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Effect of storage container and initial seed moisture content on quality of shelled groundnut seed

M.M. Alam, M.M. Rahman[1], M.A. Samad[1], R. Ashrafi[2] and M.M. Rahman[3]
OFRD, BARI, Bandarban, Bangladesh, [1]Department of Agronomy, Bangladesh Agricultural University, Mymensingh, [2]Soil Science Division, BINA, Mymensingh, [4]Department of Agricultural Extension, Khamar Bari, Dhaka, Bangladesh

Abstract: The experiment was conducted at the Seed Laboratory of the Department of Agronomy, Bangladesh Agricultural University, Mymensingh during June 2010 to December 2011 to develop a suitable and low cost groundnut seed storage technology. Four storage container Polythene bag, Plastic pot, Tin container and Cloth bag and three initial seed moisture content (8%, 10% and 12%) were included in the present study to evaluate their effects on germination performance of groundnut seed. Experiment was arranged in completely randomized design with three replications. The highest germination performance was recorded from seeds stored at 8% initial seed moisture content (SMC) in polythene bags. The present study concludes that shelled groundnut seed could be stored safely from one rabi season to the next if stored in polythene bags after drying to 8% initial seed moisture content.
Key words: Groundnut, moisture content and storage container.

Introduction

Rapid loss of germination and vigour during storage under ambient condition is a major constraint in groundnut (*Arachis hypogaea* L.) production especially under tropical condition like Bangladesh. As oilseed, groundnut encounters rapid seed deterioration during storage. Rate of increase of seed moisture content depends on the type of storage container. The impermeable containers (non-porous) such as polythene bag, tin container etc. can keep seed moisture content at safer level than porous container. Research at Bangladesh Agricultural University, Mymensingh suggests that polythene bag is capable of maintaining the low moisture content of seed even when stored at high (60-80% RH) ambient relative humidity (Rahman *et al*., 1994). On the other hand, if seeds are stored in shelled condition, it can save 60-70% volume. But experiment on the effect of different storage environment of shelled groundnut seed has not been conducted so far. So, there is a need to evaluate the performance of shelled and unshelled groundnut seed under variable storage environment. Considering the above facts and observation, the present research work, therefore, was undertaken with a view to develop suitable techniques for storage of groundnut seed to study the effect of storage container on groundnut seed quality and to determine the effect of seed moisture content and relative humidity on groundnut seed quality.

Materials and methods

The experiment was conducted during June 2010 through December 2011 to study the effect of storage environment on quality of groundnut seed at the Seed Laboratory, Department of Agronomy, Bangladesh Agricultural University (BAU), Mymensingh. Freshly, harvested seeds of groundnut cv. BINA badam4 was taken in four storage container (polythene bag. plastic pot, tin container and cloth bag) and three initial seed moisture content (8%, 10% and 12%) were included in the study. The groundnut seed was properly sun dried and the shelling of groundnut seed was done manually with care and safety to avoid mechanical injury of shelled seed. Completely randomized design was used with three replications. The seed quality parameters such as seed moisture content, germination (%), and vigour index were recorded at start of storage and also at 40, 80, 120 and 200 days after storage (DAS). The following parameters were measured by standard rules (ISTA, 2003). The number of seedlings emerged each day were counted up to 15 days after sowing. Data analysis was done following analysis of variance technique adopting the design followed in each experiment using computer package programs (ANOVA) MSTAT–C. Mean comparison was done following Duncan's Multiple Rang Test (DMRT) at 5% level of significance.

Results and Discussion

Seed moisture content (SMC): Seeds stored at different storage container showed significant variation in their moisture content at each of the testing dates during the storage period. In 2010, the moisture content of seeds stored in polythene bag were 10.45%, 10.78%, 11.24%, 11.47% and 12.01% at 40, 80, 120, 160 and 200 days after storage (DAS) while those stored at cloth bag were 11.90%, 14.22%, 14.71%, 14.77% and 14.79%, respectively. In 2011, the moisture content of seeds stored in polythene bag were 10.48%, 10.79%, 11.26%, 11.48% and 12.03% at 40, 80, 120, 160 and 200 DAS while those stored in cloth bag gained 11.92%, 14.24%, 14.73%, 14.78%, 14.81%, respective (Fig. 1).

