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Effect of Magnesium, *Bradyrhizobium* Inoculation, Initial Moisture Content and Storage Container on the Vigour Index of Groundnut Seed

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Abstract

The study was performed to determine the effect of magnesium and *Bradyrhizobium* fertilized seed at different initial moisture content of seed and storage container on the vigour index of groundnut seed. Results revealed that increase in the vigour index was observed with the doses of magnesium up to 10 kg/ha in storage but the seeds obtained from inoculation failed to check the deterioration. Results of vigour index indicated that groundnut seeds obtained from magnesium and *Bradyrhizobium* fertilizer elements during production and stored in polythene bags can retain better seed quality, provided seeds were dried to a safe moisture level of 7.25%.

Key words : Groundnut seed, Magnesium, Inoculation, Moisture content, vigour index.

Introduction

Magnesium is the component of chlorophyll and is essential for amino acids and fat synthesis. It also affects the viability of seed (Dwivedi, 1988). Application of magnesium in the dry season planting did not affect either the percentage of seed germination or vigor of the four groundnut cultivars. However, in the rainy season, seed germination and seed vigour as determined by the accelerated aging technique and field emergence counted at 14 and 21 days after planting was found to increase with the application of magnesium (Junangiun, 1991). Uninoculated seeds with 8% moisture content gave highest percentage of germination irrespective of storage containers. Seed stored in cloth bags gave significantly higher percentage of germination than those stored in aluminum foil pouches (Jayaraj and Karivaratharaju, 1988). Among containers, the polyvinyl bags gave the greatest percentage of germination and seed vigour after 16 months, but differences at earlier stages were not significant. All containers maintained the minimum certification standard of 70% germination for 12 months, and polyvinyl bags maintained this standard for 14 months (Krishnappa *et al*, 1998). Seed vigour decreased under all storage conditions. The fastest reduction occurred in seed stored

under ambient condition. The seed moisture content increased to an unsafe level for maintaining good seed quality in seed stored under ambient condition. Whereas moisture content in seed stored under the two controlled conditions remained at a safe level during the entire storage period (Prasat, 1990). The present study was designed with the objectives to find out the performance of magnesium and *Bradyrhizobium* inoculation, initial moisture content of seed and storage container on the vigour index of groundnut seeds.

Materials and Methods

A. Magnesium: Five dose of Magnesium *viz.* i Mg_0 ii. Mg_5 iii. Mg_{10} iv. Mg_{15} v. Mg_{20}

B. *Bradyrhizobium* fertilization: Two dose of inoculation *viz* i. 0 g *Br* /kg of seed ii.50 g *Br* /kg of seed.

Bradyrhizobium inoculant BAU-700 was used in the study. The Department of Soil Science of Bangladesh Agricultural University (BAU), Mymensingh, developed the inoculant.

C. Initial moisture content of seed: Three treatments were selected. The treatments were i.7.25% initial moisture content of seed (Ml_1) ii. 8.46% initial moisture content of seed (Ml_2) iii. 9.25% initial moisture content of seed (Ml_3)

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

i. Tin container with airtight lid (Sc_1). ii. Polypropylene bag with 0.25mm thickness (Sc_2).

The experiment was set combining the treatment following the principles of Complete Randomized Design with three replication. The data was analyzed through a statistical computer programmed MSTAT-C.

Vigour test: Vigour index was measured by using the following formula (Maguire, 1962).

Vigour = (number of normal seedling at initial count ÷ days to initial count) + ---------- + (no. of normal seedling at final count ÷ days to final count)

Results and Discussions

1. Effect of Mg, *Bradyrhizobium*, container and moisture content on vigour index of stored seed

At the early stage of storage the speed of germination showed by different level of magnesium was significant. The highest speed of germination was showed by the treatment Mg @ 10kg/ha and the control plot showed the lowest seed of germination. At the interval of 2 months the seeds with Mg @10 kg/ha and Mg @15kg/ha retained significantly higher speed of germination. The lowest speed of germination was noticed by the control treatments. The data were plotted in the graphs (Mg_0 Mg_5 and Mg_{20} (Fig. 1 and Fig. 2) which revealed a trend of lower vigour

