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Influence of temperature and relative humidity on viability of coated seeds of chilli under stored conditions

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Abstract: *The Seed is the primary investment for successful crop production that demands good germination to produce a vigorous seedling ensuring high yields. The chilli seed after extraction from pod is viable for shorter periods ranging from 8-10 months under ambient storage conditions. This hybrid chilli seed is the most critical input to the farmer and is available in the market after coating with polymer/fungicide. Weather parameters like temperature and relative humidity play a key role in maintaining the viability of chilli seed during open storage. Keeping this in view a study was initiated at YSRHU, HRS, Lam under AICRP on vegetable Crops during 2009-11 for a period of 20months with 5 periods of storage viz; 6months, 8months, 12months, 16months and 20 months and 6 Seed Coatings i.e., polymer, imidacloprid, bavistin, polymer and imidacloprid, Polymer and bavistin, polymer with imidacloprid and bavistin and untreated seed as control. The meteorological data for the period under the study and its influence on seed viability parameters as %germination, %field emergence, %mortality and speed of germination was recorded at different periods of storage. The seedling vigour indices were also studied as influenced by the temperature and relative humidity. During the period under study the mean maximum temperature ranged from 29.5 to 41.7^oC and mean minimum temperature ranged from 16.1 to 27.9^oC and the mean morning relative humidity ranged from 70.1 to 96.2 and the mean evening relative humidity ranged from24.2 to 73.1. There was gradual decrease in all the above viability parameters of chilli seed starting from 6months to 20months of ambient storage. Among the storage periods percent field emergence was within the acceptable limit (> 60%) up to twelve months of storage. Among the different combinations of seed coatings with polymer and polymer with different plant protection chemicals the seed coated with polymer alone was viable and recorded field emergence >60% up to 6months of storage under ambient conditions. Seed coated with plant protection chemicals alone or in combination with polymer lost its viability during storage before six months under ambient conditions. It can be inferred that under ambient conditions of storage the chill seed can be stored viable for 6months when coated with polymer alone and for 12months without any seed coating.*

Keywords: *Relative humidity, Seed, Storage, Temperature, Variability, and Vigour.*

I. Introduction

Chilli (*Capsicum annum* L.) is an important spice and vegetable crop of global importance valued for its colour, flavour and nutritional value (Berke *et al.*, 2004). Under ambient conditions the chilli seeds with thin seed coat show rapid deterioration in the prevailing tropical to subtropical climate in India. (Umajyothi *et al*., 2008) To combat this situation in recent times the *film coating* techniques on the seeds are being studied. These film formulations consist of a mixture of polymer, plasticizer and colourants (Robani, 1994). These are commercially available as ready to use liquids or as dry powders (Ni 1997). The polymer film coating may act as a physical barrier, which has been reported to reduce the leaching of inhibitors from the seed coat and may restrict oxygen diffusion to the embryo (Vanangamudi *et al*., 2003) thus reducing the speed of deterioration. Seed coating with synthetic polymer (polykote) in combination with fungicides was a tool for quality hybrid rice seed storage and was effective against seed and soil borne pathogens (Pham Long Giang and Rame Gowda 2007). It is the immediate need to develop polymer based seed coats that prevent moisture entry, fungus penetration and insect attack during storage (Jitendra Kumar *et al*., 2007). Hence in the present investigation efforts have been made to study the seed quality status of polymer coated chilli seed during storage in ambient conditions under the coastal environment of Andhra Pradesh with high temperature and high relative humidity.

II. Materials And Methods

A storage experiment was carried out from 2009-11 at Dr. Y.S.R.H.U., HRS, Lam under AICRP on Vegetable crops. The harvested chilli seeds of the year 2008-09 were taken, cleaned, dried to 7%moisture content and then treated with polymer coatings and stored in cloth bags for 20 months. The experiment was done in RBD with factorial concept with 35 treatment combinations with 5 periods of storage for study i.e., 6months, 8months, 12months, 16months and 20months and 6 seed coatings with polymer (10 mg/1kg seed), Imidacloprid (8 g/1kg seed), Bavistin (1g/kg seed) and combination of polymer with Imidacloprid, Bavistin and untreated seeds as control.

The temperature and relative humidity for the period under study and its influence on seed viability was recorded at the specific periods of storage. The seed samples were drawn at specific periods of study and the observations were recorded on germination percentage (ISTA 1993) seedling length, vigour index (Abdul Baki and Anderson, 1973), field emergence, mortality and speed of germination. The data obtained from the experiment was subjected to statistical analysis (Panse and Sukhmate, 1985).

III. Results And Discussion

The safe storage conditions for short periods, from harvest to next planting season (1-9 months) are those in which the seed equilibrium moisture is lower than 14%for cereal seeds, 11% for oil seeds and 7-8 % for most of the vegetable seeds. This means seed moisture in equilibrium with 50%RH at 30^{o}c or 60% RH at 20^{o}c (Delouche *et al*., 1973) or with 65% RH at a temperature higher than 33^{o}c for only few hours.