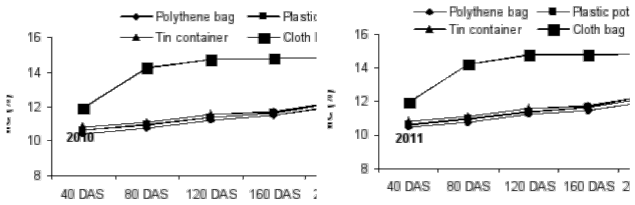

Fig 1. Effect of storage container on moisture content of shelled groundnut seed at different days after storage in 2010 and 2011.

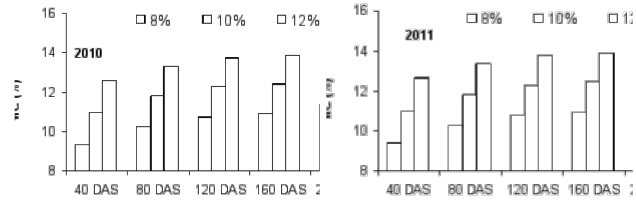

Fig 2. Effect of initial SMC on moisture content of shelled groundnut seed at different days after storage in 2010 and 2011.

The initial SMC had significant effect on moisture content of groundnut seed at each of the observation dates during the storage period from June to December in 2010 and 2011. In 2010, the seeds stored at 8% initial SMC attained moisture content of 9.33%, 10.22%, 10.72%,10.91% and

11.35% at 40, 80, 120, 160 and 200 DAS while those stored at 12% initial SMC attained at 12.59%, 13.30%, 13.72%, 13.86% and 14.30%, respectively. In 2011, the seeds stored at 8% initial SMC gained moisture content of 9.35%, 10.23%, 10.73%, 10.92% and 11.37% while those values for 12% initial SMC were 12.62%, 13.31%, 13.74%, 13.88% and 14.33% SMC, respectively (Fig. 2)

The interaction effect of storage container and initial SMC on moisture content of groundnut seed was also statistically significant. In 2010, the moisture content of seeds stored at 8% initial SMC in polythene bag obtained 8.47%, 8.84%, 9.31%, 9.58% and 10.12% at 40, 80, 120, 160 and 200 DAS while those stored at 12% initial SMC in cloth bags had 12.70%, 14.62%, 14.92%, 14.98% and 15.00% SMC. In 2011, seeds stored at 8% initial SMC in polythene bag reached seed moisture content of 8.49%, 8.85%, 9.32%, 9.59% and 10.13% at 40, 80, 120, 160 and 200 DAS, respectively while those stored at 12% initial SMC in cloth bag exhibited 12.72%, 14.64%, 14.94%, 15.00% and 15.03%, respectively (Table 1).

Table 1. Effect of storage container (SC) and initial seed moisture content on seed moisture content of BINA badam4 during storage period 2010 and 2011

