

Efect of Sulphur, *Bradyrhizobium* Inoculation, Initial Moisture Content of Seed and Storage Container on the Germination Percentage of Groundnut Seed

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Abstract

The study was aimed at determining the effect of sulphur and *Bradyrhizobium* fertilized seed at different initial moisture content of seed and storage container, to improving the germination percentage of groundnut seed. The germination test was carried out after storing the seed for five months. Results revealed that seeds obtained from 60kg S/ha. stored in polythene bags retained the germination percentage up to the standard level of ISTA for 5 months efficiently. Least initial moisture content of seed (7.25 %) produced from the above doses of fertilizer elements also played a vital role in keeping the quality of stored seed. Results in the respect of storage performance in terms of percentage of germination indicated that groundnut seed obtained from sulphur and *Bradyrhizobium* fertilizer elements during production and stored in polythene bag can retain better seed quality, provided seed were dried to a safe moisture level of 7.25 % to 8.46 %.

Introduction

Sulphur has long been recognized as an essential nutrient elements for plants and it ranks in importance with nitrogen and phosphorous. the legume oilseed crops are more susceptible for sulphur deficiency due to their higher requirement. Since groundnut is a legume crop it is quite likely that it may respond to sulphur. Sulphur also plays a vital role in the longevity of seed in storage and better performance of seedling in the field. Sulphur is a component element of proteins, sulpholipids, enzymes etc.

Seed moisture content is regarded as the most important factor that impairs seed quality at storage. The metabolic activities of stored seed are dependent on the absolute seed moisture content. Moreover, it helps to establish relative humidity surrounding seeds, which in turn influences microbial growth in the seed lot. This does not apply only to the absolute moisture content of the seeds, but also to the fluctuation of moisture depending on the relative humidity from the immediate atmosphere and type of storage container. Therefore, to achieve good survival at stor-

age, reduction of seed moisture content to a suitable level through drying is of paramount importance (Harrington and Minges, 1973).

Storage condition plays a significant role in seed preservation. Storage containers of semi-permeable to non-permeable status may be of note worthy for short-term as well as long-term seed preservation. Seed growers at farm level use various containers but most of them are not conducive to seed health because of permeable in nature. Under high humid condition, permeable containers allow moisture penetration, which in turn increases humidity surround the seeds. Seeds with presence of excess moisture and with the rise of ambient temperature during summer months tend to germinate at storages even with the absence of other conditions required for seed germination. In this process, seeds gradually lose vigour and eventually complete destruction of viability. Once there grows tendency of germination in seeds at storage, these seeds deceive germination second time in the field.

The storage potential of groundnut seeds depends on the genetic make up of each groundnut line, initial seed germ inability and vigour. Viability of stored groundnut seeds in both traditional and improved containers was found to decrease with passage of time. Seed quality, especially germination, is essential to establish adequate plant stand for crop production (Bhuiyan and Quashem, 1983). Seed quality can be adversely affected by the environmental factors. Seed storage throughout the hot-humid season mainly for

carry-over seeds becomes a chronic problem. Subsistent seed growers cannot afford costly storage containers. It is imperative to indentify cheap and handy containers that would be used safely for long-term seed preservation. Information in these aspects is almost lacking in Bangladesh. This basic information is very much essential for improvement of overall management practices of groundnut seed crop. Therefore, the present study was designed with the objectives to find out the performance of sulphur and *Bradyrhizobium* fertilization, initial moisture content of seed and storage container on the of germination percentage.

Materials and Methods

To find out the germination percentage the following parameters were used :

A. Sulphur : Five dose of sulphur, .i. 0 kg/ha S up to v. 80 kg/ha S viz. i. 0 kg/ha S ii. 20 kg/ha S iii. 40 kg/ha S iv. 60 kg/ha S v. 80 kg/ha S.

B. *Bradyrhizobium* fertilization : Two dose of inoculation viz inoculation@.i. 0 g I/kg of seed and ii. 50 g I/kg of seed were applied to the groundnut seed before sowing.

C. Initial moisture content of seed L Three treatmeents were selected. The treatments were

- i. 7.25 % initial moisture content of seed
- ii. 8.46 % initial moisture content of seed
- iii. 9.25 % initial moisture content of seed

D. Storage container : Two treatments were chosen as storage containers.

- i. Biscuit tin with air tight lid.
- ii. Polypropylene bag with 0.25mm thickness.

