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Effect of seed coating materials on seed quality during storage of paddy

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Abstract
A laboratory experiment was conducted in the Department of Seed Science and Technology, Orissa University of Agriculture and Technology, Bhubaneswar to assess the effect of seed coating materials on storability of paddy seeds var-Naveen. After harvest seeds were treated with polymers, fungicides or their combinations and kept in storage under ambient condition in two different containers viz. cloth bag and 700 gauge polythene bag. Observations were recorded at monthly intervals on different seed quality parameters and the effect of different coating materials on storability of seeds was assessed. The results of the study revealed that there was increase in seed germination up to three months of storage (60-96%) and then decline in germination was observed. This indicated that there was seed dormancy in the paddy variety Naveen up to about 2 months and actual deterioration started after 4 months of storage. Seeds stored in 700 gauge polythene bags showed better performance and maintained germination percentage above minimum seed certification standard (80%) even after 7 months of storage compared to cloth bags.

Keywords: Germination, Vigour, Seed coating, Seedling, Seed treatment

Introduction

Rice (*Oryza sativa* L.) is a major dietary food for higher percentage of the world's population particularly in Asia, where more than 90 per cent of rice is grown. India has emerged as the second largest rice growing country in the world (Yuan 1970). Rice covers about 69 per cent of cultivated area and is the major crop, covering about 63 per cent of total area under food grains. So rice is a unique creation of crop plant domestication; it is unique in having cultivars of maturity duration varying from less than 80 days to more than 180 days and showing adaptability to a wide range of land situation and water regimes including conditions of water stagnation where no other crop could possibly be grown. Maintenance of seed vigor and viability during storage is a matter of prime concern in India. Owing to the prevailing sub-tropical climate in the major parts of the country, seeds of most crop species show rapid deterioration and rice is no exception. In general, there are differences among species (Agrawal, 1976) [1] and also among varieties within a species (Agrawal, 1978) with respect to loss of viability during storage of rice.

Research on storability of rice in India is of recent origin. With the development of organized seed production and marketing system in India, seeds men are becoming aware of the problems of seed storage and thereby systematic research has been initiated. It is estimated that 80 per cent of the certified seeds produced in India require storage for at least one planting season and 20 percent of the seed is carried over for subsequent sowings (Bal, 1976). However, when the awareness and infrastructure develops, substantial quantity of seeds may be stored for few planting season as a safeguard against monsoon failure and as a precaution against production of poor quality seeds. Seed quality is a multiple concept comprising several physical, chemical and biological components. Seed being a biological or living entity, deterioration in its quality is inevitable, irreversible and inexorable. It occurs with advance in ageing, which is common for all the living organisms. Seed deterioration is a phenomenon which begins immediately after attaining physiological maturity even on the mother plant itself (Helmer *et al.* 1962).

It is known fact that seed is a basic and crucial input in agriculture and it is the quality of seed that decides the commercial success of a crop variety. Obviously, the bumper harvest could be possible only when the seeds possess high quality standards *viz.*, purity, germination, uniformity in weight and size apart from freedom from pest and diseases. These quality traits are known to be influenced largely by interplay of environment, cultural, harvest and post-harvest management practices at both field and storage levels. Among these several factors, particularly maintenance of high quality seed in storage is the most important aspect in many crops and particularly in rice which is a major food grain of our country.

Materials and Method

The present investigation was planned to study the effect of seed coating materials on quality of paddy seed during storage. The experiment was conducted in the Seed testing laboratory of National Seed Project (NSP), Orissa University of Agriculture & Technology (OUAT), Bhubaneswar, located at a latitude of $20^0$15"N & longitude of $85^0$15"E with an elevation of 25.9 meter MSL(above mean sea level) & at 64km west of Bay of Bengal during the year October,2012 to June 2013.

The breeder seeds of paddy Cv. Naveen were obtained from the Central Research Station, Orissa University of Agriculture & Technology (OUAT), Bhubaneswar. This paddy variety Naveen (CR-749-20-2) was released from CRRI (Central Rice Research Institute), Cuttack and recommended for Odisha under both irrigated & rainfed cultivation. Its parentage is Sattari x jaya. It is a medium maturing (125days) variety with yielding ability of 4.5 tons per hectare with high adoptability.

The details of treatments are

T_0 : Control

T_1 : Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water)

T_2 : Flowable thiram (Royal flow 40 SC)@2.4ml/kg of seed

T_3 : Polymer + flowable thiram (T_1+T_2)

T_4 : Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed

T_5 : Polymer + vitavax200

Six kilograms of healthy freshly harvested seeds of paddy var-Naveen were taken in six separate plastic pots. Each plastic pot contained one kilogram of paddy seed. Among six plastic pots, five pots were treated with combination of different chemicals mentioned above in the treatment details & one is untreated control. After treatment of chemicals, the pots were shaked till the seeds were uniformly coated. Later on the treated seeds were spread on a sheet under the shade and dried completely. The seeds after treating were dried back to the original moisture level and stored in cloth bags and polythene bags separately. The design of the experiment adopted was two factors (factorial) Completely Randomized Design replicated three times. Monthly observations on seed quality parameters were recorded for a period of seven Months. About 5 g of finely ground seed material was taken separately from each treatment in a pre-weighed (M1) moisture estimation bottle and the weight was recorded (M2). The bottles were then placed in a hot air oven maintained at 103 ± 2°C for 16h. After that the bottles were cooled in a desiccators for 30 minutes and the final weight (M3) was recorded. The moisture content was calculated using the following formula and expressed as percentage on wet weight basis (ISTA, 1999).

$$\text{Moisture content (\%)} = \frac{M2 - M3}{M2 - M1} \times 100$$

Germination test was conducted in three replications of 100 seeds each by adopting between paper method as described by ISTA (Anon, 1999). The seeds were incubated at slanting position in a germinator at 25 ± 10^0C temperature and 95 per cent relative humidity during the germination test. The number of normal seedlings were counted on the 14th day ie. The day of final count for paddy and percentage germination was computed.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Number of seeds put for germination}} \times 100$$

Ten normal seedlings were selected randomly in each treatment from all the replications on fifth day (first count) & fourteenth day (final count) of germination test. The root length was measured from the tip of the primary root to base of hypocotyle with the help of a scale and mean root length was expressed in centimeters. The ten normal seedlings used for root length measurement, were also used for the measurement of shoot length. The shoot length was measured form the tip of the primary leaf to the base of the hypocotyle and mean shoot length was expressed in centimeter. The ten normal seedlings used for root and shoot length measurements were dried in a hot air oven at 85 ± 10 ^{0}C for 24 hours. The dry weight of the seedlings was recorded and expressed in grams.The seed vigour index was calculated by adopting the method suggested by Abdul-Baki and Anderson (1973) and expressed in number by using below formula.

Seed vigour Index-1 = Germination (%) x Seedling length (cm)

Seed vigour Index-2 = Germination (%) x Seedling dry weight

Storage fungi present on seeds were tested using blotter method as prescribed by ISTA. Ten seeds were placed equidistantly on three layered moistened blotter taken in sterilized Petri plates. Each treatment was replicated four times. They were incubated at 20 ± 2° C for seven days with alternate cycles of 12 h in near ultraviolet light (NUV) range and for the remaining 12 h in dark. On eighth day the plates were examined under stereobionocular microscope (50X) for the presence of seed borne fungi. The number of infected seeds were counted and expressed in percentage; besides this kind of fungi present were also identified and documented (ISTA, 1999). One hundred paddy seeds selected at random from each treatment in three replications was used for the seedling emergence studies. The seeds were sown in trays filled with well-prepared soil at 3 to 5 cm deep and covered with soil. Seedling emergence count was taken on the 14th day after sowing and the emergence percentage was calculated taking into account the number of normal seedlings emerged three centimeter above the soil surface.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedling emerged on 14}^{th}\text{ day}}{\text{Total number of seeds sow}} \times 100$$

The number of seeds germinated were counted daily in all the treatments in the germination test from first day to 14th day of the test. The seedlings with the plumule exposed (3.00cm) were considered as emerged. From the mean percentage of germination on each counting date, the speed of germination was calculated employing the following formula and expressed as whole number (Maguire, 1962).

$$GRI = \frac{X1}{Y1} + \frac{X2 - X1}{Y2} + \ldots + \frac{Xn - X(n-1)}{Yn}$$

Where,

GRI is Germination rate index
X1 is the number of seeds germinated on Y1 the day
Y1 is the day on which germination count was taken
Xn is the germination percentage on nth counting day
Yn is the number of days taken for nth date.
The data were statistically analyzed using analysis of variance appropriate factorial completely randomized design.