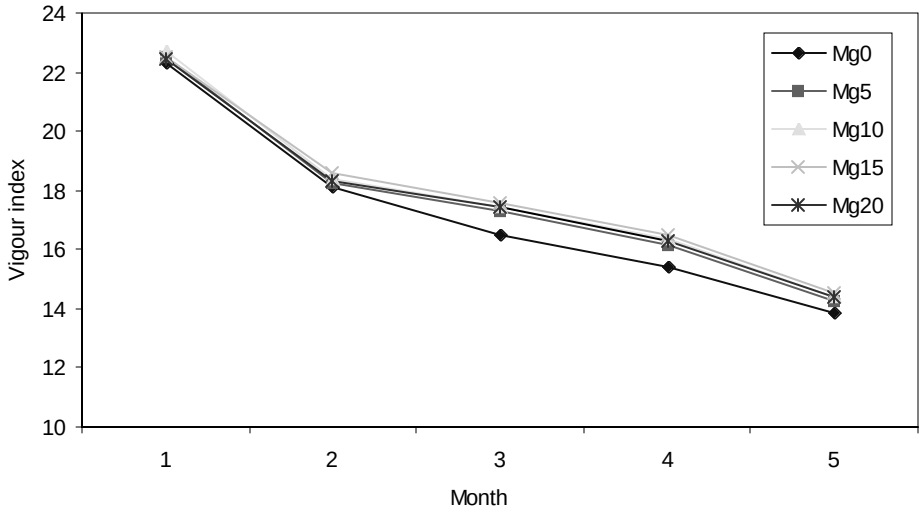

Fig. 1. Effect of magnesium on the vigour index of stored seed in 1997-98

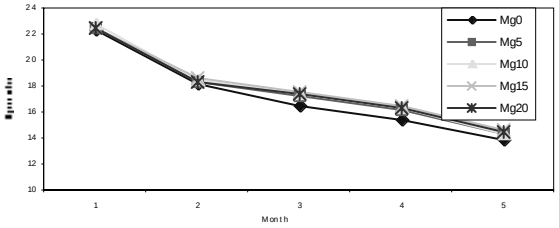

Fig. 2. Effect of magnesium on the vigour index of stored seed in 1998-99

index of magnesium treated stored seed with passage of time. These results continued up to 5 months.

The inoculation of seed with *Bradyrhizobium* did not affect the speed of germination of stored seed in early stage of storage. In the later stage of storage inoculation affected the speed of germination. In 1997-98 at an interval of 3, 4, and 5 month inoculated seed retained superior speed of germination of stored seed. In 1998-99 the speed of germination was not affected by the inoculation treatment.

Table I Effect of magnesium level, *Bradyrhizobium* fertilization, storage container and moisture level on seed vigour index over storage period

Teratment	1997-98					1998-99				
	1mon	2mon	3mon	4mon	5mon	1mon	2mon	3mon	4mon	5mon
Mg level										
Mg_0	22.36	18.29	16.78	15.66	14.81	22.34	18.11	16.50	15.39	13.85
Mg_5	22.45	18.45	17.46	16.23	15.10	22.50	18.25	17.29	16.18	14.26
Mg_{10}	22.67	18.66	17.68	16.51	15.37	22.73	18.40	17.45	16.36	14.38
Mg_{15}	22.52	18.64	17.69	16.48	15.29	22.53	18.60	17.57	16.46	14.55
Mg_{20}	22.44	18.36	17.49	16.26	15.07	22.44	18.35	17.41	16.32	14.41
LSD (0.05)	0.005	0.121	0.092	0.169	0.179	0.005	0.063	0.123	0.131	0.209
Inoculatio										
Br_0	22.49	18.45	17.39	16.17	14.96	22.50	18.30	17.21	16.12	14.25
Br_{50}	22.49	18.51	17.45	16.28	15.04	22.51	18.38	17.28	16.17	14.33
LSD (0.05)	NS	NS	NS	0.583	NS	NS	0.256	0.256	NS	NS
St. contain										
Sc_1	22.48	17.94	16.75	15.33	14.00	22.49	17.62	16.70	15.57	13.51
Sc_2	22.50	19.02	18.09	17.12	16.00	22.53	19.07	17.79	16.71	15.07
LSD (0.05)	0.016	0.367	0.107	0.583	0.767	0.016	0.256	0.423	0.454	0.775
Moisture level										
Ml_1	22.51	21.03	19.93	19.01	17.81	22.52	21.00	19.70	18.49	16.92
Ml_2	22.50	19.70	18.62	17.39	15.98	22.51	19.59	18.46	17.62	14.82
Ml_3	22.45	14.71	13.71	12.28	11.23	22.48	14.43	13.57	12.32	11.13
LSD (0.05)	0.004	0.033	0.071	0.131	0.139	0.004	0.049	0.034	0.102	0.162

