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Effects of Dry Seed Treatment on Various Quality Characters in Maize (*Zea mays* L.)

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ABSTRACT

Maize cultivar Shalimar KG2 was evaluated for the assessment of vigor and viability during long term storage after dry treatments, with different products and chemicals. The results revealed a positive association between various dry seed treatments and seed deterioration during storage. Treatment of seeds with various chemicals and crude plant products had a positive correlation with vigor and viability. A significant association was also found between bioassay material and production of volatile toxic bioinhibitory compounds. Various chemicals and crude plant products were found to enhance the vigor and viability levels of maize seed during storage.

Keywords:- Bio-inhibitor, chemical, crude plant product, dry treatment, seed invigoration, toxic, volatile.

1. INTRODUCTION

Maize the "queen of cereals" ranks only next to wheat and rice in terms of area under cultivation and production. It is cultivated in the whole world on over 150 million hectares of land with a yield of 782 million tonnes. In India maize is extensively grown in Uttar Pradesh, Punjab, Bihar, Himachal Pradesh, Karnataka, Jammu and Kashmir as well as in Madhya Pradesh. The maize grown as a kharif crop in India over on area of 8.12 million hectares produces about 619.77 million tonnes of grains per year. In Jammu and Kashmir, the productivity enhancement is associated with several constraints including the loss of vigor and viability during storage. Here the maize is grown as a kharif crop and the seeds harvested in September-October are stored under ordinary conditions for several months up to the time of next sowing. Due to inadequate storage facilities, the farmers are forced to use the deteriorated seeds for sowing in the May-June causing an irreparable loss to the poor farming community of the state. Several attempts had

been made earlier by various workers including those at SKUAST-K to minimize the vigor and viability losses during storage by the application of various dry and wet treatments. In addition to this, certain toxic volatile bio-inhibitory compounds are produced by germinating maize seeds. Such gaseous bio-inhibitory compounds may be inhibitory or supportive to the germination of other seeds kept in the vicinity of the seeds. These gaseous compounds and their amounts as well as effects can be detected by seed vigor bioassay methods.

Keeping above in view, it is important to elucidate the basic physiological reasons of seed deterioration and understanding of the factors controlling seed germinability in storage. Therefore the present investigations were made to explore the probable dry-dressing compounds that are affordable to the local farmers which could slow down the loss of vigor and viability of seeds under different storage conditions. The production of toxic volatiles by germinating maize seeds and the effects of various dry treatments on the production of such volatile toxins was also evaluated in the present study.

2. MATERIALS AND METHODS

The experimental material for the present study consisted of one cultivar of maize available locally viz Shalimar KG2, and a variety of jute namely UPC-94 (Reshma). The maize cultivar Shalimar KG2 was procured from the Sales cum Extension counter of Sher-e- Kashmir University of Agricultural Sciences and Technology of Kashmir Shalimar Srinagar, however jute variety UPC-94 (Reshma) was procured from seed stock of Department of Seed Technology Govt. Degree College Boys Anantnag. The experiments were carried out in the laboratory of Department of Seed Technology Govt. Degree College Boys Anantnag during August-September 2013. The pure seed component of the maize cultivar Shalimar KG2 was subjected to following tests in laboratory to evaluate various parameters of the vigor and viability.

2.1. LABORATORY ANALYSIS:

Dry-dressing treatment:- Highly superior seeds (3 months old) of maize were dry dressed with various chemicals, pharmaceutical product and crude plant materials following the method of Basu and coworkers, (Basu and Rudrapal 1980; Mandal and Basu, 1986) with minor modification. In this experiment 300 gm, of maize seeds were taken for each treatment. Dry dressing treatments was given in the rubber stoppered glass bottles (1000 ml capacity) at room temperature (27 ± 1°C) to prevent the escape of volatiles from different

treatments. After treatment, bottles were shaken twice in a day up to 7 days, for thoroughly mixing the chemicals, pharmaceutical products and crude plant materials with the seed. The concentrations of different chemicals, pharmaceuticals and crude plant products were used as:

Product	**Concentrations with seed**
Aspirin	100 mg / kg of seed
Potassium iodide	100 mg / kg of seed
Celin (Vit.C)	500 mg / kg of seed
Bleaching powder	3 gm / kg of seed
Calcium Carbonate	2 gm / kg of seed
Red Chilli Powder	1 gm / kg of seed
Trigonella seed powder	100 mg / kg of seed
Almond shell powder	2 gm / kg of seed
Walnut shell powder	1 gm / kg of seed
Carrot seed powder	1 gm / kg of seed

* Normal untreated seeds were taken as non treated control

Immediately after dry dressing treatment, the seeds were allowed to germinate and the germination percentage of seeds as well as the mean total seedling length was measured following the Roll towel method (according to *Seshu et al*., 1988).

