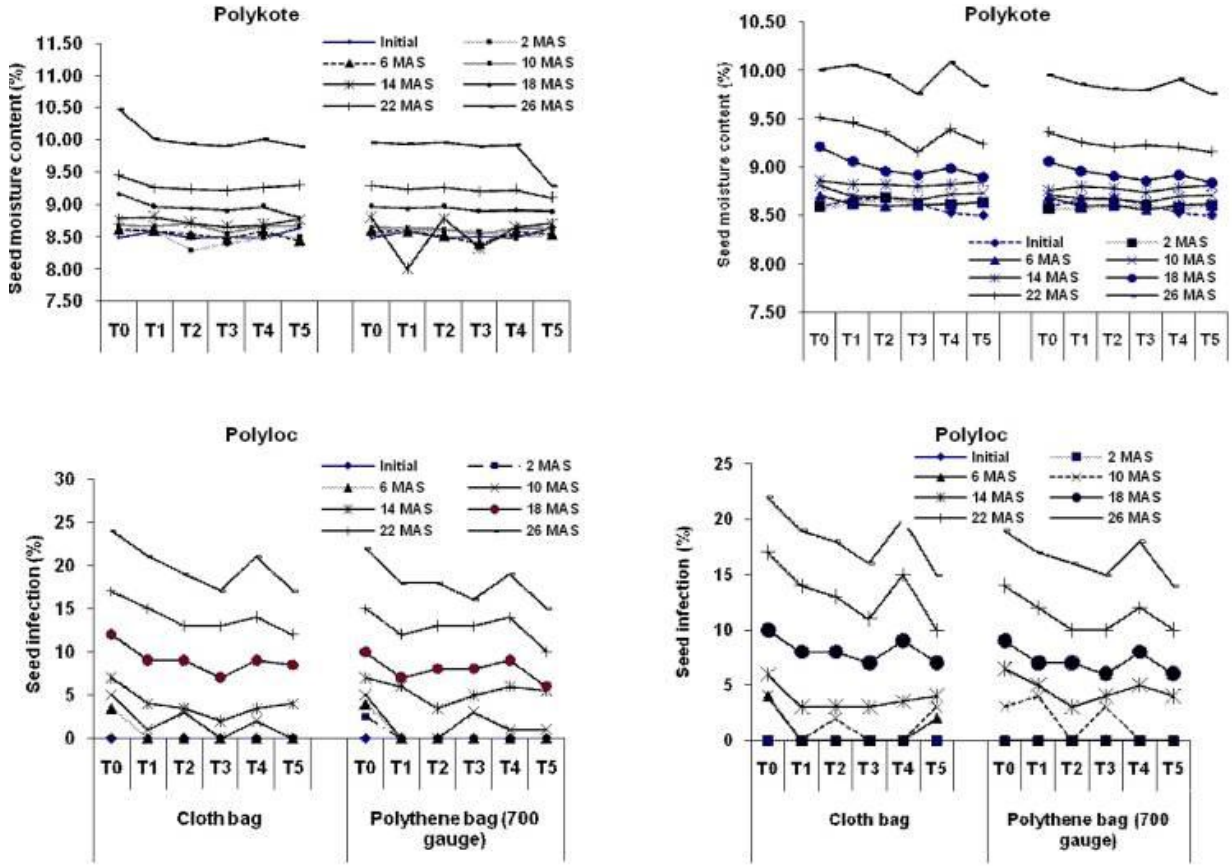

FIG. 3: Effect of polymer film coating on seed moisture content (%) and seed infection (%) of cotton cv. Sumangala under ambient storage

storage period, since the coating act as a barrier for dissipation of atmospheric moisture (Fig. 3). Similarly, increased germination and plant stand establishment from polymer-coated seed has been reported in canola (Kaur, and Bishnoi, 2008) and soybean seeds coated with polymer and aminoacids (Ludwig *et al*.,2011). Low performances of uncoated seeds are attributed to its higher moisture content and seed infections (Ludwig *et al*., 2011), which may indirectly triggers the metabolic process and fasten the deteriorative process. Impermeable nature of polymer to water vapour (Sherin *et al*., 2005,) might have prevented the seed moisture increase during storage, however, polymer did not inhibit water uptake during germination as it is highly water soluble and speed up the imbibition due to its hydrophilic nature (West *et al*., 1985). This is also in accordance with the finding of Dexter and Takao (1960), and they reported that surface coating with polymer did not accelerate uptake of moisture from the air in sugar beet seeds when stored at various relative humidity levels. The low degree of fungal infection in polymer+fungicide+ insecticide + colourant coated seeds might be due to the protection offered by the polymer against invading fungal pathogens (Hill, 1998; Robani 1994) and toxic effect of seed treating chemicals (Whipps *et al*., 2001). It was reported that mycelia growth was significantly less in polymer coated soybean seeds since polymer itself provide protection from the fungal invasion (West *et al*., 1985; Ludwig *et al*.,2011); in vegetable seeds (Whiteakar gary,2003) in maize (Sherin, 2003). The higher degree of seed moisture and seed infection recorded in seeds stored in cloth bag might be due to the high pervious nature which was less in polythene bag, due to its semi pervious to water vapour. The superiority of poly bag (700 gauge) seed in storage was recorded in green gram (Raja *et al*., 2003); in ragi (Vigneshwaran, 2002); in papaya (Sasikala, 2002) and in maize (Sherin, 2003). The decline in germination and vigour due to advancement of storage period might be due to depletion of food reserves and decline in synthetic activity (Raja *et al*., 2003) or due to the phenomenon of ageing of seeds associated with irreversible physical, physiological and biochemical changes occurring in them (Sherin, 2003).

CONCLUSION

The critical observations of the present investigation paved the way for conclusion that delinted cotton seeds film coated with polymer ("polykote" or "polyloc") with fungicide, insecticide, colourant and packed in polythene bag (700 gauge) stored for a period of 26 months under ambient storage conditions and the seeds are capable of maintaining its viability above Indian Minimum seed certification standards.

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