Result and Discussion

Storage of paddy seeds is an integral part of seed production and distribution system. Storage period means the period between the time of harvest of the crop and sowing for the next crop. When a seed produced in one season is used for sowing purpose in the subsequent season, then the storage period is usually shorter. However, when the seeds are used with a gap of one season or more, a long period of storage is inevitable. Paddy seeds are produced in both kharif and rabi seasons. Since paddy is cultivated extensively, the quantum of seed requirement is much higher. In practice, a part of seed demand is met through the stored seeds, which have been produced before one or two seasons. Sometimes seeds of some varieties maintain desirable germinability during storage because all the varieties under cultivation do not possess equal storability (Mishra, 2005) [5]. The present investigation has been planned in order to assess the storability of paddy seeds treated with polymers, fungicides or their combination. The results obtained from the investigation have been discussed under the following heads. The average value of seed moisture content before was 9.8% (Table.2). Since the seed treatment and storage in different containers was set in the month of November, 2012, the atomospheric relative humidity did not show appreciable rise till march 2013. With the onset of premonsoon there was remarkable rise in R.H. The moisture pervious container (cloth bag) could not protect the seeds from contact with the moisture content in the environment (RH). However, the seeds stored in moisture impervious container were virtually insulated from high RH prevalent in the external seed environment. As the seeds are poikilohydric in nature (Sahoo *et.al*., 1990) the moisture content was equilibrated with atomospheric RH when stored in cloth bags.

The changes in seed moisture content of seeds stored in cloth bags were observed at monthly intervals (Fig.1). During the first four months of storage there was slow rise in seed moisture content and the values ranged between 9.8% to 10.2%. However, after 4 months there was rapid rise in seed moisture content till 7 months of storage and the table values were more than 10.6%. Because of the poikilohydric nature of seeds, the rise in seed moisture content was proportional to the rise in atomospheric RH. The rise in seed moisture content was faster when seeds were stored in cloth bag.

In the moisture impervious container (polythene bag), the rise in seed moisture content was very slow and the observed peak values were about 10.2%. Since seeds were insulated from the high RH of the environment such low values were recorded. Again the small rise in seed moisture content might be attributed to accumulation of metabolic water, (Sahoo *et al*., 1999) [6] and also to incomplete imperviousness of the container. Seed treatment did not show any effect on changes in seed moisture content up to 3 months of storage and after that significant variation was observed among treatments. However container effect was well marked since beginning of the experiment in all the treatments. The findings of the present experiment confirmed the findings of previous workers (Paul *et al.* 1970, Khanna and Yadav 1979 [9], Agrawal 1980 [2], Kaur and Srivastava 1982, Haque and Haroo, 1983, Ankaiah *et al*., 1992 and Tripathy *et al.* 1996).

The assessment of the ability of seeds to germinate is the most useful and commonly used test of seed quality. Even under most ideal conditions of storage, loss in seed viability cannot be checked completely, but it could be substantially reduced. In the present investigation the average initial germination of paddy seeds before storage was 50 and 60 % (Table.3 & 4) in the first and final count respectively. There was progressive increase in germination values of seeds with increase of storage period irrespective of storage container and the peak germination values were 94 and 95 % after 3 months of storage in cloth bag and polythene bag respectively. Progressive decrease in germination was noticed after 4 months of storage. After 7 months of storage in cloth and polythene bags the 1st count germination values were 73 and 76 % respectively. Similar trend was obtained with regard to final germination count which was 82 and 84.5 % in cloth and polythene bag respectively. The germination value obtained after 7 months of storage was above the Indian Minimum Seed Certification Standard. The above result indicated that the kharif harvested paddy variety Naveen have seed dormancy up to a period of two months and the seeds can be safely stored up to more than 7 months under ambient condition.

Among the treatments T_5 (polymer + vitavax) and T_3 (polymer + flowable thiram) showed superiority over other treatment combinations. Polymer and fungicide alone did not show appreciable result with regard to storability; however, found better than control. The present finding agrees the positive role of polymer and fungicides on germination of paddy and other crop seeds (Vanangamudi, 2003, Sherin, 2003, Ramaya, 2003 [15], Saritha Devi, 2003, Keshvulu & Krishna Swami, 2005, Geetharani *et al*, 2005 and Vinitha, 2006) [16].

Seedling emergence value represents the expression of germination potentiality of a seed lot under the field condition. The results of seedling emergence as influenced by seed treatments, containers and their interactions are presented in the Table 5.

The seedling emergence of paddy seeds declined progressively with enhanced storage period. On an average, the seedling emergence percentage recorded at the beginning and at the end of storage period was 48% & 79% respectively. Significant difference in seedling emergence due to seed treatment was observed throughout the storage period except initial month. The polymer coating alone or in combination with fungicide (flowable thiram+vitavax) recorded significantly higher seedling emergence as compared to untreated control. Significantly higher seedling emergence was recorded in (T_5) both at 1st (88%) and at the end of storage period. i.e in 7th month (86%). Significantly lower seedling emergence was recorded throughout the storage period in untreated control (T_0) which recorded a seedling emergence of 64% at the end of 7th months of storage period. The seeds stored in polythene bag (PT) recorded significantly higher seedling emergence over cloth bag (CT) throughout the storage period. The seedling emergence percentage recorded with polythene bag (PT) & cloth bag (CT) at the end of 7th months of storage was 82 % & 77 % respectively.

When paddy seeds were stored in cloth bag the recorded seedling emergence values ranged between 64% and 84% after 7 months of storage and side by side when this same paddy seeds were stored in polythene bag the recorded seedling emergence values ranged between 72% and 86%

after 7 months of storage. However, it is noteworthy that the treated seeds either in moisture pervious container or moisture impervious container maintained a higher seedling emergence values as compared to untreated seeds. Such observations were also recorded in an experiment conducted earlier (Savitri *et al.*, 1998). The interaction effects due to containers and seed treatments differed significant except initial months of storage. A good number of workers recorded higher field emergence values of seeds stored in polythene bag in comparison to gunny bag confirming the present results. (Padmanabham *et al*., 1995, Savitri *et al*., 1998, Swain, 1999) [6]. Maintenance of higher seedling emergence values during storage might be attributed to slower deterioration.

The results of rate of germination as influenced by seed treatments, containers and their interactions are presented in the Table. 6. Significant differences in speed of germination due to seed treatments with polymer and fungicides like (flowable thiram, vitavax-200) and their combination were observed throughout the storage period. The polymer coating alone or in combination with fungicide recorded significantly higher rate of germination compared to untreated seeds.

Higher rate of germination was recorded with polymer coating @4ml + vitavax200@2g/kg seeds (T_5) both at 1st month (28) and at the end of storage period (23), followed by vitavax200 coating@2g/kg of seeds (T_4) which recorded the rate of germination (21) at the end of storage period. Significantly lower rate of germination was recorded throughout the storage period with untreated control (T_0), which recorded the rate of germination of (13) at the end of 7th month of storage. The rate of germination differed significantly with the containers throughout the storage period. The rate of germination recorded with polythene bag (PT) and cloth bag (CT) was (20) and (19) respectively. The interaction effects due to containers and treatments showed significant variation throughout the storage period. Higher rate of germination was recorded with PT_5 (23) and lower rate of germination was recorded with CT_0 (13) at the end of 7th month of storage period.