Sulphur doses were 5, Bradyrhizobium fertilization doses were 2, initial moisture content of seed level was 3 and storage container were 2. The experiment was set combining the treatment following the principles of Complete Randomized Design with three replication. The germination percentage data were collected from each test and analyzed through a statistical computer programme M STAT-C. When the F value was significant, Least Significance Difference was used as a scale to distinguish between the different means. During analysis arc-sine transformation was made in case of germination percentage.

Germination test

The germination test was performed at intervals of one-month starting from August to December in 1998 and 1999. A total number of 400 seeds were set for germination in 16 Petri dishes each containing 25 seeds. Filter paper was used as media of germination. The Petri dish was kept at normal room temperature. germinated seedlings were made at 3, 5 and 7 days after placing seeds for germination. Percentage of germination was measured by the following formula :

$$\% \text{ Germination} = \frac{\text{No. of normal seedling}}{\text{Total no. of seed set for germination}} \times 100$$

Results and Discussion

Effect of sulphur, inoculation, initial moisture content of seed and storage container on the germination percentage of stored seed

A. Sulphur did not affect the germination percentage of seed at 1 month interval in 1997-98 indicating that deterioration of stored seed had not yet been started (Table I). At an interval of 2 months, the effect of sulphur on the germination percentage of seed was significant and the highest percentage of germination was obtained in 60 kg S/ha and the lowest in control. At an interval of 3 and 4 months, the effect of sulphur on the germination percentage of stored seed was also significant and the trend was similar to that of 2 months interval. At an interval of 5 months, the effect of sulphur was significant. In addition to that 40 and 80 kg S/ ha retained identical percentage of germination. The highest and the lowest percentage of germination were obtained by 60 and 0 kg S/ha, respectively. In 1998-99, at an interval of 1-month the effect of sulphur on the germination percentage of seed was significant. At an interval of 2 months, the seed of the treatment 60, 80 and 40 kg S/ha produced at par percentage of germination. At an interval of 3 months, 60 kg S/ha retained significantly higher and 0 kg S/ha lower percentage of germination. The treatments 80, 40 and 20 kg S/ha retained identical percentage of germination (Table I). From the above results it was clear that doses of sulphur increased the germination retention capacity of seed up to 60 kg S/ha and higher doses of sulphur

beyond it had no impact on the germination percentage of stored seed. Juangjum and Sumran (1991) obtained similar results. The data were plotted in the graphs (Fig. 1 and 2) showed the clear trend of deterioration in germination percentage of sulphur treated stored seed.

B. The effect of inoculation of seed with *Bradyrhizobium* at an interval of 1 month was not significant in 1997-98 (Table I). From the interval of 2 months the inoculated seed retained significantly superior percentage of germination over uninoculated one and these results continued up to 5 month