The seeds of the maize cultivar Shalimar KG2 were then subjected to accelerated ageing as well as natural ageing and the germination percentages after both types of ageing tests were calculated. The methodology followed for such experiments is as follows:

(a) Accelerated ageing: 100 gm of maize seeds from each treatment were taken separately in perforated paper packets. Different humidity regimes were made in a glass desiccator by mixing sulphuric acid; then it was covered with glass lid and kept for 24 hours. Then it was transferred to BOD incubator at a constant temperature of 40°C. Seeds in the paper packets were kept inside desiccator over the procelin plate. After requisite intervals seeds were placed for germination tests.

(b) Natural ageing: 100 gm of seeds from each treatment were taken separately in perforated paper packets, placed in cloth bags and stored on a shelf in the laboratory under ambient conditions (30 ± 1°C; 72% RH) for natural ageing. For uniform ageing of seeds all packets were shaken continuously each

day. After ageing germination tests were carried out, following the Roll towel method (according to *Seshu et al*., 1988).

2.2. PRODUCTION OF VOLATILE BIO-INHIBITORY COMPOUNDS OF TREATED SEEDS AFTER AGEING:-

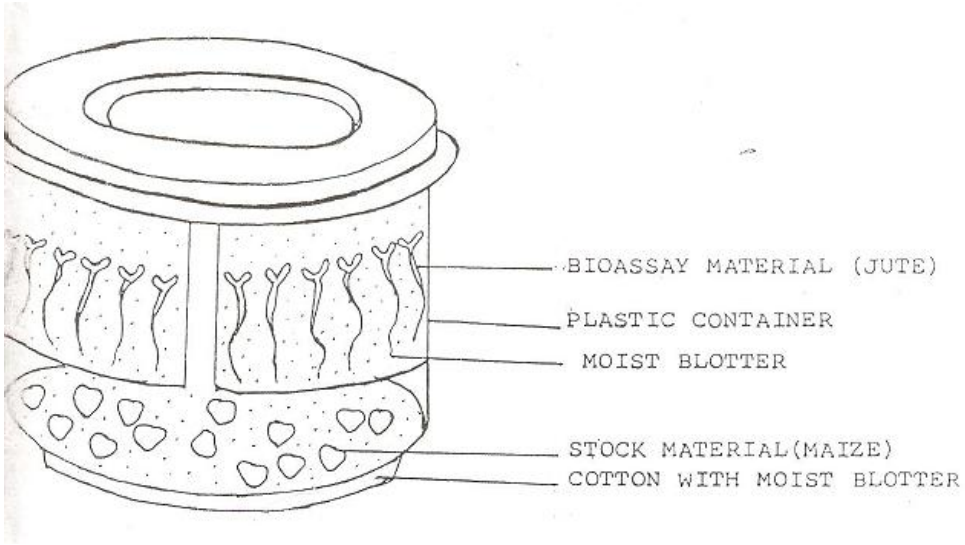
Production of toxic volatile compounds was estimated from aged treated and untreated seeds during germination process, employing a seed vigor bioassay method. (Basu, Kulchan and Sur 1990).

Bioassay was done by exposing the bioassay material (high vigorous jute seeds) to the gaseous emanations of germinating stock material (treated and untreated maize seeds) of different vigor levels (fig. A) by seed invigoration treatments.

For this purpose, air tight wide mouth plastic containers (diameter 8 cm; height 6 cm.) were used. Maize seeds were placed on a disc shaped moist blotter paper (6 cm diameter) in five rows (total 20 seeds). Ten (10) ml of distilled water was then poured on the blotter in the container, so that blotter would remain moist and will provide continuous supply of water to the germinating seeds. Fresh jute seeds (U.P. Reshma) were used as a bioassay material. Forty (40) jute seeds were placed on a line on a folded strip blotter paper (22cm×7cm). The blotter paper along with the jute seeds was introduced carefully inside the plastic container in such a way that the wall of the container was lined by blotting paper. After proper placement of the blotter, the cap of the container was then tightly closed. The containers meant for different sizes of maize seeds and a blank containing only bioassay materials (jute) were maintained at 24 ± 1°C as shown in the figure A. The data of the germination percentage and that of root length, shoot length (seedling length) of jute and maize seeds were then taken, after 48 hours and 7 days respectively.