During the period under study the mean maximum temperature ranged from 29.5^{0}C to 41.7^{0}C and mean minimum temperature ranged from 16.1^{0}C to 27.9^{0}C. The mean morning relative humidity ranged from 70.1 to 96.2 % and the mean evening relative humidity from 24.2 to 73.1 %.

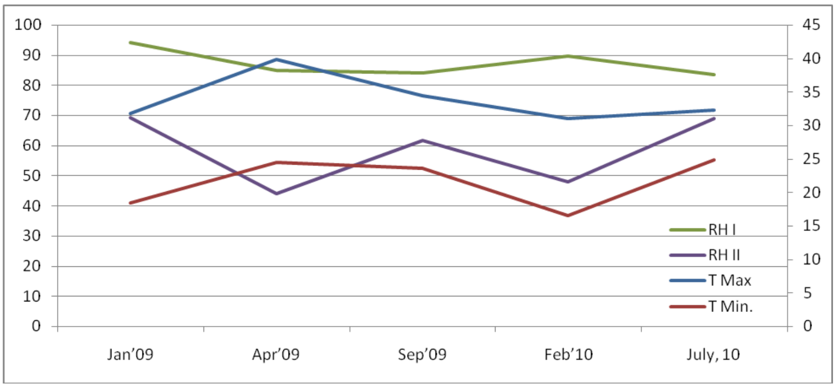

Figure 1: Temperature and Relative Humidity during the storage period

Under this prevailing climatic storage under high fluctuating temperatures and moisture levels, the seed being highly hygroscopic living material it absorbs moisture from air if it is stored in an environment where relative humidity is higher than seed moisture content.

There was gradual decrease in all the viability parameters of chilli seed *i.e.*, from 92.29 to12% in germination ,72.21 to3 % in field emergence,31.9 to 1.04 in speed of germination,5.53to1.23 in SVR-Iand 669.21 to40.87 in SVI-II starting from 6months to 20months period of ambient storage. Among the storage periods percentage field emergence was within the acceptable limit (> 60%) up to twelve months of storage. The treatment decline over periods of storage for viability of chilli seed might be attributed due to storage in cloth bag where there was much fluctuation in seed moisture .It could be attributed to the hastened process of deterioration in the seed collected from the chilli kept at high temperatures and high humidity and stored in cloth bags. Similar results were reported in chilli by Doijode (1991) UmaJyothi *et al*., (2008) Barua *et al*., (2009). The decline in viability parameters of the seeds might be attributed to ageing effect, leading to depletion of food reserves and synthetic activity of embryo apart from death of seed because of fungal invasion, insect damage and storage conditions.

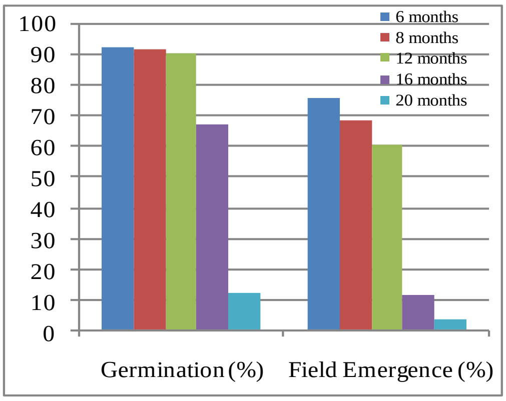

Figure 2: Germination and field emergence as influenced by periods of storage

The viability of chilli seed was significantly influenced by different combinations of seed coatings with polymer and polymer with different plant protection chemicals. Among the seed coatings treatments maximum seed germination (78.32 %), field emergence percentage (38.2 %) least mortality (15.23%)higher vigour indices (3.32 and 474.3) were recorded in control *i.e.* untreated seed closely followed by the seed treated with polymer alone (T2) and significantly superior over other polymer treatments.

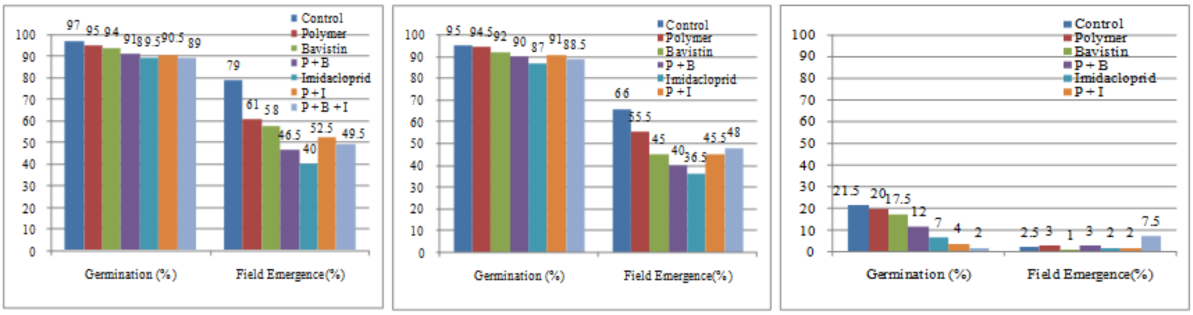

Figure 3: Germination and field emergence as affected by seed coatings at 6, 12 and 20 months after storage