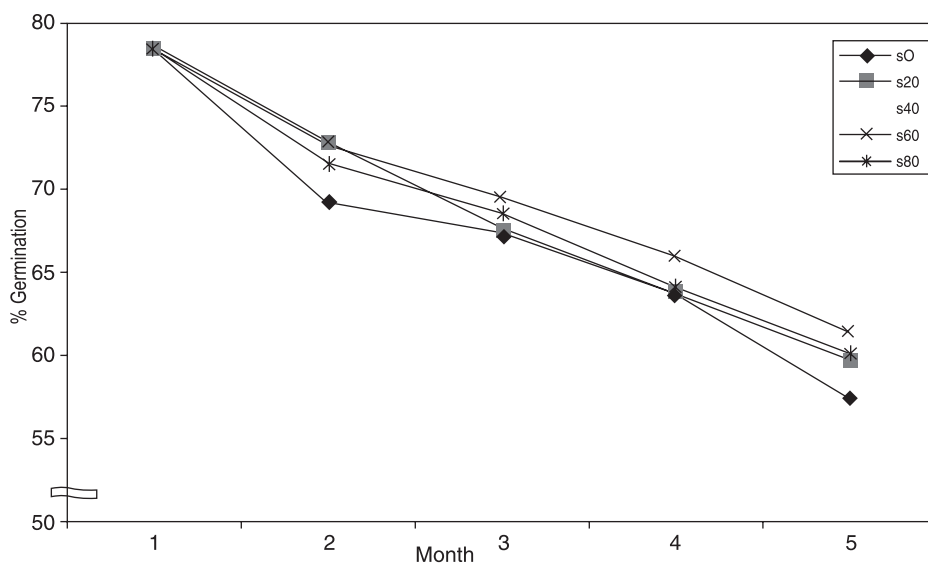


Fig. 1. Effect of sulphur on the germination percentage of stored seed in 1997-98

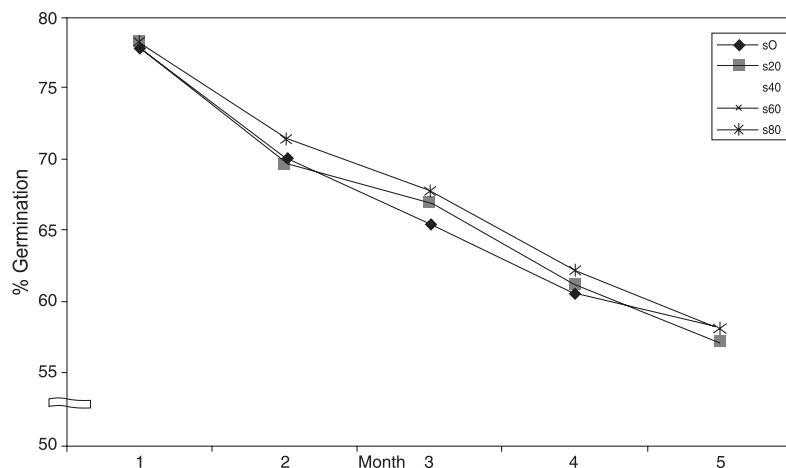


Fig. 2. Effect of sulphur on the % of germination of stored seed in 1999-99

Table I. Germination percentage of seed over storage period as affected by sulphur level, inoculation, storage container and moisture level

Treatment	1997-98					1998-99				
	1 month	2 month	3 month	4 month	5 month	1 month	2 month	3 month	4 month	5 month
S level										
S ₀	77.57	67.98	64.96	59.85	55.47	77.90	69.99	65.45	60.71	58.03
S ₂₀	77.53	69.95	65.90	60.89	56.39	78.26	69.70	66.83	60.99	57.01
S ₄₀	77.50	71.13	66.67	61.87	57.29	78.18	71.08	67.58	62.14	58.09
S ₆₀	77.91	72.16	68.04	62.84	58.67	78.49	72.32	68.84	62.88	59.28
S ₈₀	77.48	69.32	65.90	60.73	57.02	78.27	71.37	67.76	62.12	57.97
LSD (0.05)	NS	0.389	0.345	0.454	0.358	0.417	0.389	0.961	0.736	0.976
Inoculation										
I ₀	77.62	69.79	66.11	61.08	56.84	78.19	70.86	67.05	61.58	58.04
I ₅₀	77.58	70.43	66.48	61.40	57.09	78.24	70.93	67.53	61.96	58.36
LSD (0.05)	NS	1.347	1.94	1.574	1.238	NS	NS	NS	NS	NS
Storage condition										
Sc ₁	77.21	69.32	64.76	58.87	54.00	78.18	68.39	65.39	59.95	55.77
Sc ₂	77.99	70.90	67.82	63.60	59.94	78.25	72.83	69.20	63.59	60.62
LSD (0.05)	NS	1.347	1.494	1.574	1.238	NS	3.68	3.328	2.549	3.381
Moisture level										
MI ₁	78.19	72.92	68.73	65.19	62.12	78.85	73.94	70.72	65.27	63.05
MI ₂	77.64	70.23	66.11	61.75	57.46	78.14	70.54	67.10	61.71	58.89
MI ₃	76.97	67.18	64.04	56.78	51.32	77.66	68.19	64.06	58.33	52.64
LSD (0.05)	0.297	0.824	0.267	0.352	0.277	0.323	0.301	0.744	0.570	0.567

intervals in storage. In 1997-98 the inoculation treatment did not affect the germination percentage of stored seed significantly. The results indicate that germination percentage of stored seed was improved with the application of inoculation.

