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Research Article

EFFECT OF SEED TREATMENT ON STORABILITY OF MAIZE (*Zea mays* L.)

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Abstract: The present studies on seed vigour and storability of hybrids & its parental line in relation to laboratory parameters and field parameters were conducted during 2017-18, on maize (*Zea mays* L.) The materials for study constituted of two hybrids and its parental lines produced in *rabi* 2016-17, were collected and half portion of seed lots subjected to accelerated ageing for seven (07) days; and another half portion of seed lots were kept for natural ageing. Immediately after accelerated ageing, all seed lots were subjected to treatment with fungicide (T1- Thiram 75% WS @ 2g/ kg of seed), insecticide (T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed) and combination of both (T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed). There was significant reduction in performances of accelerated aged seed lots than natural aged seed lots. The effect of treatment T1 (Thiram 75% WS @ 2g/ kg of seed) and T3 (Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) was found significant and positive for field emergence and field emergence index.

Keywords: Seed Vigour, Field Emergence, Field Emergence Index

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Introduction

Seed enhancement treatments have the potential to alleviate the effects of ageing and improve the planting value of the seed Taylor, *et al*. (1998) reported that post-harvest seed treatments significantly improve germination, faster seedling emergence and uniform establishment [12]. Seeds may experience a wide range of conditions in soil after sowing *i.e*. from drought to flooding, nutrient deficiency to its toxicity and expose to various soil pathogenic microfloras. Treating the seed before sowing can often protect young seedling, which are particularly susceptible to fungus attack, with a fungicidal compound that prevents fungal. Anuja and Aneja (2000) reported that seed treatments with capton, thiram, mancozeb, and carbendazine showed significant improvement in field emergence and seed yield [3]. The seed treatment with insecticides is a more environmentally friendly method of insecticide application and can provide direct economic benefits by reducing both chemical and application costs. Kumar *et al*. (2007) reported that seeds coated with the different polymeric formulations in general deteriorate at slower pace as manifested in high germination percentage [6]. Pandey *et al*. (2005) also reported that the polymer coats act as moisture barriers [9].

Materials and Methods

The research material consists of six lots of maize varieties such as BML-6, BML-7, DHM-117, VQL-1, SML-1 and SHM-1 were collected and dried upto 12 % seed moisture content. Half portions of seed lots of each variety were subjected to accelerated ageing at 40°C temperature (T) and 100 percent relative humidity (RH) for seven (07) days; and another half portion of seed lots were kept for natural ageing. Immediately after accelerated ageing, all seed lots were subjected to treatments with fungicide, insecticide and combination of them. Treated seed lots were packed in muslin cloth and put for storage upto six months *i.e*. September-2017 to February-2018, under ambient conditions for laboratory and field studies. The seed quality parameters were recorded at three-months interval; and after six months it was also evaluated for field parameters.

Treatment details

T0- Control
T1- Treatment with Fungicide (Thiram 75 %WS) @ 2gm/kg seed
T2- Treatment of Insecticide (Imidacloropid 17.8% SL) @ 2ml/kg seed
T3- Treatment with Fungicide (Thiram75 %WS) @ 2gm/kg seed followed by Insecticide (Imidacloropid1 7.8% SL) @ 2ml/kg seed

Germination (%)

Eight replicates of 50 seed each variety and each treatment were tested for germination studies as per ISTA method [2]. In this method, seed were placed between two layer of wet germination paper which was then rolled and wrapped in wax sheet and placed in germinator in an upright position under 20 ± 1 C and 95 % RH for 14 days. On the day of final count *i.e*. 14th day, it was evaluated for Normal seedling, Abnormal seedling, Dead and Hard seed.

Abnormal Seedling (%)

The entire damaged, decayed and deformed seedlings which were not able to produce normal seedling were counted and considered as abnormal seedling.

Total Seedling length (cm)

Ten normal seedlings were taken at random from each replication and shoot and root lengths of each seedling were measured. The mean value was taken for analysis.