The effect of storage container on the speed of germination was significant from the early stage of storage in 1997-98 and 1998-99 (Table I). The seeds stored in polythene bags showed significant superiority over tin container in both the years. The data were plotted in the graphs which (Fig. 3 and Fig. 4) also showed the clear trend of deterioration of speed of germination of seed stored in tin container in course of time. The effect of initial moisture contents of the seed was significant from the early stage of storage. After 2 months the highest speed of germination was restored by the treatment Ml_1 and the lowest speed was obtained by the treatment Ml_3 (Table I). The results continued up to 5 months indicating that initial moisture content of seed played very important role in the storage behavior. The data were plotted in the graphs which (Fig. 5 and Fig. 6) showed the clear trend of deterioration in speed of germination of stored seed at higher initial moisture content as the storage period is elongated.

2. Interaction of magnesium and *Bradyrhizobium* inoculation of the vigour index of stored seed

The interaction of magnesium and *Bradyrhizobium* inoculation was not signifi-

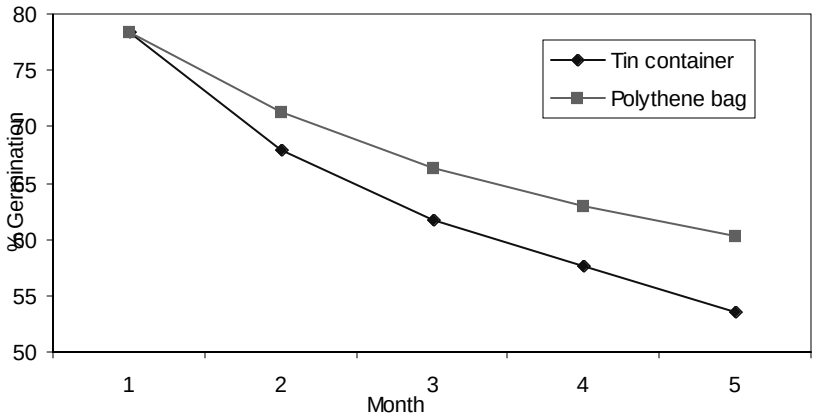

Fig. 1.3. Effect of storage container on the germination percentage of stored seed in 1997-98

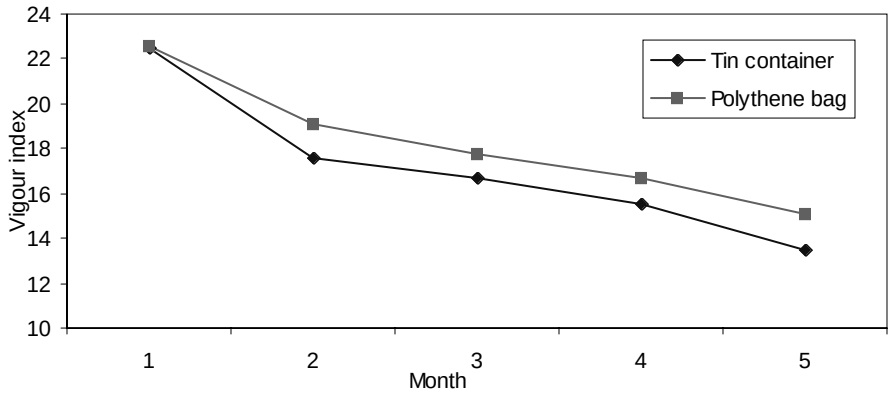

Fig. 4. Effect of storage container on the vigour index of stored seed in 1998-99