C. The initial moisture content of the seed affected significantly the germination percentage of seed from 2 month interval in 1997-98 (Table I). The highest percentage of germination was retained by the treatment of 7.25 % initial moisture while the lowest

percentage of germination was obtained in 9.25% initial moisture content and 8.25% initial moisture content retained intermediate level of germination. Similar results were also obtained in the entire 4 months interval. In 1998-99, the effect of initial moisture content was at par (Table I). The results indicated that the initial moisture content of the seed was very important for retaining germination percentage of seed. The data were plotted in the graphs (Fig. 5 and 6) showed the trend of deterioration in germination percentage of stored seed at different level of

initial moisture content as the duration of seed in storage lingered. Paungthong and Lamduan (1987) obtained similar results.

D. The container affected the germination percentage of stored seed significantly in 1997-98 and 1998-99 except at an interval of

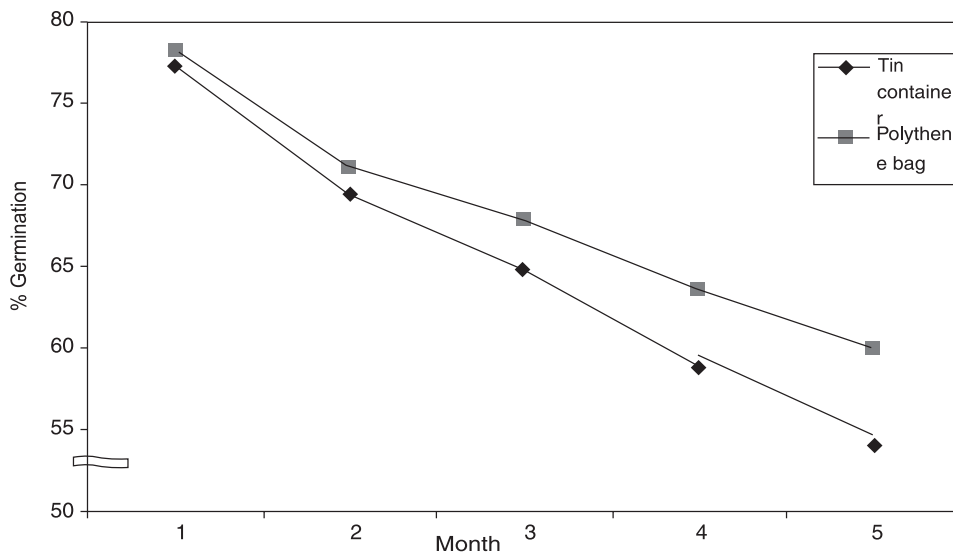


Fig. 3. Effect of storage container on the % of germination of stored seed in 1997-98