The results of root length as influenced by seed coating are presented in Table.7 & 8. The average root length of germinated seeds of paddy before storage was 2.7 and 8.0 cm in first count and final count respectively. The root length values increased progressively up to 4 months of storage in cloth bag and polythene bag as well as in all treatment combinations. After 4 months root length values started declining till the end of the experiment.

Significant differences in root length due to seed coated with polymer and fungicides were observed throughout the storage period. The polymer coating alone or in combination with fungicides recorded significantly higher root length compared to untreated control. The highest root length obtained was 20.6 and 12.2 cm after 4 and 7 months of storage respectively in polymer + vitavax200 coated seeds.

Significant difference in root length was also noticed among the seeds stored in cloth bag and polythene bag. Relatively lower root length of germinated seeds stored in cloth bags in comparison to polythene bags was observed. This indicated faster deterioration of seeds in cloth bags in comparison to polythene bags. Seed deterioration might have affected the translocation and growth process resulting in greater reduction in root length. Such observations were also recorded by Ghosh *et al*., 1978 and Babu *et al*., 1982.

The results of shoot length during storage as influenced by seed coating with polymer and fungicide are presented in Table. 9 & 10. The average shoot length of germinated seeds before storage was 1.8 and 10.5 cm at first and final count respectively. The shoot length values increased up to 4 months of storage and thereafter declined till the end of the experiment irrespective of containers and treatments. After 7 months of storage in cloth bag the shoot length values of germinated seeds ranged from 2.01 to 4.05 cm and 11.0 to 15.9 cm in the first and final count respectively. Where as in polythene bags it was 11.3 to 16.0 cm with significant variation among treatments. Relatively greater shoot length of germinated seeds was observed in the seeds stored in polythene bag than cloth bag. However, it did not reach the level of significance. Higher values of shoot length in polythene bag might be attributed to slower deterioration of seeds stored in polythene bags as compared to those stored in cloth bags. Such observation confirmed the earlier work of Toole (1953) and Toole *et al*., (1957) [10].

The average seedling length of germinated seeds of paddy var. Naveen before storage was 4.5 and 18.5 cm in the 1st and final count respectively (Table.11 & 12). The seedling length values increased progressively up to 4 months of storage in cloth bag and polythene bag as well as in all treatment combinations. After 4 months seedling length values started declining till the end of the investigation.

Significant differences in seedling length due to seed coated with polymer and fungicides were observed throughout the storage period. The polymer coating recorded significantly higher seedling length compared to untreated control. The highest seedling length obtained was 34 and 23 cm after 4 and 7 months of storage respectively. Significant difference in seedling length was also seen among the seeds stored in cloth bag and polythene bag. Relatively greater seedling length of germinated seeds stored in polythene bags might be attributed to slower deterioration of seeds as compared to those stored in cloth bag. Such observation confirmed the earlier works of Toole (1953) and Toole *et al*., (1957) [10] who stated that the deteriorated seeds if germinate are often produce seedlings which grow slowly.

The average root dry weight values of germinated paddy seeds var. Naveen before storage was 10.2 and 11.0 mg/10 seedlings at first and final count respectively. (Table.13 & 14). The root dry weight values increased up to 4 months of storage and there after declined till the end of the investigation irrespective of containers and seed coating materials. Significant differences in root dry weight due to seeds coated with polymer and fungicides were observed throughout the storage period. The polymer coating with vitavax-200 or thiram (18.0 and 21.1) recorded significantly higher root dry weight compared to untreated control at 7 months of storage. Significant variation in root dry weight was also seen among the seeds stored in cloth bag and polythene bag. Relatively greater root dry weight of germinated seeds might be attributed to slower deterioration of seeds as compared to those stored in cloth bag. Such observation confirmed the earlier works of Dadlani *et al.*, (1992) [13], Vanangamudi (2003), Saritha Devi (2004) [12] and Geetharani *et al.* (2005).

The average shoot dry weight values of germinated seeds of paddy var. Naveen before storage was 12.6 and 42.0 mg/10 seedlings at first and final count of storage there was gradual increase in shoot dry weight up to 4 months and after that decline in shoot dry weight was observed. After 7 months of storage in cloth bags the values ranged between 12.2 to 21.4 and 48.3 to 60.6 in first and final count where as in polythene bags it was 13.8 to 21.7 and 51.1 to 74.7 mg/10 seedling. Significant difference in shoot dry weight values was obtained

among different seed coating materials. Polymer coating with vitavax or thiram recorded higher shoot dry weight values compared to untreated control or polymer coating alone. The higher value of shoot dry weight obtained in polythene bag or seeds coated with polymer along with vitavax or thiram may be due to slower rate of deterioration of paddy seeds. This observation of the present study confirmed the finding of Ramya (2003) [15], Sarathi Devi (2004) [12], Keshvulu and Krishnaswami (2005) and Vinitha (2006) [16].

The results of seedling dry weight (root dry weight + shoot dry weight) as influenced by seed coating during storage are presented in Table 11 & 12. The average seedling dry weight of germinated seeds of paddy before storage was 22.8 and 53.0 mg in first and final count respectively. The seedling dry weight values increased progressively up to 4 months of storage in cloth bag and polythene bag as well as in all treatment combinations. After 4 months the seedling dry weight values started decreasing till the end of the investigation. Significant differences in seedling dry weight due to seed coated with polymer and fungicides were observed throughout the storage period. The polymer coating alone or in combination with vitavax-200 or thiram recorded higher seedling dry weight compared to untreated control. The highest root dry weight obtained was 118.6 and 95.8 mg after 4 and 7 months of storage respectively in polymer + vitavax-200 coated seeds. Significant difference in seedling dry weight was also noticed among the seeds stored in cloth bag and polythene bag. Relatively lower seedling dry weight of germinated seeds stored in cloth bags in comparision to polythene bags was observed indicating faster deterioration of seeds in cloth bags. Seed deterioration might have affected the translocation and growth process resulting in greater reduction in seedling dry weight. Such observations were also observed by Ghosh *et al.,* (1978), Babu *et al.,* (1982) and Dadlani *et al.,* (1992) [13]. In the present investigation, seed vigour is expressed in terms of "Seed Vigour Index". In order to derive the values of the parameter both seed germination and seedling length as well as seedling dry weight were taken into consideration.

The average value of vigour index-1 of paddy seeds before storage was 225 and 1110 in first count and final count respectively (Table.19 & 21). Similarly the vigour index-2 before storage was 114 and 318 in the first count and final count respectively (Table.20 & 22). Both vigour index values increased up to 4 months of storage and thereafter declined till the end of the investigation. signifiacnt variation in both the vigour index were observed in cloth and polythene bags throughout the storage period in first count as well as in final counts. Higher vigour index was noticed in seeds stored in polythene bags compared to cloth bag at all stages.

Similarly also significant differences were obtained in vigour index-1 and vigour index-2 values in the treatments. The treatment polymer + vitavax-200 as well as polymer + thiram recorded higher vigour index values over untreated control. Stored in both cloth bags and polythene bags. Significantly lower seed vigour index was recorded throughout the storage period with untreated control seeds which recorded vigour index values 336 and 1368 in first and final count at the end of 7th month. Storage period in the present investigation might be due to the hygroscopic nature of paddy seeds which absorb moisture from the atomosphere when stored in cloth bags. Such findings agree the results of Sangakara and Somaratne (1988) [11] who reported that the seeds absorb moisture from the ambient atomosphere when stored in moisture pervious containers like cloth bags. They also pointed out that loss of seed germinability and seedling vigour was associated with increasing seed moisture content and improper storage conditions.

These findings were also in agreement with the observations of Saxena *et al.* (1987) who found that seed germination and weight of both root and shoot of some vegetable seeds decreased with length of storage period in polythene bags at room temperature. Dadlani *et al*. (1992) [13] Saritha Devi (2004) [12] were also reported higher seedling dry weight and seedling length in seeds stored in polythene bags indicating slower rate of deterioration.