Table-1 *Effect of seed treatments on Germination (%) of Aged Seed Lots after 0, 3 and 6 Months of Storage*

Treatments	Germination (%)								
	0 MoS			3 MoS			6 MoS		
	NA	AA	Mean (T)	NA	AA	Mean (T)	NA	AA	Mean (T)
T0	86.83	77.39	82.11	85.11	68.83	76.97	82.94	56.11	69.52
T1	89.06	81.56	85.31	87.83	76.05	81.94	85.61	73.22	79.41
T2	86.50	77.28	81.89	84.83	69.33	77.08	82.94	56.94	69.94
T3	89.61	81.72	85.66	87.50	75.88	81.69	85.27	73.00	79.13
Mean (S)	88.00	79.48		86.31	72.52		84.19	64.81	
CD (P=0.01)									
S	0.33			0.35			0.35		
T	0.47			0.49			0.49		
S x T	0.66			0.69			0.70		

S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Table-2 *Effect of Seed Treatments on Seedling Length (cm) of Aged Seed Lots after 0, 3 and 6 Months of Storage*

Treatments	Seedling Length (cm)								
	0 MoS			3 MoS			6 MoS		
	NA	AA	Mean (T)	NA	AA	Mean (T)	NA	AA	Mean (T)
T0	21.28	18.92	20.10	20.42	16.48	18.45	18.91	12.06	15.48
T1	23.29	21.12	22.20	22.72	18.68	20.70	21.11	14.75	17.93
T2	21.56	19.54	20.55	20.81	17.10	18.95	19.53	12.75	16.14
T3	23.68	21.19	22.43	22.76	18.75	20.75	21.18	14.59	17.88
Mean (S)	22.46	20.19		21.68	17.75		20.19	13.54	
CD(P=0.01)									
S	0.29			0.28			0.24		
T	0.41			0.39			0.34		
S x T	NS			NS			NS		

S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Table-3 *Effect of Seed Treatments on Seedling Dry Weight (mg) of Aged Seed Lots after 0, 3 and 6 Months of Storage*

Treatments	Seedling Dry Weight (mg)								
	0 MoS			3 MoS			6 MoS		
	NA	AA	Mean (T)	NA	AA	Mean (T)	NA	AA	Mean (T)
T0	100.03	88.91	94.47	93.28	80.90	87.09	85.12	65.90	75.51
T1	109.48	99.25	104.36	103.78	91.24	97.51	95.02	76.24	85.63
T2	101.34	91.83	96.58	95.04	83.83	89.43	87.92	68.83	78.37
T3	111.31	99.59	105.45	103.94	91.58	97.76	95.35	76.58	85.96
Mean (S)	105.54	94.89		99.01	86.89		90.85	71.13	
CD (P= 0.01)									
S	1.37			1.35			1.26		
T	1.93			1.90			1.78		
S x T	NS			NS			NS		

S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Table-4 *Effect of Seed Treatments on Vigour Index- I of Aged Seed Lots after 0, 3 and 6 Months of Storage*

Treatments	Vigour Index-I								
	0 MoS			3 MoS			6 MoS		
	NA	AA	Mean (T)	NA	AA	Mean (T)	NA	AA	Mean (T)
T0	1853.98	1466.87	1660.42	1743.61	1137.70	1440.65	1573.48	718.70	1146.09
T1	2078.94	1727.12	1903.03	2000.24	1423.32	1711.78	1814.20	1081.95	1448.07
T2	1870.66	1511.58	1691.12	1770.64	1187.87	1479.25	1624.03	727.83	1175.93
T3	2127.36	1735.91	1931.63	1996.78	1426.01	1711.39	1812.16	1067.33	1439.74
Mean (S)	1982.73	1610.37		1877.82	1293.72		1705.97	898.95	
CD (P=0.01)									
S	26.84			24.44			20.02		
T	37.95			34.56			28.31		
S x T	NS			NS			40.03		

S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Seedling Dry Weight (mg)

Ten normal seedlings were taken at random from each replication for observing seedling length were dried in hot air oven maintained at 70 ± 1C for 48 hr and cooled in desiccators. The mean value of seedling dry weight was taken for analysis.

Vigour Index I and II

The vigour indices were calculated by adopting following formula [1];

Vigour Index I= Germination (%) × Seedling Length (cm)
Vigour Index II= Germination (%) × Seedling Dry Weight (mg)

Table-5 *Effect of Seed Treatments on Vigour Index- II of Aged Seed Lots after 0, 3 and 6 Months of Storage*

Treatments	Vigour Index-II								
	0 MoS			3 MoS			6 MoS		
	NA	AA	Mean (T)	NA	AA	Mean (T)	NA	AA	Mean (T)
T_0	8713.72	6894.27	7803.99	7962.54	5583.79	6773.16	7080.70	3920.47	5500.58
T_1	9771.01	8117.48	8944.24	9134.38	6950.93	8042.65	8163.90	5592.71	6878.30
T_2	8792.08	7104.44	7948.26	8085.61	5821.11	6953.36	7308.15	3927.61	5617.88
T_3	9998.57	8158.76	9078.66	9114.99	6963.07	8039.03	8154.72	5602.21	6878.46
Mean(S)	9318.85	7568.74		8574.38	6329.73		7676.86	4760.75	
CD(P=0.01)									
S	126.13			118.21			99.49		
T	178.37			167.17			140.68		
S x T	NS			NS			198.95		