	2010					2011				
SC × SMC	40 DAS	80 DAS	120 DAS	160 DAS	200 DAS	40 DAS	80 DAS	120 DAS	160 DAS	200 DAS
$C_1 \times M_1$	8.47e	8.84f	9.31e	9.58d	10.12d	8.49g	8.85d	9.32e	9.59e	10.13e
$C_1 \times M_2$	10.45d	10.75e	11.22d	11.46c	11.98c	10.47e	10.76c	11.23d	11.47d	12.00d
$C_1 \times M_3$	12.45a	12.74d	13.21c	13.38b	13.95b	12.47a	12.75b	13.23c	13.39c	13.97c
$C_2 \times M_1$	8.71e	9.01f	9.48e	9.75d	10.35d	8.73fg	9.02d	9.49e	9.76e	10.37e
$C_2 \times M_2$	10.67d	10.96e	11.43d	11.64c	12.22c	10.69de	10.97c	11.44d	11.65d	12.24d
$C_2 \times M_3$	12.52a	12.81d	13.28c	13.49b	14.05b	12.54a	12.83b	13.30c	13.50c	14.07c
$C_3 \times M_1$	8.91e	9.21f	9.68e	9.84d	10.44d	8.93f	9.22d	9.69e	9.85e	10.45e
$C_3 \times M_2$	10.79cd	11.09e	11.56d	11.73c	12.32c	10.81d	11.10c	11.57d	11.74d	12.34d
$C_3 \times M_3$	12.72a	13.02d	13.49c	13.61b	14.21b	12.75a	13.03b	13.50c	13.63c	14.24bc
$C_4 \times M_1$	11.23c	13.82c	14.42b	14.48a	14.50ab	11.25c	13.84ab	14.44b	14.50b	14.53b
$C_4 \times M_2$	11.79b	14.22b	14.79ab	14.85a	14.87a	11.82b	14.24a	14.80a	14.86a	14.89a
$C_4 \times M_3$	12.70a	14.62a	14.92a	14.98a	15.00a	12.72a	14.64a	14.94a	15.00a	15.03a
CV (%)	2.81	1.87	1.92	2.72	2.87	1.69	1.79	1.73	1.30	1.59
LS	**	**	**	**	**	**	**	**	**	**

C_1= Polythene bag, C_2= Plastic pot container, C_3= Tin container, C_4= Cloth bag, M_1= 8% initial SMC, M_2= 10% initial SMC, M_3= 12% initial SMC, CV=Co-efficient of variation and LS= Level of significance, Figures with similar letter(s) or without letter within the column do not differ significantly whereas figures with dissimilar letter(s) differ significantly at 0.05 level of probability by DMRT, ** = Significant at 0.01 level of probability.

Germination percentage: The effect of storage container showed significantly differed on germination percentage was in 2010 and 2011. In 2010, the germination percentages of seeds stored in polythene bag were 81.33%, 77.11%, 73.44%, 69.66% and 65.00% at 40, 80, 120, 160 and 200 DAS, respectively. The corresponding values for the seed stored in cloth bag were 60.88%, 35.22%, 13.22%, 5.22% and 3.55%, respectively. In 2011, the germination percentages of seeds stored in polythene bag were 81.44%, 78.11%, 74.44%, 71.33% and 67.11% at 40, 80, 120, 160 and 200 DAS, respectively. The corresponding values for seed stored in cloth bag were 60.66%, 36.22%, 14.22%, 6.22% and 4.22%, respectively (Fig. 3).

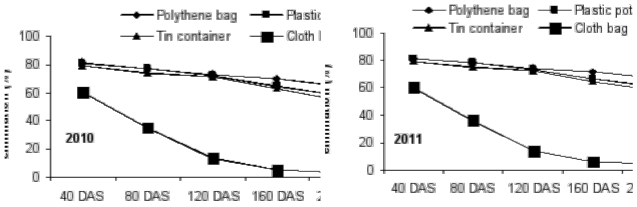

Fig 3. Effect of storage container on germination of shelled groundnut seed at different days after storage in 2010 and 2011.

The result revealed that seeds stored in polythene bag attained significantly higher germination than those in cloth bag. The reason of higher seedling emergence performance with seeds stored at lower initial moisture content in polythene bag may be due to low internal physiological activities in seeds at low seed moisture content. Alencar *et al.* (2006) and Sucheta *et al.* (2007) reported that soybean seeds viability generally deteriorated with storage duration and deterioration was particularly strong for seed stored with higher (14.8%) than lower (12.8%) initial moisture content.

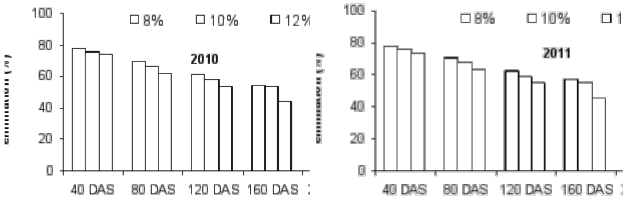

Fig 4. Effect of initial SMC on germination of shelled groundnut seed at different days after storage in 2010 and 2011.

