

## EFFECT OF PLANT OIL TREATMENTS AND CONTAINERS ON SEED QUALITY OF FORAGE SORGHUM

BITTU RAM<sup>1\*</sup>, S. S. JAKHAR<sup>2</sup>, DIGAMBER<sup>3</sup> AND SATPAL<sup>4</sup>

<sup>1, 2 & 3</sup>Department of Seed Science and Technology,

<sup>4</sup>Forage Section, Department of Genetics & Plant Breeding,  
CCS Haryana Agricultural University, Hisar-125004 (Haryana), India

\*(e-mail : [bittunaigal14@gmail.com](mailto:bittunaigal14@gmail.com))

(Received : 16 April 2020; Accepted : 02 June 2020)

### SUMMARY

The present investigation was carried out at Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar to assess the effect of plant oils treatments and storage containers on seed quality and storability in sorghum. The seeds of forage sorghum variety HJ 541 were treated with plant oils and stored in three containers. The two factor experiment comprising of ten different treatments including plant oils were given to seeds (T<sub>0</sub> – Untreated, T<sub>1</sub> - Castor oil @ 2 ml/kg seed, T<sub>2</sub> - Neem oil @ 2 ml/kg seed, T<sub>3</sub> - Aonla oil @ 2 ml/kg seed, T<sub>4</sub> - Til oil @ 2 ml/kg seed, T<sub>5</sub> - Linseed oil @ 2 ml/kg seed, T<sub>6</sub> - Karanj oil @ 2 ml/kg seed, T<sub>7</sub> - Akhrot oil @ 2 ml/kg seed, T<sub>8</sub> - Ajwain oil @ 2ml/kg seed, T<sub>9</sub> - Carbendazim @ 2 g/kg seed) and kept in different containers (C<sub>1</sub>: Cloth bag, C<sub>2</sub>: Polythene bag and C<sub>3</sub>: Metal box) under ambient conditions in laboratory in three replicates. All the treatment combinations were evaluated for seed quality parameters viz. germination, shoot length, root length, seedling dry weight and vigour indices (I and II). All the treatments showed better performance as compared to untreated control. The neem oil (2 ml/kg of seed) performed better than others and among containers polythene bag was proved better followed by metal box and cloth bag for storability at ambient condition. Seed quality parameters found decreased with the passage of time in all the containers and treatments with the progress of storage period.

**Keywords :** Forage sorghum, plant oil, carbendazim, container, seed treatment, seed quality and vigour

Sorghum an important food and fodder crop of India belongs to family Poaceae. It is the fifth major cereal crop in the world after wheat, rice, maize and barley. Lack of availability of quality seeds led to a decline in production caused by the use of low-quality seeds and adaptation in the field is reduced (Jyoti and Malik, 2013). The most important single factor affecting crop production is the quality of seed. The seed quality in term of seed viability and vigour looses during storage (Raj *et al.*, 2013). The maintenance of seed quality during storage is becoming challengeable due to problem of quick loss of seed quality. So, many biotic and abiotic factors influenced the storage potential of seeds and results in gradual seed deterioration (Kumar *et al.*, 2014). Seed containers or packaging materials are considered as one of the most important factors influencing longevity of seeds in storage. The seed treatment has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to embryo to enhance the rapid germination (Vanagamudi *et al.* 2003; Simon, 1974). Chemical methods of disease management can affect the beneficial microbial population present in

the ecosystem. Natural plant extracts are important sources of new agrochemicals and non-selective pesticides for control of plant diseases (Tripathi and Dubey, 2004). Plant oils showed antifungal activity against a wide range of fungi (Masoko *et al.*, 2007; Abd-Alla *et al.*, 2001). Therefore, seed treatment with different plant oils was done to reduce the spread, development and infestation of storage mycoflora and consequently check the deterioration of seeds.

### MATERIALS AND METHODS

The study was carried out on sorghum seed (variety: HJ 541) produced in *kharif* 2017 having seed germination 92 per cent (above Indian Minimum Seed Certification Standards). The two factor experiment comprising of ten different seed treatments and three different containers was conducted in three replicates in CRD design. The forage sorghum variety seed treated as per the ten different treatments including plant oils [ (T<sub>0</sub> – Untreated, T<sub>1</sub> - Castor oil @ 2 ml/kg seed, T<sub>2</sub> - Neem oil @ 2 ml/kg seed, T<sub>3</sub> - Aonla oil @ 2 ml/kg seed, T<sub>4</sub> - Til oil @ 2 ml/kg seed, T<sub>5</sub> - Linseed