Data collected from different parameters of laboratory germination test before and after treatment was statistically analyzed to evaluate the effect of dry seed invigoration treatments. Germination percentages were calculated and total seedling length data was also measured. The effect of various seed treatments and their interaction were calculated statistically following the analysis of variance method. (Fishers 1948).

Fig-A



The Set-up for bioassay of seed vigor

3. RESULTS

The germination test of the treated (immediately after treatment) and untreated seeds revealed that the germinability of seeds was not significantly influenced by various dry treatments such as bleaching powder, calcium carbonate or walnut shell powder (Table 1). However, it is evident from the Table 1, that seedling growth was quietly improved by the seed invigoration treatment.

After accelerated ageing at 100% RH and 40°C temperature for 14 days, treated seeds showed significant improvement in germination percentage and seedling growth over untreated seeds (Table 2). The germinability of the treated seeds was also significantly improved, even after natural ageing as shown in Table 3. After five months of natural ageing under ambient conditions, the treatments such as calcium carbonate, trigonella seed powder, walnut shell powder, almond shell powder as well as bleaching powder effectively controlled the deterioration of seeds during accelerated and natural conditions.

Table 1 : Effect of seed invigoration treatments on the germinability of maize seeds immediately after treatment (before ageing)

Treatments (gm or mg/kg of seed)		Germination percentage	Mean root length (mm)	Mean shoot length (mm)	Total seedling length (mm)
Control (untreated)		94.63	445.00	69.67	514.67
Aspirin (100 mg)		93.57	539.00	81.00	620.00
Potassium iodate (100 mg)		93.23	497.00	76.67	573.67
Celin (500 mg)		95.87	418.00	67.67	485.67
Bleaching powder (3 g)		94.23	438.33	73.67	511.33
Calcium carbonate (2 g)		95.20	535.00	92.33	627.33
Red chilli powder (1 g)		97.20	416.67	85.67	502.33
Trigonella seed powder (2 g)		97.27	425.33	70.00	495.33
Almond shell powder (2 g)		97.57	506.00	76.00	582.00
Walnut shell powder (1 g)		94.10	477.00	70.33	547.33
Carrot seed powder (1 g)		95.00	476.67	72.67	549.33
Mean		95.26	470.36	75.97	546.27
Range	Max	97.57	539.00	92.33	620.00
	Min	93.23	416.67	69.67	485.67
CV		0.72	0.28	3.09	0.44

Table 2 : Effect of seed invigoration treatments on the germinability of maize seeds after subjected to accelerated ageing.

Treatments (gm or mg/kg of seed)		Germination percentage	Mean root length (mm)	Mean shoot length (mm)	Total seedling length (mm)
Control (untreated)		50.43	250.00	51.00	301.00
Aspirin (100 mg)		60.23	400.00	61.00	461.00
Potassium iodate (100 mg)		60.67	410.00	62.67	472.67
Celin (500 mg)		54.53	388.00	58.00	446.00
Bleaching powder (3 g)		57.73	403.00	59.67	464.67
Calcium carbonate (2 g)		69.33	470.00	67.00	537.00
Red chilli powder (1 g)		58.60	397.33	61.00	458.33
Trigonella seed powder (2 g)		61.70	463.00	66.67	529.67
Almond shell powder (2 g)		60.87	459.33	62.33	522.33
Walnut shell powder (1 g)		54.67	453.00	57.67	510.67
Carrot seed powder (1 g)		58.87	395.33	53.00	448.33
Mean		58.88	408.09	60.00	468.15
Range	Max	69.33	463.00	67.00	537.00
	Min	50.43	250.00	51.00	301.00
CV		0.86	0.48	3.86	0.66

Table 3 : Effect of seed invigoration treatments on the germinability of maize seeds after subjected to natural ageing.