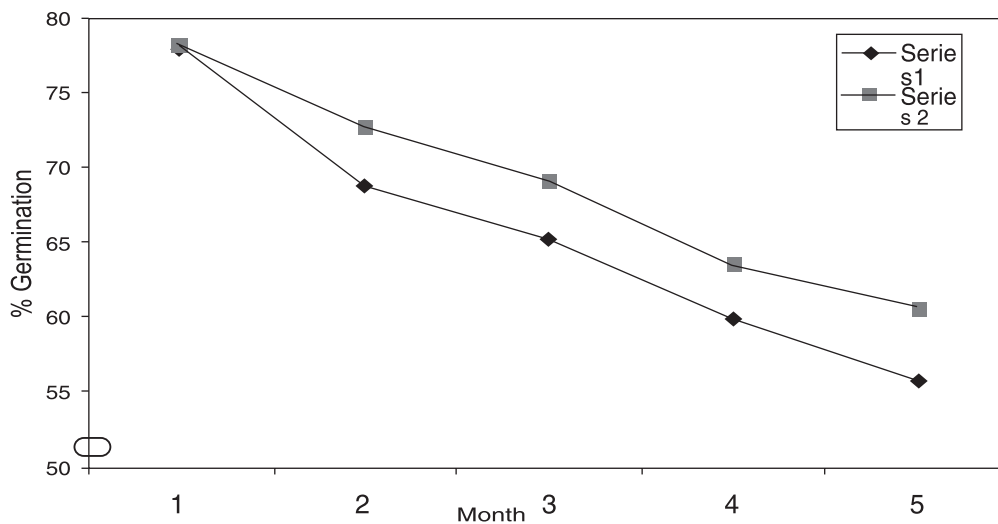


Fig. 4. Effect of storage container on the germination percentage in 1998-99

1 month in 1997-98 (Table I). In all the intervals plastic bags retained significantly higher percentage of germination over tin container. The data were plotted in the graphs and the figure (Fig.3 and 4) showed the clear trend of

deterioration in germination percentage of seed stored in different container. Similar results were obtained by Paungthong *et al.* (1990) and Vichai, *et al.* (1988).

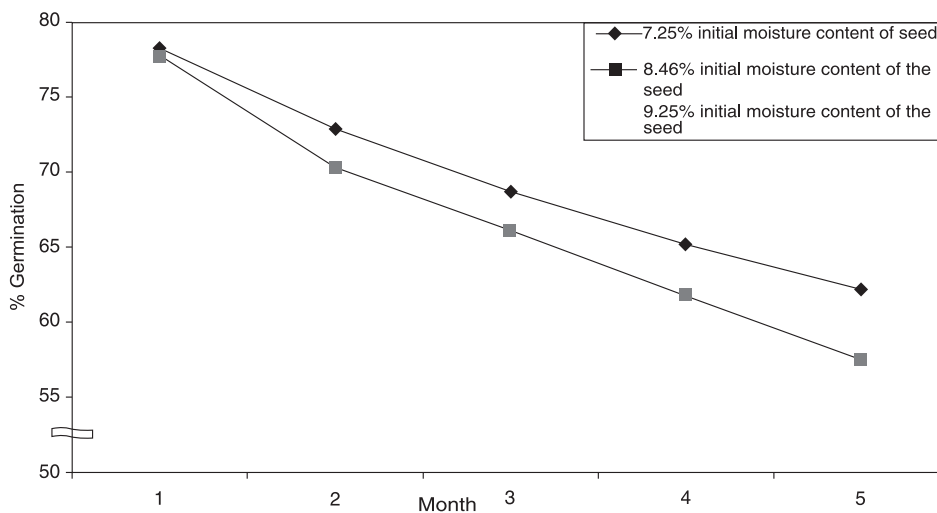


Fig. 5. Effect of initial moisture content of the seed on the % of germination of stored seed in 1997-98

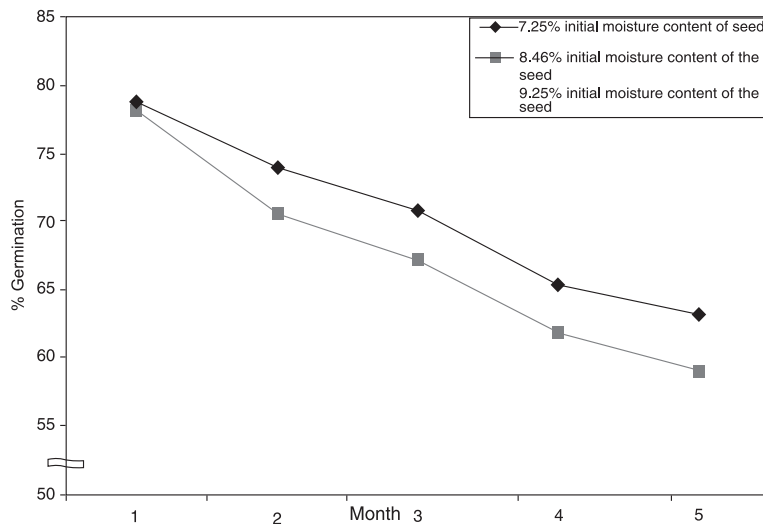


Fig. 6. Effect of initial moisture content of the seed on the % of germination of stored seed in 1998-99

Interaction of sulphur and inoculation of bradyrhizobium on the germination percentage of stored seed

The interaction of sulphur and inoculation was not significant in 1997-98 and 1998-99.