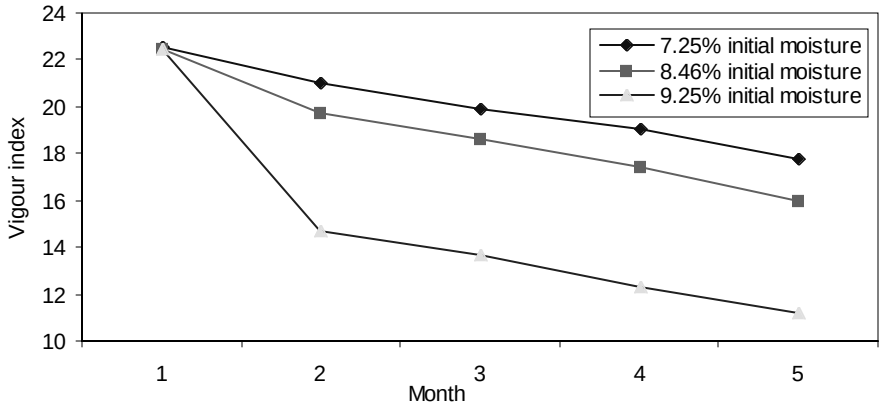

Fig. 5. Effect of initial moisture content of seed on the vigour index of stored seed in 1997-98

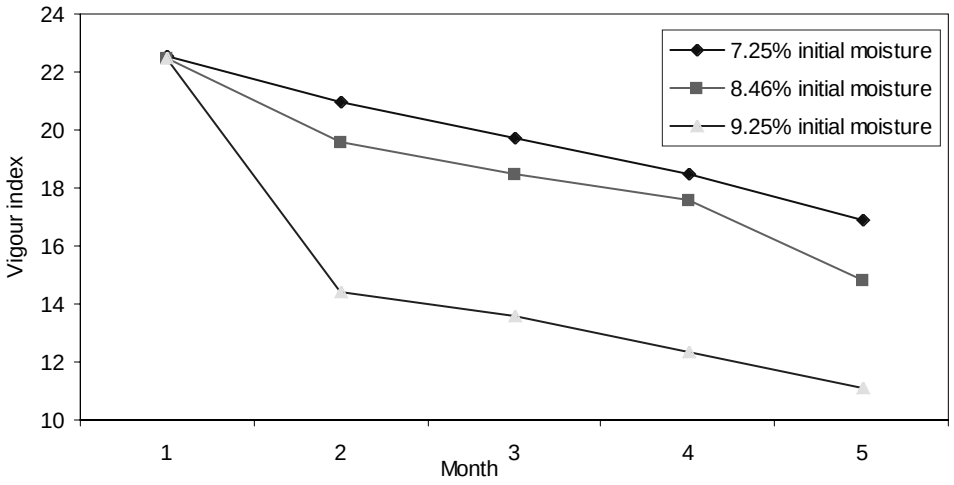

Fig. 6. Effect of initial moisture content of seed on the vigour index of stored seed in 1998-99

cant in 1997-98 and 1998-99. It was evident-from the Table II that inoculation did better than the uninoculated one. The vigour index increased with the increasing magnesium level up to optimum level and then it declined.