Another reason for the reduced seedling vigour of the deteriorated seeds as observed in the present investigation might be due to their slow growth. Toole (1953) and Toole *et al*. (1957) [10] stated that the deteriorated seeds, if they germinate at all, often produce seedlings which grow slowly. However, reduction in seedling growth which either precede or accompany loss of germinability do not necessarily occur in every case of deterioration (Anderson, 1970) [4] which suggests that germination and seedling growth, though closely related, are regulated by two mechanisms which seem to operate independently during surviving seed deterioration. Toole *et al* (1948) reported that the survived seedling may show poorly developed root and shoot. The results of seed infection as influenced by seed treatments, containers and their interactions are presented in the Table. 23. The seed infection per cent increased progressively with the enhanced storage period. On an average, the seed infection per cent recorded at the beginning and at the end of storage period was 2.3 and 7.6 per cent respectively. Lower seed infection was recorded in PT_4 at the end of storage period (2.6 %). Significantly higher seed infection was recorded throughout the % infection at the end of 7th months of storage.

Significant variations were recorded in containers throughout the storage period. Significantly lower seed infection was observed in polythene bag (7.21 %) compared to cloth bag (8.13 %) at the end of the 7th months of storage period. The interaction effects due to containers and seed treatments were significant throughout the storage period. Storage fungi have been reported to invade and destroy seeds if the seeds are not protected and storage environment is favourable to them, which may leads to loss of viability, development of discolouration of seeds. The incidence of storage pathogen increased with increase in storage period (Prasanna, 1994). The per cent infection differed with seed treatments and storage period. The minimum infection was observed in the seeds treated with vitavax-200@2g/kg seed, followed by polymer + flowable thiram treatment combination, which recorded 2.6 & 3.0 per cent respectively at the end of the storage period. Where as, the untreated control (T_0) seeds recorded significantly higher seed infection (17.0 %) at the end of the storage. This may due to the fluctuation in the moisture content of seed treated with or without polymer, fungicides.

Table 1: Meteorological data during the investigation period at seed testing laboratory, OUAT, Bhubaneswar

		Temperature (°C)		Relative humidity (%)		Rainfall
Year	**Month**	**Mean Max.**	**Mean Min**	**7hr**	**14 hr**	**In (mm)**
2012	December	29.9	15.3	93	44	0.0
2013	January	29.7	15.1	91	43	0.0
2013	February	32.3	16.7	90	37	2.8
2013	March	37.8	21.6	89	32	0.0
2013	April	32.9	21.4	90.6	55.2	100.6
2013	May	32.9	21.4	90.6	55.2	100.6
2013	June	33.0	21.3	90.5	54.5	99.3