S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Table-6 *Effect of Seed Treatment on Field Performance of Aged Seed Lots after Six Month of Storage*

Treatments	Field Emergence (%)			Field Emergence Index		
	NA	AA	Mean (T)	NA	AA	Mean (T)
T0	76.58	40.70	58.64	90.79	72.62	81.70
T1	79.66	62.58	71.12	93.12	85.50	89.31
T2	76.62	41.45	59.04	91.16	72.87	82.02
T3	79.29	62.50	70.89	92.95	85.75	89.35
Mean (S)	78.04	51.81		92.01	79.18	
S	0.33			0.378		
T	0.46			0.53		
S x T	0.65			0.75		

S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Field Emergence (%)

Field emergence was estimated by sowing hundred seeds in four replications in the field. Observations were recorded on alternate day till 14th day of sowing. The emergence was expressed as percentage of seedling emergence.

Field Emergence Index (FEI)

The number of seedlings emerged were counted on each day up to final seedling establishment (14thday) in the field. The field emergence index was calculated as described by Maguire (1962) [8].

$$Field\ Emergence\ Index = \frac{No\ of\ Seedling\ Emerged}{Days\ of\ First\ Count} + \frac{No\ of\ Seedling\ Emerged}{Days\ of\ Last\ Count}$$

The data from laboratory experiments were analysed by adopting complete randomized design (CRD), while data collected from the field experiments were analysed in Randomized Block Design (RBD). The statistical computer software's SPSS (version10) and SAS were used in the present study

Results and Discussion

The effect of seed treatment on germination percentage of natural aged and accelerated aged seed lots stored for three storage periods is presented in [Table-1]. After accelerated ageing germination percent of seed lots was significantly reduced in comparison to natural aged seed lot. The effect of seed treatment significantly improved the germination percentage of both natural as well as accelerated aged seed lots after 0, 3 and 6 months of storage. The treatment with fungicides (T1-Thiram 75% WS @ 2g/ kg of seed) and combination of fungicides and insecticides (T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) was significantly improved the standard germination percent than control all three-storage duration. There were no significant differences between control and treatment with insecticides (T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed). The effect of seed treatment on seedling length of natural aged and accelerated aged seed lots stored for three storage periods is presented in [Table-2]. The Storage Condition had significantly affected the seedling length. The accelerated aged seed lots showed significant reduction in seedling length. All the seed treatments significantly improved the seedling length at 0 months, 3 months and 6 months of storage. The highest seedling length was recorded in treatment with combination of fungicides and insecticides (T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) followed by fungicide (T1- Thiram 75% WS @ 2g/ kg of seed). Seed treatment with insecticide (T2-Imidacloropid 17.8% SL @ 2ml/ kg of seed) was at par with Control (T1). There was no any significant effect of seed treatments on storage condition for seedling length at all three storage periods. At 6 month of storage effects shown similar to the three months of storage but aged seed lots reduction in seedling length was faster than natural aged seed. The effect of seed treatment on seedling dry weight of natural aged and accelerated aged seed lots stored for 3 storage periods is presented in [Table-3]. The Storage Condition had significantly affected seedling dry weight. The accelerated aged seed lots showed significant reduction in seedling dry weight. All the seed treatments significantly improved the seedling dry weight at 0 months, 3 months and 6 months of storage. The highest seedling dry weight was recorded in treatment with combination of fungicides and insecticides (T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) followed by fungicide (T1- Thiram 75% WS @ 2g/ kg of seed). Seed lots treated with insecticide (T2-Imidacloropid 17.8% SL @ 2ml/ kg of seed) was at par with Control (T1). There was no any significant effect of seed treatments on storage condition for seedling dry weight at all 3 storage periods. At 6 month effects shown similar to the 3 month of storage but aged seed lots reduction in seedling dry weight was faster than natural aged seed. The mean data observed at 0 months of storage for vigour index-I indicated significant differences between natural aged (1982.73) and accelerated aged seed lots (1610.37). The seed treatments significantly improved the vigour index-I. It was highest in treatment with T3 (Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) followed by T1 ((Thiram 75% WS @ 2g/ kg of seed) and lowest in T0 (Control). There was non-significant interaction between ageing and treatments. The seed treatment with insecticide (T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed) having non-significant impact on vigour index-I. Similar results were reported in three months of storage. After six months of storage, there was significant interaction between ageing and treatment. Highest vigour index-I was reported in seed treatment with T1 ((Thiram 75% WS @ 2g/ kg of seed) followed by T3 ((Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed). The treatment T1 and T3 was at par. The perusal of the data on vigour index-II as presented in [Table-5] revealed that at 0 month seed treatment with T3 reported highest (9078.66) followed by T1 (8944.24). The mean data for vigour index-II indicated significant differences between natural aged (9318.85) and accelerated aged seed lots (7568.74).