3. Interaction of magnesium and storage container on the vigour index of stored seed.

Magnesium and storage container interacted significantly from the early stage of storage but the mean did not vary significantly (Table II). In 1997-98 from the interval of 2

Table II. Interaction of magnesium and storage container on seed vigour index over storage period

Interaction	1997-98					1998-99				
Mg×St.cont.	1mon	2mon	3mon	4mon	5mon	1mon	2mon	3mon	4mon	5mon
$Mg_0 \times Sc_1$	22.33	17.73	16.14	14.94	13.39	22.31	17.39	15.53	14.79	13.08
$Mg_0 \times Sc_2$	22.39	18.84	17.42	16.37	14.96	22.37	18.84	17.07	15.99	14.62
$Mg5 \times Sc_1$	22.44	17.97	16.72	15.23	13.97	22.46	17.53	16.76	15.66	13.48
$Mg5 \times Sc_2$	22.46	18.93	18.20	17.22	16.23	22.54	18.97	17.83	16.70	15.04
$Mg_{10} \times Sc_1$	22.64	18.23	16.96	15.58	14.32	22.68	17.70	16.92	15.83	13.57
$Mg_{10} \times Sc_2$	22.70	19.09	18.39	17.43	16.42	22.77	19.11	17.99	16.89	15.19
$Mg_{15} \times Sc_1$	22.53	18.02	17.06	15.57	14.28	22.54	17.88	17.02	15.86	13.77
$Mg_{15} \times Sc_2$	22.51	19.26	18.32	17.40	16.31	22.52	19.32	18.12	17.06	15.33
$Mg_{20} \times Sc_1$	22.44	17.77	16.88	15.33	14.06	22.44	17.58	16.89	15.74	13.63
$Mg_{20} \times Sc_2$	22.44	18.96	18.10	17.18	16.09	22.43	19.11	17.93	16.89	15.18
LSD (0.05)	0.006	0.171	NS	0.239	0.254	0.006	NS	NS	NS	NS

months the seed with higher level of magnesium and stored in polythene bags retained the higher speed of germination and the seeds with higher level of magnesium stored in tin container retained identical speed of germination. From the interval of 3 months the speed of seed germination grouped into three. The highest germination speed was showed by higher level of magnesium stored in polythene bags and the seeds with lower level showed lowest level of magnesium. The result indicated that storage container dictated more on vigour index than magnesium levels.

4. Interaction of *Bradyrhizobium* fertilization and storage container on the vigor index of stored seed

Bradyrhizobium fertilization and storage container fail to interact significantly from the early stage of storage on the vigor index of stored seed. On the following months theseeds kept in polythene bag, with or without inoculation showed higher level of germination over the tin containers.

5. Interaction of magnesium, *Bradyrhizobium* fertilization and storage container on the vigour index of stored seed

The interaction of magnesium, *Bradyrhizobium* inoculation and storage container was not significant in 1997-98 and 1998-99. Seeds with higher level of magnesium and stored in polythene bags showed higher level of germination. The seeds with or without magnesium stored in tin container expressed lowest level of germination.

This result continued up to the 5 months of storage but with the advance of time in storage the seeds with higher magnesium dose with or without inoculation and stored in tin container showed poorer speed of germination. The lowest speed of germination was retained by the treatment with poorer magnesium and stored in tin container.

6. Interaction of magnesium and moisture content of seed on the vigour index of stored seed

The interaction of magnesium and initial moisture content of the seed was not significant in 1997-98 and 1998-99 (Table III). From the later interval the seeds of higher level of magnesium and lower initial moisture content (ML_1 and ML_2) showed identical germination level while the seed with lower level of magnesium or zero magnesium with higher (ML_3) of percentage of initial moisture content retained poorer speeds of germination. In course of time of storage the effect of magnesium gradually lost its dominance in the interaction process and the speed of germination became grouped with percentage of initial moisture content of seed.

Table III. Interaction of magnesium level and moisture level on seed vigour index over storage period