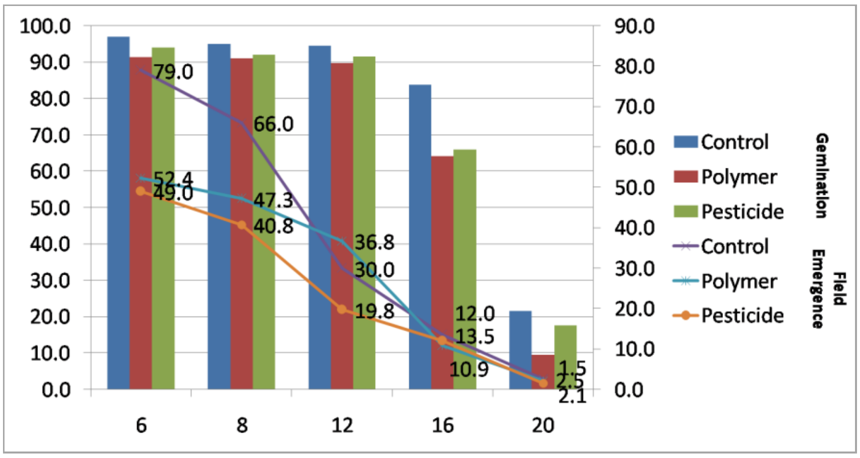

Figure 4: Germination and field emergence during storage period in Control (C), Polymer (P) and Pesticide coatings.

From the treatment interactions it was observed that the untreated chilli seed maintained its viability up to 12 months. However, among the treatments all the viability parameters were below the minimal standards with regard to field emergence, speed of germination and vigour indices after six months of storage. Similar results of decrease of viability parameters due to seed coating with dye, pelleting and polymer with increase in storage period was reported in cotton (Vijaykumar *et al*., 2007), Soya bean (Kurdikeri *et al*., 1996), hybrid Rice (Rettinassababady *et al*., 2012), Tomato (Shashibhaskar *et al*., 2012) and Chilli (Manjunatha *et al*., 2008).

IV. Conclusion

. There was gradual decrease in all the seed viability characters of chilli over periods of storage starting from 6months to 20months. Seed coated with plant protection chemicals alone or in combination with polymer lost its viability during storage before six months under ambient conditions. It can be inferred that under ambient conditions of storage the chill seed can be stored viable for 6months when coated with polymer alone and for 12months without any seed coating.

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Table 1. Effect of seed coatings and periods of storage on seed viability parameters

Treatments	Germination %	Field Emergence %	Mortality %	Speed of germination	Seedling Vigour Index-I	Seedling Vigour Index-II
Factor I : Storage Periods (S)						
S1-6 months	92.29 (74.20)	75.21 (62.51)	36.93 (37.30)	31.92	5.53	669.21
S2-8 months	91.14 (72.90)	68.07 (56.84)	43.07 (40.99)	24.62	5.54	627.13
S3-12 months	90.29 (71.99)	60.21 (50.13)	12.72 (19.91)	8.26	3.98	566.21
S4-16 months	66.89 (55.21)	11.57 (19.39)	10.87 (18.79)	2.16	2.13	583.83
S5-20 months	12.00 (19.10)	3.0 (9.4)	13.81 (12.56)	1.04	1.23	40.87
CD (5%)	**1.2**	**1.25**	**1.17**	**0.99**	**0.14**	**4.81**
Factor II: Seed Coatings (T)						
T1-Control	78.35(65.49)	38.2 (36.16)	15.3 (19.02)	14.61	3.32	474.3
T2-Polymer	76.80(63.81)	32.29 (33.08)	25.28 (29.43)	16.18	3.55	475.0
T3-Bavistin 1%	72.20(60.29)	30.0 (30.92)	16.56 (20.44)	11.35	4.34	445.9
T4-Polymer-Bavistin1%	69.80(58.04)	26.7 (29.18)	24.44 (25.51)	11.76	3.55	544.3
T5-Imidacloprid 1%	66.55(55.25)	19.2 (23.49)	25.37 (26.73)	11.32	3.39	432.1
T6 –Polymer – Imidacloprid 1%	66.05(55.01)	29.2 (30.16)	21.58 (24.66)	14.72	3.55	481.0
T7 –Polymer – Imidacloprid 1% - Bavistin 1%	63.90(52.84)	32.1 (32.96)	35.81 (35.58)	15.21	3.92	559.7
CD (5%)	**1.41**	**1.48**	**0.91**	**1.17**	**0.17**	**5.69**