The initial SMC had significant effect on germination percentages of groundnut seeds during the storage period in 2010 and 2011. In 2010, the germination percentage for the seeds stored at 8% initial SMC were 77.50%, 69.33%, 61.16% 54.25% and 50.08% at 40, 80, 120, 160 and 200 DAS, respectively and those for 12% initial SMC were 73.50%, 62.00%, 53.75%, 43.91% and 38.08%, respectively. In 2011, the germination percentage of seeds kept at 8% initial SMC were 77.75%, 70.33%, 62.16%, 56.83% and

52.83% at 40, 80, 120, 160 and 200 DAS and those for 12% initial SMC were 73.58%, 63.00%, 54.75%, 45.41% and 40.50%, respectively (Fig. 4). Thus, it was noted that the germination percentage decreased with the increase of initial SMC and also with increase storage duration in both the years. The present study revealed that seedling emergence performance decreased with increase of initial SMC. The reason of higher seed viability at lower initial SMC may be due to low internal physiological activities in seeds (Rahman *et al.,* 2010*)*. Similar decrease of soybean seedling emergence performance with increase of initial SMC was also reported by Sarmin (2009).

Table 2. Effect of storage container (SC) and initial seed moisture content on germination percentage of BINA badan4 during storage period 2010 and 2011

SC × SMC	2010					2011				
	40 DAS	80 DAS	120 DAS	160 DAS	200 DAS	40 DAS	80 DAS	120 DAS	160 DAS	200 DAS
$C_1 \times M_1$	83.3a	81.0a	78.3a	74.6a	71.0a	83.3a	82.0a	79.3a	77.3a	74.6a
$C_1 \times M_2$	81.3abc	78.0abc	74.3ab	73.3a	68.6b	81.3ab	79.0ab	75.3abc	74.3b	70.3ab
$C_1 \times M_3$	79.3cde	72.3d	67.6c	61.0d	55.3f	79.6ab	73.3c	68.6e	62.3e	56.3e
$C_2 \times M_1$	82.3ab	80.0a	76.0ab	67.3bc	64.0c	82.6ab	81.0a	77.0ab	71.6c	67.0bc
$C_2 \times M_2$	80.3bcd	77.6abc	72.3bc	69.0b	61.3d	80.6ab	78.6ab	73.3bcd	70.0cd	64.3cd
$C_2 \times M_3$	78.3de	74.0cd	68.6c	57.0e	48.6g	78.6ab	75.0c	69.6de	58.0f	52.3ef
$C_3 \times M_1$	81.3abc	79.0ab	75.0ab	67.6bc	59.6d	81.6ab	80.0a	76.0abc	70.0cd	63.3cd
$C_3 \times M_2$	79.3 cde	75.0bcd	71.0bc	66.0c	57.3e	79.6ab	76.0bc	72.0cde	68.0d	61.0d
$C_3 \times M_3$	77.3e	68.3e	67.3c	54.3f	46.6h	77.6b	69.3d	68.3e	57.0d	51.0f
$C_4 \times M_1$	63.0f	37.3f	15.3d	7.3g	5.6i	63.3c	38.3e	16.3f	8.3g	6.3g
$C_4 \times M_2$	60.7g	35.0f	13.0d	5.0gh	3.3j	60.3cd	36.0ef	14.0f	6.0h	4.0g
$C_4 \times M_3$	59.0g	33.3f	11.3d	3.3h	1.6j	58.3d	34.3f	12.3f	4.3h	2.3g
CV(%)	6.59	3.58	5.06	3.15	4.41	3.50	2.88	4.32	3.53	5.50
LS	**	**	**	**	**	**	**	**	**	**

C_1= Polythene bag, C_2= Plastic pot container, C_3= Tin container, C_4= Cloth bag, M_1= 8% initial SMC, M_2= 10% initial SMC, M_3= 12% initial SMC, CV=Co-efficient of variation and LS= Level of significance, Figures with similar letter(s) or without letter within the column do not differ significantly whereas figures with dissimilar letter(s) differ significantly at 0.05 level of probability by DMRT, ** = Significant at 0.01 level of probability.