Table No.2 EFFECT OF SEED COATING MATERIALS ON MOISTURE CONTENT(%) OF PADDY SEEDS DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	9.8	9.8	9.9	9.8	10.2	10.6	10.8	11.2
Ct_1	9.8	9.6	9.7	9.7	9.9	10.1	10.1	10.2
Ct_2	9.8	9.7	9.8	9.8	10.1	10.5	10.8	11.1
Ct_3	9.8	9.6	9.8	9.7	9.9	10.0	10.0	10.2
Ct_4	9.8	9.7	9.8	9.8	10.0	10.1	10.2	10.2
Ct_5	9.8	9.6	9.7	9.7	9.8	9.9	10.1	10.1
Pt_0	9.8	9.8	9.9	9.9	10.0	10.1	10.1	10.3
Pt_1	9.8	9.6	9.7	9.7	9.8	9.8	9.9	10.0
Pt_2	9.8	9.7	9.8	9.8	9.9	9.9	10.0	10.1
Pt_3	9.8	9.6	9.7	9.7	9.7	9.8	9.8	10.1
Pt_4	9.8	9.6	9.7	9.7	9.8	9.9	10.0	10.2
Pt_5	9.8	9.5	9.6	9.6	9.7	9.8	9.8	10.0
$Sem_{(C=}$		0.04	0.03	0.04	0.04	0.07	0.10	0.08
$CD_{(C)}5\%=$		NS	NS	NS	0.12	0.21	0.30	0.24
$Sem_{(T)=}$		0.07	0.05	0.07	0.07	0.13	0.18	0.14
$CD_{(T)}5\%=$		0.21	0.15	0.21	0.21	NS	0.52	0.42
$CD_{(interaction)}5\%=$		NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.3 EFFECT OF SEED COATING MATERIALS ON GERMINATION PERCENTAGE (FIRST COUNT) OF PADDY SEEDS DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	50(45.00)	50(45.000	76(60.67)	76(60.67)	72(58.05)	68(55.55)	64(53.13)	60(50.77)
Ct_1	50(45.00)	54(47.29)	86(68.03)	80(63.44)	80(63.44)	76(60.67)	72(58.05)	68(55.55)
Ct_2	50(45.00)	56(48.45)	88(69.73)	82(64.90)	82(64.90)	78(62.03)	76(60.67)	73(58.69)
Ct_3	50(45.00)	70(56.79)	90(71.56)	88(69.73)	88(69.73)	86(68.03)	82(64.90)	80(63.44)
Ct_4	50(45.00)	64(53.13)	90(71.56)	90(71.56)	86(68.03)	82(64.90)	80(63.44)	77(61.34)
Ct_5	50(45.00)	88(69.73)	90(71.56)	90(71.56)	88(69.73)	86(68.03)	84(66.42)	80(63.44)
Pt_0	50(45.00)	54(47.29)	80(63.44)	78(62.03)	74(59.34)	70(56.79)	68(55.55)	64(53.13)
Pt_1	50(45.00)	56(48.45)	86(68.03)	80(63.44)	80(63.44)	78(62.03)	74(59.34)	72(58.05)
Pt_2	50(45.00)	58(49.60)	90(71.56)	82(64.90)	84(66.42)	84(66.42)	80(63.44)	78(62.03)
Pt_3	50(45.00)	74(59.34)	92(73.57)	90(71.56)	90(71.56)	88(69.73)	84(66.42)	82(64.90)
Pt_4	50(45.00)	68(55.55)	92(73.57)	90(71.56)	88(69.73)	86(68.03)	84(66.42)	80(63.44)
Pt_5	50(45.00)	88(69.73)	92(73.57)	92(73.57)	90(71.56)	88(69.73)	86(68.03)	82(64.90)
$Sem_{(C)}$=		0.296	0.478	0.512	0.373	0.434	0.392	0.391
CD $_{(C)}$5%=		0.864	1.395	NS	1.088	1.266	1.145	1.142
$Sem_{(T)=}$		0.513	0.828	0.887	0.645	0.751	0.679	0.677
$CD_{(T)}$5%=		1.496	2.417	2.590	1.884	2.192	1.983	1.977
$CD_{(interaction)}$ 5%=		NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.4 EFFECT OF SEED COATING MATERIALS ON GERMINATION PERCENTAGE (FINAL COUNT) OF PADDY SEEDS DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	60(50.77)	58(49.60)	80(63.44)	90(71.56)	80(63.44)	80(63.44)	80(63.44)	72(58.05)
Ct_1	60(50.77)	60(50.77)	90(71.56)	92(73.57)	92(73.57)	90(71.56)	88(69.73)	78(62.03)
Ct_2	60(50.77)	62(51.94)	92(73.57)	94(75.82)	92(73.57)	92(73.57)	90(71.56)	82(64.90)
Ct_3	60(50.77)	74(59.34)	94(75.82)	96(78.46)	94(75.82)	94(75.82)	94(75.82)	88(69.73)
Ct_4	60(50.77)	70(56.79)	94(75.82)	94(75.82)	94(75.82)	94(75.82)	92(73.57)	84(66.42)
Ct_5	60(50.77)	92(73.57)	94(75.82)	96(78.46)	96(78.46)	96(78.46)	94(75.82)	88(69.73)
Pt_0	60(50.77)	58(49.60)	86(68.03)	90(71.56)	90(84.26)	90(71.56)	86(68.03)	75(60.00)
Pt_1	60(50.77)	60(50.77)	90(71.56)	94(75.82)	92(73.57)	92(73.57)	90(71.56)	80(63.44)
Pt_2	60(50.77)	68(55.55)	94(75.82)	94(75.82)	92(73.57)	92(73.57)	92(73.57)	85(67.21)
Pt_3	60(50.77)	78(62.03)	96(78.46)	96(78.46)	96(78.46)	96(78.46)	94(75.82)	90(71.56)
Pt_4	60(50.77)	7459.34)	94(75.82)	96(78.46)	94(75.82)	94(75.82)	94(75.82)	85(67.21)
Pt_5	60(50.77)	94(75.82)	96(78.46)	98(81.87)	96(78.46)	98(81.87)	96(78.46)	92(73.57)
$Sem_{(C)}$=		0.479	0.627	0.681	0.865	0.776	0.723	0.481
CD $_{(C)}$5%=		1.398	1.830	NS	NS	2.265	2.109	1.402
$Sem_{(T)=}$		0.829	1.086	1.180	1.499	1.344	1.252	0.832
$CD_{(T)}$5%=		2.421	3.170	3.442	4.373	3.922	3.653	2.429
$CD_{(interaction)}$5%=		NS	NS	NS	6.185	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.5 EFFECT OF SEED COATING MATERIALS ON SEEDLING EMERGENCE (%) OF PADDY SEEDS DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	48(43.85)	50(45.00)	70(56.79)	80(63.44)	82(64.90)	76(60.67)	74(59.34)	64(53.13)
Ct_1	48(43.85)	56(48.45)	82(64.90)	88(69.73)	92(73.57)	88(69.73)	84(66.42)	74(59.34)
Ct_2	48(43.85)	58(49.60)	84(66.42)	90(71.56)	92(73.57)	90(71.56)	88(69.73)	78(62.03)
Ct_3	48(43.85)	68(55.55)	88(69.73)	94(75.82)	94(75.82)	92(73.57)	92(73.57)	84(66.42)
Ct_4	48(43.85)	62(51.94)	88(69.73)	92(73.57)	94(75.82)	92(73.57)	90(71.56)	80(63.44)
Ct_5	48(43.85)	86(68.03)	90(71.56)	94(75.82)	96(78.46)	94(75.82)	94(75.82)	84(66.42)
Pt_0	48(43.85)	52(46.15)	74(59.34)	86(68.03)	88(69.73)	84(66.42)	78(62.03)	72(58.050
Pt_1	48(43.85)	58(49.60)	82(64.90)	90(71.56)	92(73.57)	88(69.73)	88(69.73)	80(63.44)
Pt_2	48(43.85)	62(51.94)	86(68.03)	92(73.57)	92(73.57)	90(71.56)	90(71.56)	82(64.90)
Pt_3	48(43.85)	72(58.05)	90(71.56)	96(78.46)	94(75.82)	94(75.82)	94(75.82)	86(68.03)
Pt_4	48(43.85)	66(54.33)	88(69.73)	96(78.46)	94(75.82)	94(75.82)	92(73.57)	84(66.42)
Pt_5	48(43.85)	88(69.73)	94(75.82)	98(81.87)	96(78.46)	96(78.46)	94(75.82)	86(68.03)
$Sem_{(C)=}$		0.58	0.64	0.59	0.72	0.65	0.05	0.39
$CD_{(C)}5\%=$		NS	NS	1.72	NS	NS	1.32	1.15
$Sem_{(T)=}$		1.01	1.11	1.02	1.25	1.13	0.78	0.68
$CD_{(T)}5\%=$		2.95	3.24	2.99	3.66	3.31	2.29	1.99
$CD_{(interaction)}5\%=$		NS	NS	NS	NS	NS	3.23	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.6 EFFECT OF SEED COATING MATERIALS ON SPEED OF GERMINATION OF PADDY SEEDS DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	14	14	17	31	37	36	19	13
Ct_1	14	15	27	38	38	39	22	19
Ct_2	14	20	29	41	41	40	22	20
Ct_3	14	22	32	43	43	43	23	21
Ct_4	14	21	31	41	43	42	23	20
Ct_5	14	25	36	45	45	44	23	22
Pt_0	14	14	18	32	37	37	21	18
Pt_1	14	19	29	39	40	40	22	19
Pt_2	14	21	31	41	42	42	22	20
Pt_3	14	22	32	45	45	43	23	21
Pt_4	14	21	31	43	43	42	23	21
Pt_5	14	28	38	47	46	45	24	23
$Sem_{(C)=}$		1.00	0.50	0.74	0.50	0.55	0.47	0.54
$CD_{(C)}5\%=$		NS	NS	NS	NS	NS	NS	NS
$Sem_{(T)=}$		1.74	0.88	1.29	0.87	0.96	0.82	0.94
$CD_{(T)}5\%=$		5.09	2.57	3.76	2.55	2.81	NS	2.75
$CD_{(interaction)}5\%=$		NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.7 EFFECT OF SEED COATING MATERIALS ON ROOT LENGTH (cm) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	2.70	3.09	3.10	3.80	4.55	4.25	3.60	3.60
Ct_1	2.70	3.17	3.27	4.90	5.60	5.20	4.90	3.95
Ct_2	2.70	3.38	3.38	5.70	6.20	5.75	5.30	4.50
Ct_3	2.70	3.61	3.80	7.15	7.60	7.50	6.65	6.00
Ct_4	2.70	3.49	3.53	5.50	7.00	6.30	6.30	5.50
Ct_5	2.70	3.69	3.95	8.10	8.85	8.00	7.35	6.20
Pt_0	2.70	3.13	3.17	4.55	5.10	4.80	4.30	3.70
Pt_1	2.70	3.30	3.33	5.50	5.75	5.70	5.15	3.85
Pt_2	2.70	3.49	3.50	6.35	6.90	6.55	5.85	5.05
Pt_3	2.70	3.63	3.75	7.20	8.70	8.10	6.95	6.15
Pt_4	2.70	3.53	3.55	7.00	7.40	7.30	6.60	5.70
Pt_5	2.70	3.92	4.20	8.30	9.10	8.50	7.40	7.10
$Sem_{(C)=}$		NS	NS	0.11	0.16	0.12	0.14	0.14
$CD_{(C)}5\%=$		NS	NS	0.33	0.47	0.37	NS	NS
$Sem_{(T)}$ =		NS	NS	0.19	0.28	0.22	0.24	0.25
$CD_{(T)}5\%=$		NS	NS	0.58	0.82	0.64	0.72	0.75
$CD_{(interaction)}5\%=$		NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.8 EFFECT OF SEED COATING MATERIALS ON ROOT LENGTH (cm) OF PADDY SEEDS (FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	8.0	8.7	11.7	12.7	14.7	14.5	8.4	8.0
Ct_1	8.0	9.2	11.9	15.1	15.5	13.9	8.9	8.6
Ct_2	8.0	10.0	12.4	15.1	15.5	13.9	8.9	8.6
Ct_3	8.0	11.9	13.5	16.4	18.4	17.4	11.0	10.8
Ct_4	8.0	11.5	13.2	15.3	17.7	17.2	10.4	10.2
Ct_5	8.0	13.2	14.4	17.6	18.9	17.5	11.7	11.4
Pt_0	8.0	9.0	11.7	13.7	14.9	14.5	8.5	8.1
Pt_1	8.0	9.7	12.2	14.3	15.7	15.3	9.4	9.0
Pt_2	8.0	11.5	12.8	15.1	17.3	16.8	10.1	9.8
Pt_3	8.0	12.3	14.3	17.5	18.7	16.9	11.3	11.3
Pt_4	8.0	11.8	13.4	17.4	18.3	16.2	10.4	10.4
Pt_5	8.0	14.9	16.9	20.1	20.6	19.1	13.0	12.2
$Sem_{(C)=}$		0.17	0.16	0.16	0.14	0.15	0.20	0.16
$CD_{(C)}5\%=$		0.51	0.48	0.47	0.42	0.44	NS	NS
$Sem_{(T)}$ =		0.30	0.28	0.28	0.25	0.20	0.34	0.28
$CD_{(T)}5\%=$		0.89	0.83	0.82	0.73	0.77	1.01	0.82
$CD_{(interaction)}5\%=$		NS	NS	1.15	NS	0.77	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.9 EFFECT OF SEED COATING MATERIALS ON SHOOT LENGTH (cm) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	1.80	2.00	2.00	2.22	2.95	2.35	2.20	2.01
Ct_1	1.80	2.00	2.37	3.03	3.25	3.20	2.90	2.45
Ct_2	1.80	2.45	2.50	3.31	3.65	3.55	3.23	3.20
Ct_3	1.80	2.80	3.15	3.90	4.25	4.17	3.90	3.85
Ct_4	1.80	2.70	2.90	3.65	3.83	3.70	3.65	3.57
Ct_5	1.80	3.05	3.55	4.64	4.80	4.75	4.10	4.05
Pt_0	1.80	2.20	2.25	3.02	3.05	3.02	2.45	2.31
Pt_1	1.80	2.40	2.45	3.14	3.55	3.30	3.12	3.10
Pt_2	1.80	2.70	2.80	3.55	3.65	3.59	3.55	3.38
Pt_3	1.80	2.80	3.40	4.17	4.50	4.45	4.10	4.00
Pt_4	1.80	2.70	2.95	3.88	4.16	4.10	3.83	3.80
Pt_5	1.80	3.50	3.55	4.89	5.75	5.40	4.25	4.05