Treatments (gm or mg/kg of seed)		Germination percentage	Mean root length (mm)	Mean shoot length (mm)	Total seedling length (mm)
Control (untreated)		50.67	271.00	42.33	313.33
Aspirin (100 mg)		64.67	363.00	55.00	418.00
Potassium iodate (100 mg)		63.87	365.33	52.00	417.33
Celin (500 mg)		60.10	320.33	50.33	437.33
Bleaching powder (3 g)		66.07	327.67	51.67	379.33
Calcium carbonate (2 g)		72.40	453.33	58.33	511.67
Red chilli powder (1 g)		63.27	373.00	55.67	428.67
Trigonella seed powder (2 g)		71.43	398.33	54.67	453.00
Almond shell powder (2 g)		70.13	402.00	60.33	462.33
Walnut shell powder (1 g)		64.00	363.00	52.33	415.33
Carrot seed powder (1 g)		63.43	358.33	48.33	406.67
Mean		64.55	363.21	52.82	422.09
Range	Max	72.40	453.33	60.33	511.67
	Min	50.67	271.00	42.33	313.33

CV	1.66	0.63	3.43	8.38

By analyzing the seed vigor bioassay method it is clear that the germination percentage of treated maize seeds (aspirin, calcium carbonate and trigonella seed powder) was significantly improved by dry treatments as compared to untreated seeds. The production of volatile gaseous compounds was less in seeds treated with various products; as such the seedling growth of jute (bioassay material) was higher in all the dry treatments than the untreated control. Maximum growth of jute seedlings was obtained in calcium carbonate, aspirin followed by rest of the treatments. Bio-inhibitory gases released by maize seeds treated with various products affected the jute seedling growth, (Fig. B) and Table 4.

A positive correlation was noted between germinability of maize seed and seedling growth of jute.

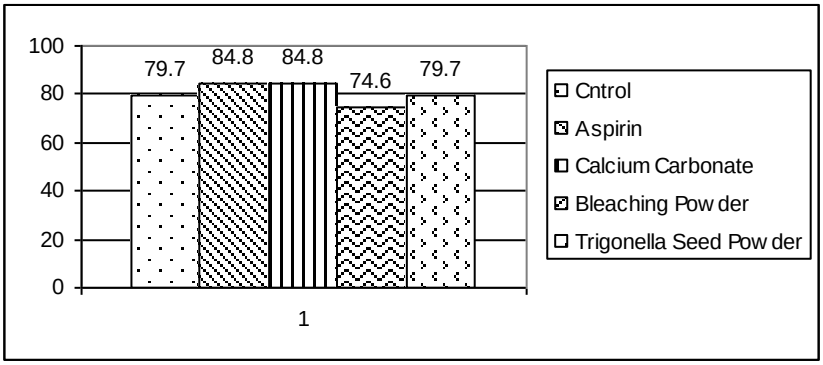
Table 4 : Effect of bioassay material on the performance of Jute seeds

Treatments (gm or mg/kg of seed)		**Germination percentage**	**Mean root length (mm)**	**Mean shoot length (mm)**	**Total seedling length (mm)**
Control (untreated)		60.00	137.67	59.00	196.67
Aspirin (100 mg)		74.00	168.33	78.33	246.67
Potassium iodate (100 mg)		69.00	158.67	65.00	223.67
Celin (500 mg)		69.33	161.67	73.67	229.33
Bleaching powder (3 g)		71.67	164.33	72.00	236.33
Calcium carbonate (2 g)		80.33	186.67	91.33	260.00
Red chilli powder (1 g)		59.67	150.33	72.67	223.00
Trigonella seed powder (2 g)		62.00	168.67	79.33	248.00
Almond shell powder (2 g)		63.00	169.00	75.00	244.00
Walnut shell powder (1 g)		60.33	153.00	64.33	217.33
Carrot seed powder (1 g)		57.67	148.00	59.33	207.33
Mean					
Range	Max	80.33	186.67	91.33	260.00
	Min	57.67	137.67	59.00	196.67
CV		2.24	1.44	5.18	3.98

Fig: B- Biochemical changes in dry dressed high medium-vigor of maize seeds after subjecting to natural ageing for 5-months.

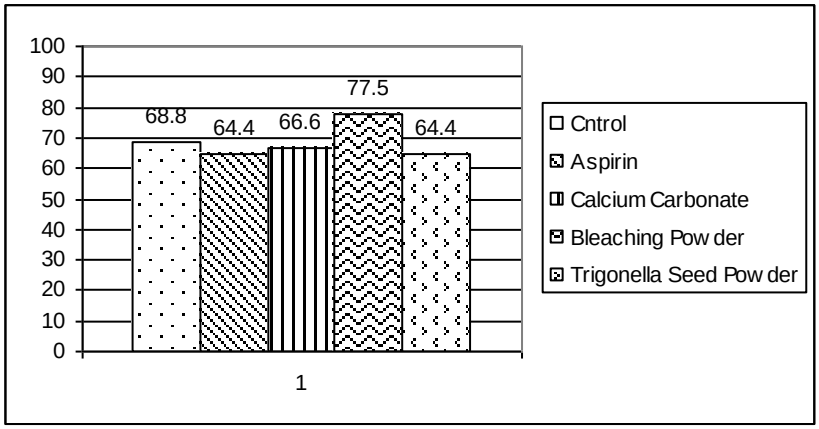
(Seed Vigor Bioassay)