Table 2: Interaction of periods of storage and seed coatings on seed viability parameters

Treatments	Germination %	Field Emergence %	Mortality %	Speed of germination	Seedling Vigour Index-I	Seedling Vigour Index-II
S1T1	**97.0 (80.1)**	**79.0 (62.71)**	26.0 (30.63)	36.1	5.6	459.0
S1T2	**95.0 (77.1)**	**61.0 (51.34)**	36.0 (36.85)	37.9	5.1	571.6
S1T3	94.0 (75.8)	58.0 (49.58)	47.0 (43.26)	26.6	6.5	537.6
S1T4	91.0 (72.5)	46.5 (42.98)	28.5 (32.25)	24.1	5.0	580.2
S1T5	89.5 (71.1)	40.0 (39.21)	47.0 (43.26)	30.1	5.3	508.1
S1T6	90.5 (72.0)	52.5 (46.41)	34.5 (35.96)	34.7	5.6	511.5
S1T7	89.0 (70.6)	49.5 (44.70)	39.5 (38.92)	34.2	5.0	466.5
S2T1	**95.0 (77.1)**	**66.0 (54.32)**	38.0 (38.04)	20.7	5.5	659.5
S2T2	**94.5 (76.4)**	**55.5 (48.14)**	41.0 (39.80)	28.4	4.9	629.0
S2T3	92.0 (73.5)	45.0 (42.11)	50.0 (44.98)	23	6.6	571.8
S2T4	90.0 (71.5)	40.0 (39.22)	40.0 (39.21)	21.3	4.8	614.8
S2T5	87.0 (68.9)	36.5 (37.15)	48.5 (44.12)	20.5	5.8	643.6
S2T6	91.0 (72.6)	45.5 (42.4)	40.5 (39.51)	26.6	5.6	626.5
S2T7	88.5 (70.2)	48.0 (43.84)	43.5 (41.25)	32.2	5.7	644.6
S3T1	**94.5 (76.4)**	**30.0 (33.19)**	17.7 (24.85)	6.5	3.4	676.0
S3T2	**92.5 (74.1)**	**29.0 (32.57)**	15.4 (23.04)	11.7	4.8	601.5
S3T3	91.5 (73.0)	26.0 (30.63)	20.7 (27.05)	5.1	3.7	544.0
S3T4	90.0 (71.6)	33.0 (35.04)	5.3 (13.23)	7.8	4.7	761.2
S3T5	87.0 (68.9)	13.5 (21.52)	11.9 (20.09)	5	3.6	563.3
S3T6	89.5 (71.1)	38.5 (38.34)	16.7 (24.06)	10.5	4.0	719.5
S3T7	87.0 (68.9)	46.5 (42.9)	1.6 (7.03)	11.4	3.7	798.1
S4T1	**83.8 (66.2)**	**13.5 (21.54)**	6.7 (14.96)	2.6	1.9	575.8
S4T2	**82.0 (64.9)**	**16.0 (23.57)**	9.0 (17.49)	2.3	2.3	555.7
S4T3	66.0 (54.3)	20.0 (26.53)	4.5 (12.24)	3.3	2.2	536.6
S4T4	66.0 (54.3)	11.0 (19.36)	9.0 (17.49)	2.6	2.8	682.6
S4T5	62.3 (52.1)	4.0 (11.44)	19.5 (26.19)	0.6	1.6	443.1
S4T6	55.3 (48.0)	7.5 (15.81)	16.3 (23.76)	1.4	1.9	486.2
S4T7	53.0 (46.7)	9.0 (17.45)	11.1 (19.40)	2.2	2.2	806.9
S5T1	**21.5 (27.6)**	**2.5 (9.04)**	71.7 (57.91)	0.7	0.2	1.0
S5T2	**20.0 (26.5)**	**3.0 (9.83)**	25.0 (29.98)	0.8	0.7	17.0
S5T3	17.5 (24.7)	1.0 (5.74)	0	0.8	2.8	39.3
S5T4	12.0 (20.2)	3.0 (9.33)	0	1	0.5	82.6
S5T5	7.0 (15.3)	2.0 (8.13)	0	0.6	0.6	2.4
S5T6	4.0 (11.4)	2.0 (7.85)	0	0.6	0.7	61.2
S5T7	2.0 (7.9)	7.5 (15.88)	0	2.8	3.0	82.6
CD (S X T)	**3.15**	**3.23**	**2.03**	**2.66**	**0.39**	**12.93**