$Sem_{(C)=}$	0.05	0.08	0.07	0.08	0.11	0.12	0.12
CD $_{(C)}$5%=	0.15	NS	0.22	0.25	0.34	NS	NS
$Sem_{(T)}$ =	0.09	0.14	0.13	0.15	0.20	0.21	0.22
$CD_{(T)}$5%=	0.26	0.42	0.38	0.44	0.59	0.62	0.65
$CD_{(interaction)}$5%=	NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.10 EFFECT OF SEED COATING MATERIALS ON SHOOT LENGTH (cm) OF PADDY SEEDS (FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	10.5	10.9	11.2	13.2	14.1	12.9	11.3	11.0
Ct_1	10.5	11.0	11.9	14.2	15.0	14.0	12.8	11.6
Ct_2	10.5	12.2	13.4	14.4	16.8	15.3	13.4	12.4
Ct_3	10.5	13.1	14.8	15.8	17.5	16.1	15.0	14.7
Ct_4	10.5	12.4	13.7	14.6	17.2	16.0	13.8	13.2
Ct_5	10.5	13.6	15.9	16.3	18.1	17.0	16.2	15.9
Pt_0	10.5	11.0	11.8	13.0	14.8	14.0	12.5	11.3
Pt_1	10.5	11.7	13.0	14.3	15.1	14.5	13.3	12.1
Pt_2	10.5	12.4	13.4	14.4	16.8	15.4	13.5	12.7
Pt_3	10.5	13.2	15.3	16.2	18.1	16.3	16.0	14.9
Pt_4	10.5	12.9	14.2	15.6	17.5	16.1	14.6	13.9
Pt_5	10.5	13.7	16.4	17.4	19.0	17.2	16.6	16.0

$Sem_{(C)=}$	0.13	0.15	0.14	NS	0.15	0.16	0.17
CD $_{(C)}$5%=	NS	0.46	NS	NS	NS	0.49	NS
$Sem_{(T)}$ =	0.23	0.27	0.25	NS	0.27	0.29	0.30
$CD_{(T)}$5%=	0.67	0.79	0.75	NS	0.79	0.85	0.88
$CD_{(interaction)}$5%=	NS	1.13	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.11 EFFECT OF SEED COATING MATERIALS ON SEEDLING LENGTH (cm) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	4.50	5.09	5.1	6.02	7.50	6.60	5.80	5.61
Ct_1	4.50	5.17	5.64	7.93	8.85	8.40	7.80	6.40
Ct_2	4.50	5.83	5.88	9.01	9.85	9.30	8.53	7.70
Ct_3	4.50	6.40	6.95	11.05	11.85	11.67	10.55	9.85
Ct_4	4.50	6.19	6.43	9.15	10.83	10.00	9.95	9.07
Ct_5	4.50	6.74	7.5	12.74	13.65	12.75	11.45	10.25
Pt_0	4.50	5.33	5.42	7.57	8.15	7.82	6.75	6.01
Pt_1	4.50	5.70	5.78	8.64	9.30	9.00	8.27	6.95
Pt_2	4.50	6.19	6.30	9.90	10.55	10.14	9.40	8.43
Pt_3	4.50	6.43	7.15	11.37	13.20	12.55	11.05	10.15
Pt_4	4.50	6.23	6.50	10.88	11.56	11.40	10.43	9.50
Pt_5	4.50	7.42	7.75	1`3.19	14.85	13.90	11.65	11.15

$Sem_{(C)=}$	0.14	0.16	0.12	0.21	0.16	0.15	0.22
$CD_{(C)}5\%=$	NS	NS	0.37	0.61	0.46	0.46	NS
$Sem_{(T)}$ =	0.25	0.29	0.22	0.36	0.27	0.27	0.38
$CD_{(T)}5\%=$	0.73	0.85	0.64	1.06	0.80	0.79	1.12
$CD_{(interaction)}5\%=$	NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.12 EFFECT OF SEED COATING MATERIALS ON SEEDLING LENGTH (cm) OF PADDY SEEDS(FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	18.5	19.6	22.9	25.9	28.8	27.4	19.7	.0
Ct_1	18.5	20.2	23.8	29.3	30.5	27.9	21.7	20.2
Ct_2	18.5	22.2	25.8	30.2	33.1	30.1	23.4	21.4
Ct_3	18.5	25.0	28.3	32.2	35.9	33.5	26.0	25.5
Ct_4	18.5	23.9	25.6	29.9	34.9	33.2	24.2	23.4
Ct_5	18.5	26.8	28.0	33.9	37.0	34.5	27.9	27.3
Pt_0	18.5	20.0	23.5	26.7	29.7	31.5	21.0	19.4
Pt_1	18.5	21.4	25.2	28.6	30.8	29.8	22.7	21.1
Pt_2	18.5	23.9	26.2	29.5	34.1	32.2	23.6	22.5
Pt_3	18.5	25.5	29.6	33.7	36.8	33.2	27.3	26.2
Pt_4	18.5	24.7	27.6	33.0	35.8	32.3	25.0	24.3
Pt_5	18.5	28.6	33.3	37.5	39.6	36.3	29.6	28.2