There was non-significant interaction between ageing and treatments. The seed treatment with insecticide (T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed) having non-significant impact on vigour index-II. Similar results were reported in three months of storage. Only after six months of storage, there was significant interaction between ageing and treatment. Highest vigour index-II was reported in seed treatment with T1 ((Thiram 75% WS @ 2g/ kg of seed) followed by T3 ((Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed). The treatment T1 and T3 was at par. It is well known that the factors influencing the seed viability during storage are temperature and relative humidity under ambient conditions {[4], [5] and [10]}. Seed treatment with different chemicals to control mycoflora in storage condition which maintain viability and vigour of seeds with increased emergence and decreased post emergence death of seedlings is always of prime importance. Effect of seed treatment on varieties for germination (%) was found non-significant at zero months, but it is significant at 3 month and 6 months of storage, The highest germination percent was observed with treatment T1 and T3 over control during all three storage duration. The treatment T0 and T2 was having non-significant effect on due to the development of storage fungi, which resulted in poor performance of seeds. The present findings are in accordance with Srimathi *et al*. (1999) in Paddy [11]. The mean data of field parameters such as field emergence and field emergence index as presented in [Table-6] indicates significant differences between varieties. The interaction effect of seed treatment on varieties for field parameters was found significant. The treatment T1 and T3 (Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) having significant and positive effect over control. Similarly, significant and positive effects were also observed for field emergence index. Similar result was reported by Kumar *et al* (2013) [7].

Conclusion

The result of present study revealed that effect of seed treatment on maize seed was found significant during six months of storage. It was also found that the response of seed treatment on acceleration aged seed lot was higher than natural aged seed lot over its control. The effect of treatment T1 (Thiram 75% WS @ 2g/ kg of seed) and T3 (Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed) was found significant and positive for germination (%), vigour index-I and II, field emergence and field emergence index

Application of research: Study of seed under storage for sowing in next season, seed treatment with fungicide and insecticide before storage significantly improve their field performance in comparison to untreated seed.

Research Category: Seed Technology

Abbreviations: Mos (Months of Storage), S-Storage Condition; T- Treatment; NA-Natural Aged Seed Lot; AA-Accelerated Aged Seed Lot; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3-Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

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Study area / Sample Collection: Bihar Agricultural University, Sabour, Bhagalpur, 813210, Bihar

Cultivar / Variety name: *Zea mays* L. BML-6, BML-7, DHM-117, VQL-1, SML-1 and SHM-1

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References

[1] Abdul B., Anderson J.D. (1973) *Crop Science*, 13,630-633.
[2] Anonymous (2004) *Handbook of ISTA, Zurich, Switzerland*.
[3] Anuja G., Aneja K.R. (2000) *Seed Research*, 28,54-58.
[4] Barton L.V. (1961) *Seed preservation and longevity, Leonard-Hill (Books) Ltd., Inter Science Publishers. Inc. New York.*
[5] James E., Bass L.N., Clark D.C. (1967) *Crop Science*, 7(5), 495-496.
[6] Kumar J., Nisar K., Kumar A.M.B., Walia S., Shakil N.A., Prasad R., Balraj S., Parmar B.S. (2007) *Indian Journal of Agricultural Sciences*, 77(11),738-743.
[7] Kumar M., Yadav S.K., Pandey S., Vari A., Yadav R., Kumar J. (2013) *Seed Research*, 41(1),16-23.
[8] Maguire J.D. (1962) *Crop Science*, 2,176-177.
[9] Pandey S., Kumar J., Parmar B.S. (2005) *Annals of Agricultural Research New Series*, 26(4),509-13.
[10] Roberts E.H. (1973) *Seed Science and Technology*, 1,499–514
[11] Srimathi P., Valluvaparidasan V., Malarkodi K., Sundaralingam K. (1999) *Joint action of fungicides and insecticides on storability of paddy and pearlmillet seeds. Proceedings of National Seminar on Seed Science and Technology, held at University of Mysore, Manasagangothri, Mysore*, 213-215.
[12] Taylor A.G., AllenP.S., Bennett M.A., Bradford K.J., Burris J.S., Misra M.K. (1998) *Seed Science and Research*, 8,245-256.