Interaction	1997-98					1998-99				
Mg×M.level	1mon	2mon	3mon	4mon	5mon	1mon	2mon	3mon	4mon	5mon
$Mg_0 \times Ml_1$	22.37	20.83	18.94	18.16	16.44	22.35	20.82	18.63	17.62	16.16
$Mg_0 \times Ml_2$	22.38	19.52	17.99	16.97	15.32	22.34	19.33	17.60	16.54	14.49
$Mg_0 \times Ml_3$	22.35	14.52	13.42	11.85	10.76	22.32	14.20	13.27	12.02	10.90
$Mg_5 \times Ml_1$	22.47	21.02	20.05	19.14	18.11	22.52	20.92	19.77	18.52	16.98
$Mg_5 \times Ml_2$	22.46	19.67	18.69	17.34	16.02	22.52	19.49	18.54	17.73	14.69
$Mg_5 \times Ml_3$	22.42	14.68	13.63	12.19	11.17	22.47	14.33	13.56	12.29	11.12
$Mg_{10} \times Ml_1$	22.71	21.21	20.33	19.41	18.38	22.75	21.06	19.95	18.74	17.06
$Mg_{10} \times Ml_2$	22.71	19.89	18.88	17.72	16.34	22.73	19.67	18.71	17.90	14.89
$Mg_{10} \times Ml_3$	22.60	14.88	13.82	12.40	11.39	22.69	14.48	13.70	12.44	11.18
$Mg_{15} \times Ml_1$	22.55	21.15	20.25	19.25	18.17	22.54	21.23	20.16	18.91	17.22
$Mg_{15} \times Ml_2$	22.53	19.83	18.83	17.59	16.21	22.55	19.87	18.86	18.06	15.17
$Mg_{15} \times Ml_3$	22.48	14.93	13.98	12.61	11.50	22.51	14.69	13.69	12.42	11.26
$Mg_{20} \times Ml_1$	22.47	20.95	20.08	19.08	17.92	22.47	20.99	20.01	18.65	17.17
$Mg_{20} \times Ml_2$	22.45	19.58	18.70	17.33	16.00	22.43	19.61	18.61	17.88	14.88
$Mg_{20} \times Ml_3$	22.41	14.56	13.69	12.35	11.31	22.41	14.44	13.62	12.42	11.17
LSD (0.05)	0.008	0.209	0.160	0.293	0.311	0.008	0.108	NS	0.227	NS

7. Interaction of storage container and initial moisture content of seed on the vigour index of stored seed

The interaction of storage container and initial moisture content of the seed was significant in 1997-98 and 1998-99 (Table IV). At an interval of 2 months in 1997-98 the seeds with 7.25% stored in polythene bags showed the highest speed at germination.

Table IV. Interaction of storage container and moisture level on seed vigour index over storage period

Interaction	1997-98					1998-99				
St.cont. ×M.level	1mon	2mon	3mon	4mon	5mon	1mon	2mon	3mon	4mon	5mon
$Sc_1 \times Ml_1$	22.51	20.67	19.35	18.00	16.86	22.50	20.47	19.19	18.25	16.53
$Sc_1 \times Ml_2$	22.49	18.95	18.18	16.62	15.30	22.50	18.72	18.19	17.23	14.25
$Sc_1 \times Ml_3$	22.43	14.22	12.73	11.38	9.851	22.46	13.66	12.73	11.24	9.741
$Sc_2 \times Ml_1$	22.52	21.40	20.51	20.02	8.751	22.55	21.54	20.21	18.72	7.311
$Sc_2 \times Ml_2$	22.52	20.45	19.05	18.16	6.661	22.53	20.47	18.74	18.02	5.401
$Sc_2 \times Ml_3$	22.47	15.21	14.69	13.18	2.60	22.50	15.20	14.41	13.39	2.51
LSD (0.05	0.005	0.132	0.101	0.185	0.197	0.005	0.068	0.134	0.144	0.229

The seeds with 8.46% initial moisture content of seed stored either in polythene bags or in tin container showed identical speed of germination. In 1998-99 the rate of germination of different initial moisture level and storage container interacted very distinctly

Table V. Interaction of magnesium level, storage container and moisture level on seed vigour index over storage period