The interaction effect of storage container and initial SMC on germination percentage was statistically significant during the storage period in 2010 and 2011. In 2010, the germination percentage of stored seed at 8% initial SMC in polythene bags were 83.3%, 81.0%, 78.3%, 74.6% and 71.0% at 40, 80, 120, 160 and 200 DAS while those seeds stored at 12% initial SMC in cloth bags were 59.0%, 33.3%, 11.3%, 3.3% and 1.6%, respectively. In 2011, the germination percentage of seeds kept at 8% initial SMC in polythene bags were 83.3%, 82.0%,79.3%, 77.3% and 74.6% at 40, 80, 120, 160 and 200 DAS while those seeds stored at 12% initial SMC in cloth bags were 58.3%, 34.3%, 12.3%, 4.3% and 2.3%, respectively (Table 2). The result revealed that seeds stored in polythene bag at any of the initial SMC had higher germination percent than those stored in cloth bag.

Vigour index: The storage container showed significant effect on vigour index of groundnut seed at each of the observation dates during the storage period in 2010 and 2011. At each observation date it was found that the vigour index decreased with the increase of initial SMC for both the years. In 2010, the vigour indexes of seeds stored in polythene bag were 17.67, 16.26, 15.12, 13.22 and 11.47 at 40, 80, 120, 160 and 200 DAS, respectively. The corresponding values for seed stored in cloth bag were 11.04, 5.12, 1.90, 0.88 and 0.67, respectively. Similarly in 2011, the vigour index of seeds in polythene bag were 10.86, 10.23, 10.028.48 and 7.51 at 40, 80, 120, 160 and 200 DAS respectively. The corresponding values for seed stored in cloth bag were 8.93, 8.32, 7.66, 5.32 and 3.44, respectively (Fig. 5). Karim *et al.* (2005) reported that seeds stored in moisture impervious containers like sealed alluminum foil bag and polythene bag showed superior germination, vigour and field performance than other containers.

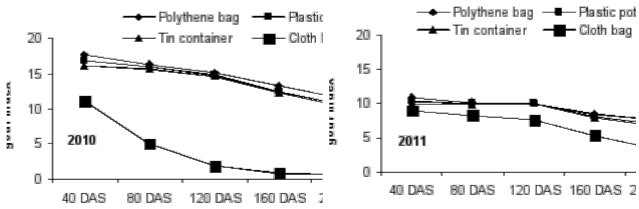

Fig 5. Effect of storage container on vigour index of shelled groundnut seed at different days after storage in 2010 and 2011.

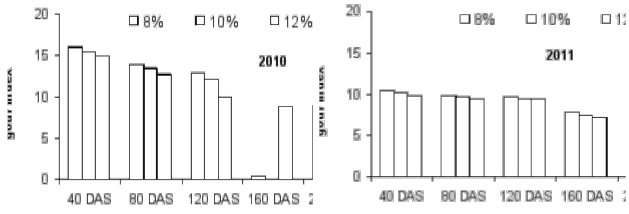

Fig 6. Effect of initial SMC on vigour index of shelled groundnut seed at different days after storage in 2010 and 2011.

The initial SMC had significant effect on vigour index at each of the observation dates during the storage period in 2010 and 2011. Those seeds stored at 8% initial SMC showed higher vigour index than those stored at 12% initial SMC in all the observation dates for both the years. In 2010, the vigour index of seed stored at 8% initial SMC were 15.99, 13.80, 12.73, 10.28 and 8.91 at 40, 80, 120,

160 and 200 DAS and those at 12% initial SMC were 14.87, 12.66, 10.00, 8.76 and 7.17, respectively. Similarly in 2011, the vigour index of seed kept at 8% initial SMC were 0.41, 9.73, 9.56, 7.73 and 6.48 at 40, 80, 120, 160 and 180 DAS and those values at 12% initial SMC were 9.74, 9.37, 9.28, 7.12 and 5.86, respectively (Fig 6).