Interaction of sulphur and storage container on the germination percentage of stored seed

The interaction of sulphur and storage container was not significant on the percentage of germination in 1997-98 and 1998-99.

Interaction of inoculation and storage container on the germination percentage of stored seed

Interaction of inoculation and storage container was not significant in 1997-98 and 1998-99 but inoculated or un-inoculated seeds in polythene bag retained high percentage of germination over un-inoculated seed kept in tin container. It is evident from the results that polythene bags can retained the standard germination percentage of seed up to 5 months of storage and after that lost the capacity to retain the germination capacity of seed up to standard level. The results are in partial fulfillment with Jayaraj and Karivaratharaju (1988).

Interaction of sulphur, inoculation and storage container on the germination percentage of stored seed

The interaction of sulphur, inoculation and storage container was not significant in 1997-98 and 1998-99. The germination percentage obtained in the treatment 60 kg S/ha with or

without inoculation and kept in polythene bags was highest. Seeds with higher doses of sulphur up to optimum level retained superior percentage of germination. The lowest percentage of germination was retained by control. It was evident that doses of sulphur and polythene bags container were the main key of storage life of stored groundnut seed while inoculation can retain better life of seed at early stage of storage only.

Interaction of sulphur and initial moisture level of seed on the germination percentage of stored seed

Seeds with higher dose of sulphur up to 60 kg/ha and low initial moisture content retained higher percentage of germination in 1997-98 and 1998-99 (Table II).

At an interval of 2 months, seeds with 60 kg S/ha and with initial moisture content of 7.2% retained significantly higher percentage of germination over other treatments. The lowest percentage of germination was retained by 0 kg S/ha with initial moisture content of 9.25%. At an interval of 3 month similar results were also obtained.

Interaction of inoculation and initial moisture content of the seed on the germination percentage of stored seed

The interaction of inoculation and initial moisture content was not significant at all the intervals in 1997-98 and 1998-99. The results are in partial agreement with Jayaraj and Karivaratharaju (1988).

Table II. Interaction of sulphur and initial moisture content of seed on the germination percentage of stored seed

Treatment	1997-98					1998-99				
	1 month	2 month	3 month	4 month	5 month	1 month	2 month	3 month	4 month	5 month
S ₀ xM ₁	70.46	70.46	67.27	63.85	60.49	78.43	72.54	69.34	64.59	62.31
S ₀ xM ₂	77.55	68.04	64.83	60.32	56.09	77.86	69.78	65.33	60.33	58.06
S ₀ xM ₃	77.08	65.45	62.78	55.38	49.83	77.40	67.67	61.98	57.21	50.67
S ₂₀ xM ₁	78.10	72.56	68.51	64.87	61.38	78.82	72.73	69.95	64.46	63.02
S ₂₀ xM ₂	77.64	70.01	65.59	61.39	56.93	78.09	69.12	66.66	61.11	58.72
S ₂₀ xM ₃	76.85	67.28	63.60	56.42	50.84	77.87	67.24	63.87	57.41	52.52
S ₄₀ xM ₁	78.10	74.13	69.38	65.38	62.42	78.69	74.25	71.00	65.57	63.81
S ₄₀ xM ₂	77.62	71.32	66.30	62.61	57.69	77.99	70.79	67.63	62.21	59.15
S ₄₀ xM ₃	76.78	67.95	64.33	57.65	51.78	77.86	68.21	64.11	58.63	52.95
S ₆₀ xM ₁	78.58	75.40	70.89	67.24	64.18	79.38	76.23	72.75	66.19	64.04
S ₆₀ xM ₂	77.57	72.37	67.70	63.25	58.86	78.46	71.86	68.47	63.00	59.97
S ₆₀ xM ₃	77.41	68.72	65.52	58.02	52.98	77.64	68.85	65.30	59.45	53.83
S ₈₀ xM ₁	78.08	72.05	67.63	64.59	62.12	78.95	73.95	70.83	65.52	62.10
S ₈₀ xM ₂	77.62	69.44	66.11	61.17	57.75	78.33	71.18	67.43	61.90	58.56
S ₈₀ xM ₃	76.74	66.47	63.97	56.41	51.18	77.52	68.99	65.02	58.93	53.24
LSD(0.05)	NS	0.674	0.597	NS	NS	NS	NS	NS	NS	NS

Interaction of sulphur, inoculation and initial moisture content of the seed on the germination percentage of stored seed

The interaction of sulphur, inoculation and initial moisture content of the seed was not significant in 1997-98 and 1998-99. The highest germination percentage was retained by the treatment 60 kg S/ha with inoculation and 7.25% initial moisture content of the seed in both the years. The lowest germination percentage was obtained by the treatment 0 kg S/ha with inoculation and 9.25% initial moisture content.