oil @ 2 ml/kg seed, T<sub>6</sub> - Karanj oil @ 2ml/kg seed, T<sub>7</sub> - Akhrot oil @ 2 ml/kg seed, T<sub>8</sub> - Ajwain oil @ 2ml/kg seed, T<sub>9</sub> - Carbendazim @ 2 g/kg seed) were kept in different containers (C<sub>1</sub>: Cloth bag, C<sub>2</sub>: Polythene bag and C<sub>3</sub>: Metal box) under ambient conditions in laboratories of Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar (Haryana). Seeds were taken from each of the different containers at three months interval up to 15 months and the seeds were used for evaluating various seed quality parameters.

**Standard germination (%) :** Germination percentage was worked out according to standard germination procedure (ISTA, 2011). This was carried out by using between paper methods in the seed germinator at 25±1°C. The germination percentage was calculated by using the formula given below :

$$\text{Seed germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds placed for germination}} \times 100$$

**Shoot length (cm) :** Ten normal seedlings per replication were selected at random at the time of final count of standard germination. Shoot length was measured using a measuring scale from the tip of the shoot to the end of the shoot in cm. Average length was recorded.

**Root length (cm) :** Ten normal seedlings per replication were selected at random at the time of final count of standard germination. Radical length was measured using a measuring scale from the tip of the

root to the end of the root in cm. Average length was recorded.

**Dry seedling weight (mg) :** Seedling dry weight was assessed after the final count in the standard germination test (7<sup>th</sup> day). The ten seedlings of each treatment replicated thrice were taken. Seedlings were dried in hot air oven for 24 h at 80±1°C. The dried seedlings of each replication were weighed and average seedling dry weight of each treatment was calculated.

**Vigour indices :** Seedling vigour index -I (SVI-I) and seedling vigour index-II (SVI-II) were calculated according to the method suggested by Abdul-Baki and Anderson (1973).

$$\text{Seed Vigour Index I} = \text{Seed germination (\%)} \times \text{Average seedling length (cm)}$$

$$\text{Seed vigour Index II} = \text{Seed germination (\%)} \times \text{Average dry seedling weight (mg)}$$

## RESULTS AND DISCUSSION

**Germination (%) :** Highest seed germination percentage (75.33%) was observed in seeds treated with carbendazim (T<sub>9</sub>) followed by seeds treated with neem oil (T<sub>2</sub>). However, seeds treated with karanj oil (T<sub>6</sub>) and ajwain oil (T<sub>8</sub>) were statistically at par with neem oil (T<sub>2</sub>) in all three containers. The polythene bag (73.90%) was found superior among the containers. Interaction effect of polythene bag with (T<sub>9</sub>) carbendazim (76%) was found superior in the last quarter of storage (Table 1). After the storage of 15 months, the maximum germination percentage (73.90)

TABLE 1  
Effect of seed treatment with plant oils and containers on germination (%) in sorghum seeds

Treatment	3 Months				6 Months				9 Months				12 Months				15 Months			
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean
T <sub>0</sub>	86.00	86.00	85.00	85.67	81.00	82.00	81.00	81.33	78.00	79.00	78.00	78.33	78.00	78.00	77.00	77.67	71.00	72.00	70.00	71.00
T <sub>1</sub>	88.00	88.00	87.67	87.89	83.00	83.00	84.00	83.33	81.00	81.00	82.00	81.33	75.33	76.33	75.33	75.67	71.67	72.33	72.00	72.00
T <sub>2</sub>	88.00	89.67	89.33	89.00	87.00	85.00	81.00	84.33	81.00	82.67	81.67	81.78	78.33	78.67	77.67	78.22	73.67	75.67	75.67	75.00
T <sub>3</sub>	87.33	87.67	88.00	87.67	83.00	84.67	83.67	83.78	82.33	82.33	79.00	81.22	75.33	76.00	77.00	76.11	71.33	73.00	72.67	72.33
T <sub>4</sub>	85.00	88.00	87.00	86.67	83.00	86.00	83.33	84.11	81.00	82.67	81.33	81.67	75.00	76.67	76.33	76.00	72.00	74.67	72.67	73.11
T <sub>5</sub>	86.00	89.00	86.00	87.00	81.00	84.00	83.00	82.67	79.00	82.00	81.00	80.67	74.33	75.33	76.33	75.33	71.00	74.00	73.00	72.67
T <sub>6</sub>	88.00	89.00	88.00	88.33	82.00	83.00	84.00	83.00	80.00	81.00	82.00	81.00	74.33	76.67	74.33	75.11	72.33	75.00	74.00	73.78
T <sub>7</sub>	87.00	89.00	89.67	88.56	84.00	83.67	83.00	83.56	81.00	82.67	81.00	81.56	75.33	75.33	76.00	75.56	72.67	73.00	74.33	73.33
T <sub>8</sub>	87.67	87.33	86.00	87.00	80.67	84.00	84.00	82.89	78.67	82.00	82.00	80.89	74.67	75.33	76.33	75.44	73.00	73.33	74.67	73.67
T <sub>9</sub>	89.00	89.00	90.00	89.33	85.00	85.00	85.00	85.00	83.00	83.00	82.00	82.67	80.00	82.00	81.00	81.00	74.00	76.00	76.00	75.33
Mean	87.20	88.27	87.67		82.97	84.03	83.20		80.50	81.83	81.00		76.07	77.03	76.73		72.27	73.90	73.50	
C. D. (P=0.05)		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T
		0.58	1.059	1.835		0.488	0.891	1.544		0.46	0.84	1.454		0.43	0.785	1.359		0.45	0.822	1.423