The interaction effect of polythene bag and 8% initial SMC on vigour index was statistically significant at each of the observation dates during the storage period in 2010 and 2011. In 2010, the vigour index of seeds stored at 8% initial SMC in polythene bags were 18.54, 16.92, 16.48, 13.98 and 12.2 at 40, 80, 120, 160 and 200 DAS while those values at 12% initial SMC in cloth bag were 10.5, 4.58, 1.53, 0.55 and 0.32, respectively. Similarly, in 2011 the vigour index of seeds stored at 8% initial SMC in polythene bags were 11.42, 10.41, 10.29, 8.91 and 7.87 at 40, 80, 120, 160 and 200 DAS while those values for cloth bag at 12% initial SMC were 8.63, 7.95, 7.51, 4.84 and 3.16, respectively (Table 3).

Table 3. Effect of storage container (SC) and initial seed moisture content on vigour index of BINA badam4 during storage period 2010 and 2011

SC × SMC	2010					2011				
	40 DAS	80 DAS	120 DAS	160 DAS	200 DAS	40 DAS	80 DAS	120 DAS	160 DAS	200 DAS
$C_1 \times M_1$	18.54a	16.92a	16.48a	13.98a	12.23a	11.42a	10.41a	10.29a	8.91a	7.87a
$C_1 \times M_2$	17.40b	16.39ab	15.78a	13.53a	11.85ab	10.73b	10.25a	10.03ab	8.58a	7.56ab
$C_1 \times M_3$	17.07bc	15.47cd	13.09b	12.14c	10.33e	10.45cd	10.03a	9.75b	7.96a	7.09cd
$C_2 \times M_1$	17.25bc	16.20abc	15.86a	12.92b	11.41bc	10.63bc	9.89a	9.95ab	8.19a	7.34bc
$C_2 \times M_2$	16.71cd	15.92bc	15.47a	12.94b	11.03cd	10.39d	10.02a	9.86ab	8.03a	7.09cd
$C_2 \times M_3$	16.27de	15.84bc	12.82b	11.35d	9.13f	10.09e	9.90a	10.03ab	7.86a	6.69de
$C_3 \times M_1$	16.47de	16.33abc	16.24a	12.91b	10.97cde	10.34d	9.90a	10.22ab	8.07a	6.92de
$C_3 \times M_2$	16.09ef	15.91bc	15.16a	12.73b	10.71de	10.11e	9.79a	9.77b	7.90a	6.82de
$C_3 \times M_3$	15.63f	14.75d	12.54b	10.99d	8.9f	9.79f	9.59a	9.86ab	7.81a	6.51e
$C_4 \times M_1$	11.68g	5.77e	2.37c	1.30e	1.05g	9.25g	8.71b	7.81c	5.76b	3.78f
$C_4 \times M_2$	10.90h	5.02ef	1.80c	081ef	0.64gh	8.92h	8.31bc	7.65c	5.36b	3.39fg
$C_4 \times M_3$	10.54h	4.58f	1.53c	0.55f	0.32h	8.63i	7.95c	7.51c	4.84b	3.16g
CV(%)	2.08	3.47	6.85	3.39	4.59	3.25	4.25	4.61	3.54	3.94
LS	**	**	**	**	**	**	**	**	**	**

C_1= Polythene bag, C_2= Plastic pot container, C_3= Tin container, C_4= Cloth bag, M_1= 8% initial SMC, M_2= 10% initial SMC, M_3= 12% initial SMC, CV=Co-efficient of variation and LS= Level of significance.

The result concludes that groundnut seed could be stored after shelling with high germination capacity (>80%) for at least 7 months (from rabi to rabi sowing) in polythene bags kept at ambient room conditions.

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