Interaction of storage container and initial moisture content of the seed on the germination percentage of stored seed

The interaction of storage container and initial moisture content of the seed was significant (Table III). In 1997-98, seed with 7.25 % initial moisture and stored in polythene bag retained the highest percentage of germination and the lowest percentage of germination were in seeds kept in tin container and with 9.25 % initial moisture content. From the interval of 3 months, the seed with different initial moisture level stored in polythene bags retained higher percentage of

Table III. Interaction of storage container and initial moisture content of the seed on the germination percentage of stored seed

Treatment	1997-98					1998-99				
	1 month	2 month	3 month	4 month	5 month	1 month	2 month	3 month	4 month	5 month
Sc ₁ xMl ₁	77.74	72.11	66.51	63.17	59.68	78.75	71.08	67.81	65.51	59.90
Sc ₁ xMl ₂	77.35	69.54	64.81	60.66	54.54	78.31	68.73	65.50	60.71	57.17
Sc ₁ xMl ₃	76.56	66.32	62.97	52.80	47.78	77.48	67.07	62.85	56.92	50.26
Sc ₂ xMl ₁	78.64	73.73	70.96	67.21	64.55	78.96	76.80	73.62	68.03	66.21
Sc ₂ xMl ₂	77.93	70.93	67.40	62.84	60.39	77.98	72.37	68.71	63.02	60.61
Sc ₂ xMl ₃	77.39	68.04	65.11	60.76	54.86	77.84	69.32	65.26	59.73	55.03
LSD (0.05)	NS	NS	0.378	0.498	0.392	0.420	1.165	1.053	0.806	3.381

germination oven seeds same initial moisture content but stored in tin container. At an interval of 4 months, the seeds with 7.25% initial moisture content and kept in tin container retained identical percentage of germination with seeds with 8.46% initial moisture content and kept in polythene bags. A similar result was also obtained in 1998-99. At an interval of 5 months in 1998-99, the results were at par to months interval but in 1997-98 the seeds with different initial moisture content and storage container retained significantly different germination percentage. The above results indicated that seeds with higher initial moisture content and kept in polythene bags can retain the germination percentage longer than seeds kept in tin containers with low initial moisture content. Prasat and Chaumsri (1987) obtained similar results.

Interaction of sulphur, storage container and initial moisture content on the germination percentage of stored seed

In 1997-98 at an interval of 2 months, the seeds with 60 kg S/ha and initial moisture content (7.25% and kept in polythene bags retained significantly superior percentage of germination which retained at par germination percentage with 40 kg S/ha and 7.25% initial moisture content and kept in polythene bag (Table IV).

In 1998-99, the seeds with initial moisture content of 7.25 % and kept in polythene bags with different levels of sulphur in control retained significantly superior percentage of germination and other retained identical percentage of germination. Puangthong *et al.* (1990) found similar results. The interaction of inoculation, storage container and initial moisture content of seed was not significant in 1997-98 and 1998-99. The lowest

percentage of germination was obtained in the treatment 9.25% initial moisture content of seed kept in tin container and without inoculation. In 1998-99 the trend of retaining germination percentage was also similar. The results were in agreement with the result of Majhi and Bandopadhyaya (1993)

Interaction of inoculation, storage container and initial moisture level on the germination percentage of stored seed

The interaction of inoculation, storage container and initial moisture content of the seed was not significant in 1997-98 and 1998-99. The results are in agreement with the results of Majhi and Bandopadhyaya (1993).

Interaction of sulphur, inoculation, storage container and initial moisture percentage of seed on the germination percentage of stored seed

At all the intervals the interaction of all the four treatments was not significant in 1997-98 and 1998-99. Bhuiyan and Quashem (1983) reported similar results.

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