Interaction						
S×St.con×M. level	1 mon	3 mon	5 mon	1 mon	3 mon	5 mon
$Mg_0 \times Sc_1 \times Ml_1$	22.33	18.45	16.05	22.32	18.28	15.70
$Mg_0 \times Sc_1 \times Ml_2$	22.35	17.53	14.75	22.32	17.12	14.03
$Mg_0 \times Sc_1 \times Ml_3$	22.32	12.45	9.38	22.28	12.40	9.50
$Mg_0 \times Sc_2 \times Ml_1$	22.40	19.43	16.83	22.38	18.97	16.62
$Mg_0 \times Sc_2 \times Ml_2$	22.40	18.45	15.90	22.37	18.08	14.95
$Mg_0 \times Sc_2 \times Ml_3$	22.38	14.38	12.13	22.37	14.15	12.30
$Mg_5 \times Sc_1 \times Ml_1$	22.45	19.33	16.85	22.48	19.22	16.55
$Mg_5 \times Sc_1 \times Ml_2$	22.43	18.13	15.27	22.48	18.30	14.08
$Mg_5 \times Sc_1 \times Ml_3$	22.43	12.68	9.78	22.42	12.75	9.82
$Mg_5 \times Sc_2 \times Ml_1$	22.48	20.77	19.37	22.55	20.33	17.42
$Mg_5 \times Sc_2 \times Ml_2$	22.48	19.25	16.78	22.55	18.78	15.30
$Mg_5 \times Sc_2 \times Ml_3$	22.42	14.58	12.55	22.52	14.37	12.42
$Mg_{10} \times Sc_1 \times Ml_1$	22.70	19.72	17.30	22.70	19.38	16.63
$Mg_{10} \times Sc_1 \times Ml_2$	22.68	18.35	15.60	22.70	18.50	14.30
$Mg_{10} \times Sc_1 \times Ml_3$	22.55	12.82	10.07	22.65	12.87	9.77
$Mg_{10} \times Sc_2 \times Ml_1$	22.72	20.93	19.47	22.80	20.52	17.48
$Mg_{10} \times Sc_2 \times Ml_2$	22.73	19.42	17.08	22.77	18.92	15.48
$Mg_{10} \times Sc_2 \times Ml_3$	22.65	14.83	12.72	22.73	14.53	12.60
$Mg_{15} \times Sc_1 \times Ml_1$	22.57	19.73	17.18	22.55	19.60	16.83
$Mg_{15} \times Sc_1 \times Ml_2$	22.53	18.47	15.53	22.55	18.63	14.62
$Mg_{15} \times Sc_1 \times Ml_3$	22.48	12.97	10.12	22.53	12.83	9.85
$Mg_{15} \times Sc_2 \times Ml_1$	22.53	20.77	19.17	22.53	20.72	17.60
$Mg_{15} \times Sc_2 \times Ml_2$	22.53	19.18	16.88	22.55	19.08	15.72
$Mg_{15} \times Sc_2 \times Ml_3$	22.47	15.00	12.88	2248.	14.55	12.67
$Mg_{20} \times Sc_1 \times Ml_1$	22.48	19.50	16.93	22.47	19.48	16.92
$Mg_{20} \times Sc_1 \times Ml_2$	22.45	18.43	15.35	22.43	18.40	14.22
$Mg_{20} \times Sc_1 \times Ml_3$	22.38	12.72	9.90	22.42	12.78	9.77
$Mg_{20} \times Sc_2 \times Ml_1$	22.45	20.67	18.90	22.47	20.53	17.43
$Mg_{20} \times Sc_2 \times Ml_2$	22.45	18.97	16.65	22.43	18.82	15.55
$Mg_{20} \times Sc_2 \times Ml_3$	22.43	14.67	12.72	22.40	14.45	12.57
LSD (0.05%)	0.011	NS	NS	0.011	0.300	NS

and each interaction treatment retained significantly different speed of germination. The result indicated that the effect of storage container affected the rate of germination at early stage of storage while the initial moisture content of seed affected the rate at germination throughout the whole storage period. The results are in full agreement with Suchanya *et.al* (1986).

8. Interaction of magnesium, storage container and initial moisture content of seed on the vigour index of stored seed

The interaction of magnesium, storage container and initial moisture content of the seed on the germination rate of stored seed was not significant in both the years.

The seeds with different level of magnesium, lower level of initial moisture content (Ml_1 and Ml_2) and stored in polythene bag showed better germination rate while seeds with different levels of magnesium with highest level of initial moisture content (Ml_3) and stored in polythene bags or tin container showed lower germination rate (Table V).

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