Germination % age of maize (Stock Material)

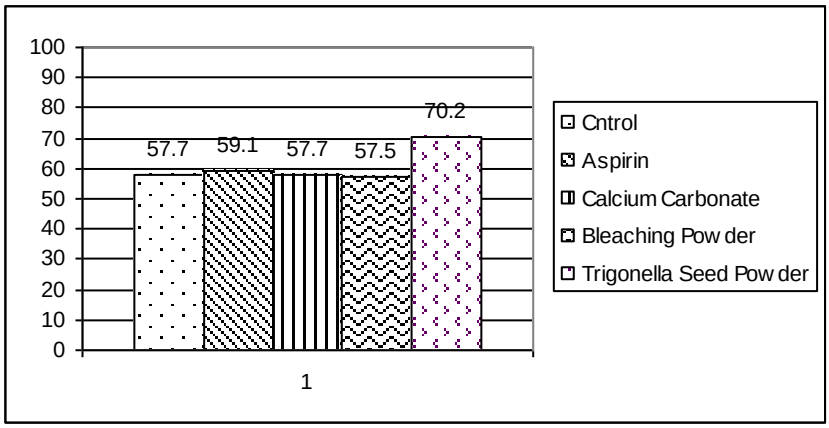


R1

R2



R3



4. DISCUSSION

The present investigation was conducted to study the effect of various dry treatments on the germinability of maize seeds under storage and to identify various chemical and natural products that could be used for proper storage of maize seeds with a minimum loss in vigor and viability. The data collected from different experiments showed that dry dressing treatments of freshly harvested maize seeds with various chemicals, pharmaceutical formulation and powdered natural plant products were very effective in controlling the loss of vigor and viability under subsequent storage conditions. It was confirmed that physiological age of seed which determine the vigor status of seed is very crucial factor determining the effectiveness of treatment. Similar results were obtained by Rudrapal 1980; Mandal and Basu 1986 who reported the positive effects of dry treatments (halogens of iodide and chlorine) over improved storability in various types of seeds. Kanta, Bokaria and Bandopadhya (2000) also found that treatments of maize seeds with different chemicals (halogenation with iodine vapour) maintained the vigor and viability of seeds in storage.

The role of natural plant preparations could also be due to reduced lipid peroxidation because volatile aldehyde production was lower in seeds treated with chemicals and plant preparations than in control. Our results were in conformity with the earlier findings of Pal and Basu (1994); and Mandal *et al* (2000). The lipid peroxidation was indirectly accessed by the growth of the bioassay material (jute seedlings) in the present study that was affected by production of toxic growth inhibitory gases by the stock material maize. Sung and Chlu (2001) have also found the free radical induced peroxidation as a causative factor of seed deterioration in sweet corn (*Zea mays* L.). The protein protective role of aspirin (acetylsalicylic acid) might be partly responsible for viability maintenance of stored seed. This finds support from the earlier findings of various Pal and Basu (1994), who studied the role of various plant leaf powders and aspirin for extending the viability in wheat seed.

After analysis of various experiments conducted in the current study, it became evident that the dry treatments had a very little effect on the germination percentages and seedling growth of maize after a very short period of 7 days. But the dry seed invigoration with aspirin, calcium carbonate, trigonella seed powder, walnut shell powder and almond shell powder was effective in controlling the deterioration of seeds during storage for longer durations (5-7 months). Some of the notable products such as calcium carbonate, trigonella seed powder, potassium iodide as well as almond shell powder were found to be very useful for decreasing the rate of deterioration of seeds in long term storages. Hence the above named products could be easily recommended for storing the maize seeds to farmers subject to proper concentrations and weights. Therefore the poor farmers of the Kashmir valley and north eastern parts of India can save the vigor and viability of their own saved seeds for longer durations. This would definitely open the ways for good storage of seeds that would in turn increase the planting value and in fact the yields.

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