$Sem_{(C)=}$	0.49	0.21	0.24	0.20	0.24	0.30	0.27
$CD_{(C)}5\%=$	NS	0.63	0.70	0.58	0.72	0.88	NS
$Sem_{(T)}$ =	0.85	0.37	0.42	0.34	0.43	0.52	0.46
$CD_{(T)}5\%=$	2.49	1.09	1.28	1.01	1.25	1.52	1.36
$CD_{(interaction)}5\%=$	NS	1.55	1.73	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.13 EFFECT OF SEED COATING MATERIALS ON ROOT DRY WEIGHT (mg) OF (FIRST COUNT) OF PADDY SEEDS DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	10.2	10.4	11.6	13.2	15.9	12.1	11.8	11.1
Ct_1	10.2	10.9	12.9	15.8	18.7	14.1	13.4	12.8
Ct_2	10.2	12.8	15.2	17.2	21.2	17.1	15.5	13.1
Ct_3	10.2	14.1	17.9	20.6	24.8	21.2	17.1	14.3
Ct_4	10.2	13.4	16.2	18.2	22.7	18.2	15.8	13.5
Ct_5	10.2	15.6	18.8	21.7	27.1	22.9	17.9	16.2
Pt_0	10.2	11.4	13.8	15.5	18.4	14.1	12.2	11.4
Pt_1	10.2	12.8	14.6	16.9	20.8	16.5	14.6	13.2
Pt_2	10.2	14.1	16.4	18.6	22.2	17.4	15.9	14.4
Pt_3	10.2	15.2	18.4	21.5	25.3	22.7	18.7	15.4
Pt_4	10.2	14.8	16.6	19.9	24.7	20.3	16.4	14.2
Pt_5	10.2	16.2	20.4	24.1	29.1	25.8	20.1	18.2
$Sem_{(C)=}$		0.17	0.15	0.17	0.17	0.16	0.16	0.15
$CD_{(C)}5\%=$		0.50	0.45	0.50	0.51	0.48	0.47	0.45
$Sem_{(T)}$ =		0.29	0.27	0.29	0.30	0.28	0.28	0.26
$CD_{(T)}5\%=$		0.87	0.78	0.86	0.89	0.83	0.81	0.78
$CD_{(interaction)}5\%=$		NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.14 EFFECT OF SEED COATING MATERIALS ON ROOT DRY WEIGHT (mg) OF PADDY SEEDS (FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	11.0	11.2	12.0	13.0	13.8	13.1	12.5	11.6
Ct_1	11.0	11.0	11.8	12.3	15.6	14.5	12.1	11.0
Ct_2	11.0	11.4	12.6	13.8	17.0	14.8	12.7	11.1
Ct_3	11.0	12.2	14.7	16.5	18.8	17.1	13.3	13.0
Ct_4	11.0	10.2	13.0	15.1	18.0	16.8	14.1	11.5
Ct_5	11.0	16.2	17.9	20.7	24.1	21.5	20.1	17.1
Pt_0	11.0	11.9	12.0	15.5	16.0	14.4	12.4	12.0
Pt_1	11.0	12.1	12.8	13.3	16.8	14.6	12.4	11.4
Pt_2	11.0	11.1	13.9	14.5	17.4	16.5	12.7	11.4
Pt_3	11.0	12.8	15.4	17.8	19.2	18.4	15.2	13.0
Pt_4	11.0	10.4	13.0	15.9	17.1	18.3	14.9	22.2
Pt_5	11.0	21.0	21.1	24.0	26.0	26.0	21.1	21.1
$Sem_{(C)=}$		0.15	0.17	0.16	0.38	0.12	0.15	0.16
$CD_{(C)}5\%=$		0.44	0.51	0.48	1.12	0.37	0.46	0.47
$Sem_{(T)}$ =		0.26	0.30	0.28	0.66	0.22	0.27	0.28
$CD_{(T)}5\%=$		0.77	0.89	0.84	1.94	0.64	0.80	0.81
$CD_{(interaction)}5\%=$		1.09	1.26	1.18	2.75	0.91	NS	1.15

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.9 EFFECT OF SEED COATING MATERIALS ON SHOOT LENGTH (cm) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	1.80	2.00	2.00	2.22	2.95	2.35	2.20	2.01
Ct_1	1.80	2.00	2.37	3.03	3.25	3.20	2.90	2.45
Ct_2	1.80	2.45	2.50	3.31	3.65	3.55	3.23	3.20
Ct_3	1.80	2.80	3.15	3.90	4.25	4.17	3.90	3.85
Ct_4	1.80	2.70	2.90	3.65	3.83	3.70	3.65	3.57
Ct_5	1.80	3.05	3.55	4.64	4.80	4.75	4.10	4.05
Pt_0	1.80	2.20	2.25	3.02	3.05	3.02	2.45	2.31
Pt_1	1.80	2.40	2.45	3.14	3.55	3.30	3.12	3.10
Pt_2	1.80	2.70	2.80	3.55	3.65	3.59	3.55	3.38
Pt_3	1.80	2.80	3.40	4.17	4.50	4.45	4.10	4.00
Pt_4	1.80	2.70	2.95	3.88	4.16	4.10	3.83	3.80
Pt_5	1.80	3.50	3.55	4.89	5.75	5.40	4.25	4.05

$Sem_{(C)=}$	0.05	0.08	0.07	0.08	0.11	0.12	0.12
$CD_{(C)}5\%=$	0.15	NS	0.22	0.25	0.34	NS	NS
$Sem_{(T)}$ =	0.09	0.14	0.13	0.15	0.20	0.21	0.22
$CD_{(T)}5\%=$	0.26	0.42	0.38	0.44	0.59	0.62	0.65
$CD_{(interaction)}5\%=$	NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.16 EFFECT OF SEED COATING MATERIALS ON SHOOT DRY WEIGHT(mg) OF PADDY SEEDS (FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	42.0	42.8	43.8	58.3	58.9	57.4	51.6	48.3
Ct_1	42.0	52.8	56.3	60.7	62.5	61.1	60.8	55.5
Ct_2	42.0	56.8	57.4	65.4	71.8	63.7	61.1	59.5
Ct_3	42.0	60.8	68.5	72.7	78.2	65.6	64.8	64.5
Ct_4	42.0	57.8	63.2	68.1	76.0	67.7	60.9	60.6
Ct_5	42.0	62.6	69.6	78.4	92.6	73.5	69.3	68.0
Pt_0	42.0	50.7	52.1	58.0	58.4	59.0	55.3	51.1
Pt_1	42.0	56.4	56.5	65.0	68.0	62.7	61.1	56.3
Pt_2	42.0	57.6	61.7	65.6	73.7	63.8	60.5	59.9
Pt_3	42.0	62.3	69.1	77.4	80.8	72.9	68.0	67.2
Pt_4	42.0	58.0	63.2	68.1	77.0	71.4	64.8	63.0
Pt_5	42.0	68.4	72.3	87.0	92.6	90.1	78.4	74.7

$Sem_{(C)=}$	0.14	0.16	0.15	0.15	0.17	0.16	0.18
$CD_{(C)}5\%=$	0.43	0.47	0.46	0.44	0.51	0.49	0.54
$Sem_{(T)}$ =	0.25	0.27	0.27	0.26	0.30	0.29	0.32
$CD_{(T)}5\%=$	0.75	0.81	0.79	0.77	0.88	0.85	0.95
$CD_{(interaction)}5\%=$	1.06	1.15	1.12	1.09	1.25	1.20	1.34

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.17 EFFECT OF SEED COATING MATERIALS ON SEEDLING DRY WEIGHT (mg) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	22.8	23.2	25.3	28.4	33.8	27.2	24.9	23.3
Ct_1	22.8	24.0	27.2	32.3	38.3	32.2	28.5	25.9
Ct_2	22.8	28.0	32.5	37.3	43.6	37.7	33.9	28.5
Ct_3	22.8	32.2	38.6	44.9	51.2	46.5	38.9	30.7
Ct_4	22.8	29.6	33.3	40.7	47.3	39.9	34.6	29.1
Ct_5	22.8	35.4	41.7	48.1	55.7	49.4	42.0	37.6
Pt_0	22.8	24.8	28.5	32.1	37.6	31.2	25.7	25.2
Pt_1	22.8	27.4	30.2	33.5	43.4	38.1	29.9	26.4
Pt_2	22.8	29.7	33.9	39.0	45.5	38.9	35.8	30.7
Pt_3	22.8	35.9	42.1	48.7	54.4	49.1	40.9	35.6
Pt_4	22.8	33.6	37.0	44.1	51.5	42.4	37.9	32.3
Pt_5	22.8	38.1	44.6	52.3	60.5	54.6	47.0	39.9

$Sem_{(C)=}$	0.23	0.29	0.44	0.21	0.24	0.42	0.24
$CD_{(C)}5\%=$	0.69	0.84	1.29	0.63	0.71	1.24	0.72
$Sem_{(T)}$ =	0.41	0.50	0.76	0.37	0.42	0.74	0.42
$CD_{(T)}5\%=$	1.20	1.46	2.23	1.09	1.24	2.15	1.24
$CD_{(interaction)}5\%=$	NS	NS	NS	NS	1.76	NS	1.76

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.18 EFFECT OF SEED COATING MATERIALS ON SEEDLING DRY WEIGHT (mg) OF PADDY SEEDS (FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	53.0	54.0	55.8	71.8	72.7	70.5	64.1	59.9
Ct_1	53.0	63.8	68.1	73.0	78.1	75.6	72.9	66.5
Ct_2	53.0	68.2	70.0	79.2	88.8	78.5	73.8	70.6
Ct_3	53.0	73.0	83.2	89.2	97.0	82.7	78.1	77.5
Ct_4	53.0	68.0	76.2	83.2	92.8	84.5	75.0	72.1
Ct_5	53.0	78.8	87.5	99.1	116.7	95.0	89.4	85.1
Pt_0	53.0	62.6	64.1	73.5	74.4	73.4	67.7	63.1
Pt_1	53.0	68.5	69.3	78.3	84.8	77.3	73.5	67.7
Pt_2	53.0	68.7	75.6	80.1	91.1	80.3	73.2	71.3
Pt_3	53.0	75.1	84.5	95.2	100	91.3	83.2	80.2
Pt_4	53.0	68.4	76.2	89.0	94.1	89.7	79.7	85.2
Pt_5	53.0	89.4	93.4	111	118.6	116.1	99.5	95.8

$Sem_{(C)=}$	0.23	0.25	0.28	0.214	0.212	0.21	0.19
$CD_{(C)}5\%=$	0.68	0.73	0.82	0.62	0.61	0.61	0.58
$Sem_{(T)}$ =	0.40	0.43	0.49	0.37	0.36	0.36	0.34
$CD_{(T)}5\%=$	1.18	1.27	1.43	1.08	1.07	1.07	1.00
$CD_{(interaction)}5\%=$	1.67	1.80	2.02	1.53	1.51	1.51	1.42

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.19 EFFECT OF SEED COATING MATERIALS ON VIGOUR INDEX- 1 (germination x seedling length) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	225	254	387	457	540	448	371	336
Ct_1	225	279	485	634	708	638	561	435
Ct_2	225	326	517	738	807	725	648	562
Ct_3	225	448	625	972	1042	1003	865	788
Ct_4	225	396	578	823	931	820	796	698
Ct_5	225	593	675	1146	1201	1096	961	820
Pt_0	225	287	433	590	603	547	459	384
Pt_1	225	319	497	691	744	702	611	500
Pt_2	225	359	567	811	886	851	752	657
Pt_3	225	475	657	1023	1188	1104	928	832
Pt_4	225	423	598	979	1017	980	876	760
Pt_5	225	652	713	1213	1336	1223	1001	914

$Sem_{(C)}$=	11.61	14.75	12.34	22.52	10.98	14.65	16.40
CD $_{(C)}$5%=	33.89	NS	36.02	65.73	32.06	42.77	47.88
$Sem_{(T)}$ =	20.11	25.55	21.38	39.01	19.03	25.39	28.42
$CD_{(T)}$5%=	58.69	74.59	62.40	113.85	55.54	74.09	82.94
$CD_{(interaction)}$5%=	NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.20 EFFECT OF SEED COATING MATERIALS ON VIGOUR INDEX -2 (germination x seedling dry weight) OF PADDY SEEDS (FIRST COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	114	116	192	215	243	184	159	139
Ct_1	114	129	233	258	306	244	205	176
Ct_2	114	156	286	305	357	294	257	208
Ct_3	114	225	347	395	450	399	318	245
Ct_4	114	189	299	366	406	327	276	224
Ct_5	114	311	375	432	490	424	352	300
Pt_0	114	133	228	250	278	218	174	161
Pt_1	114	153	259	268	347	233	221	190
Pt_2	114	172	305	319	382	326	286	239
Pt_3	114	265	387	438	489	432	343	291
Pt_4	114	228	340	396	453	364	318	258
Pt_5	114	335	410	481	544	480	404	327

$Sem_{(C)}$=	1.75	3.21	3.65	3.04	3.07	15.63	4.86
CD $_{(C)}$5%=	5.11	9.38	10.67	8.87	8.96	45.61	14.19
$Sem_{(T)}$ =	3.03	5.56	6.33	5.26	5.32	27.07	8.42
$CD_{(T)}$5%=	8.85	16.25	18.48	15.37	15.53	79.00	24.58
$CD_{(interaction)}$5%=	12.51	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.21 EFFECT OF SEED COATING MATERIALS ON VIGOUR INDEX -1 (germination x seedling length) OF PADDY SEEDS(FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	1110	1136	1832	2331	2304	2192	1576	1368
Ct_1	1110	1212	2142	2695	2806	2511	1909	1575
Ct_2	1110	1376	2373	2838	3045	2769	2106	1754
Ct_3	1110	1850	2660	3091	3374	3149	2444	2244
Ct_4	1110	1673	2406	2810	3280	3120	2226	1965
Ct_5	1110	2465	2632	3254	3552	3312	2622	2402
Pt_0	1110	1160	2021	2403	2673	2835	1806	1455
Pt_1	1110	1284	2268	2688	2833	2741	2043	1688
Pt_2	1110	1625	2462	2773	3137	2962	2171	1912
Pt_3	1110	1989	2841	3235	3532	3178	2566	2358
Pt_4	1110	1827	2594	3168	3365	3036	2350	2065
Pt_5	1110	2688	3196	3675	3484	3557	2841	2594

$Sem_{(C)=}$	39.04	24.74	199.04	28.70	29.67	30.32	27.13
$CD_{(C)}5\%=$	NS .	72.20	NS	83.78	86.61	88.51	79.18
$Sem_{(T)}$ =	67.63	42.85	344.75	49.72	51.40	52.53	49.99
$CD_{(T)}5\%=$	197.37	125.05	1006.12	145.11	150.01	153.30	137.14
$CD_{(interaction)}5\%=$	NS	NS	NS	NS	NS	NS	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Table No.22 EFFECT OF SEED COATING MATERIALS ON VIGOUR INDEX -2 (germination x seedling dry weight) OF PADDY SEEDS(FINAL COUNT) DURING STORAGE

	Months after storage							
TREATMENT	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month
Ct_0	318	313	446	641	581	564	512	431
Ct_1	318	382	612	671	718	680	641	518
Ct_2	318	422	644	744	816	722	664	578
Ct_3	318	540	782	856	911	773	734	682
Ct_4	318	476	716	782	872	794	690	605
Ct_5	318	724	822	951	1120	912	840	748
Pt_0	318	363	551	661	669	660	768	473
Pt_1	318	411	623	736	780	711	661	541
Pt_2	318	467	710	752	838	738	673	606
Pt_3	318	585	811	913	960	876	782	721
Pt_4	318	506	716	854	884	843	749	724
Pt_5	318	840	896	1087	1138	1137	952	881

$Sem_{(C)=}$	4.39	4.87	4.63	5.74	5.81	5.07	11.38
$CD_{(C)}5\%=$	12.81	14.23	13.52	16.76	16.98	14.80	33.21
$Sem_{(T)}$ =	7.60	8.45	8.02	9.94	10.07	8.78	19.71
$CD_{(T)}5\%=$	22.19	24.66	23.43	29.02	29.41	25.64	57.53
$CD_{(interaction)}5\%=$	31.38	34.87	33.13	41.05	41.59	36.26	NS

T_0:Control, T_1:Polymer coating (polykote@4ml/kg of seed diluted with 5ml of water), T_2:Floable thiram (Royal flow 40 SC)@2.4ml/kg of seed, T_3:Polymer + floable thiram (T_1+T_2), T_4:Vitavax200 (containing Thiram 37.5% & carboxyl 37.5%) @2g/kg seed, T_5:Polymer + vitavax200

Conclusion

The germinability above MSCS level for a longer period, improved methods of storage are to be adopted. The results of paddy seeds in 700 gauge polythene bag with polymer coating in combination with either vitavax-200 or thiram can maintain germinability and vigour at acceptable levels for longer period.

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