C<sub>1</sub>: Cloth bag

C<sub>2</sub>: Polythene bag

C<sub>3</sub>: Metal box

T<sub>0</sub>: Untreated (Control); T<sub>1</sub>: Castor oil; T<sub>2</sub>: Neem oil; T<sub>3</sub>: Aonla oil; T<sub>4</sub>: Til oil; T<sub>5</sub>: Linseed oil; T<sub>6</sub>: Karanj oil; T<sub>7</sub>: Akhrot oil; T<sub>8</sub>: Ajwain oil; T<sub>9</sub>: Carbendazim (control)

TABLE 2  
Effect of seed treatment with plant oils and containers on shoot length (cm) in sorghum seeds

Treatment	3 Months				6 Months				9 Months				12 Months				15 Months			
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean
T <sub>0</sub>	17.35	17.63	17.48	17.49	15.83	15.56	15.59	15.66	13.79	13.53	14.39	13.90	11.31	11.62	11.99	11.64	8.31	9.96	9.17	9.15
T <sub>1</sub>	17.10	17.39	17.91	17.47	16.02	16.77	16.24	16.34	13.94	14.62	14.24	14.27	12.54	13.12	12.84	12.83	8.84	10.12	9.85	9.60
T <sub>2</sub>	17.45	18.17	18.15	17.92	16.94	16.91	16.66	16.84	14.48	14.54	13.94	14.32	13.75	13.93	12.93	13.54	9.60	10.75	8.93	9.76
T <sub>3</sub>	17.50	17.43	17.61	17.51	15.95	16.06	15.36	15.79	14.03	14.18	14.03	14.08	12.63	12.68	12.63	12.65	8.75	10.26	10.01	9.67
T <sub>4</sub>	16.79	17.02	17.20	17.00	15.11	16.12	16.12	15.78	13.82	14.54	13.92	14.09	12.42	13.04	12.52	12.66	8.52	10.00	9.52	9.35
T <sub>5</sub>	16.87	17.75	16.79	17.14	16.53	15.99	16.20	16.24	13.23	14.77	14.12	14.04	11.83	13.27	12.72	12.61	8.72	10.07	9.27	9.35
T <sub>6</sub>	17.21	17.70	17.78	17.56	16.53	16.12	16.37	16.34	13.74	14.33	14.01	14.03	12.34	12.83	12.61	12.59	8.61	9.98	9.83	9.47
T <sub>7</sub>	16.82	17.51	17.90	17.41	16.35	16.66	16.79	16.60	13.16	14.57	14.46	14.06	11.76	13.07	13.06	12.63	8.39	10.01	9.28	9.23
T <sub>8</sub>	16.84	17.24	17.68	17.25	16.31	16.33	16.46	16.37	13.16	14.51	14.13	13.93	11.76	13.01	12.73	12.50	8.73	10.10	9.86	9.56
T <sub>9</sub>	18.67	19.25	18.58	18.83	17.01	17.17	17.23	17.14	13.71	14.34	16.36	14.80	13.98	13.84	13.96	13.93	10.98	10.84	10.38	10.73
Mean	17.26	17.71	17.71		16.26	16.37	16.30		13.71	14.39	14.36		12.43	13.04	12.80		8.95	10.21	9.61	
C. D. (P=0.05)		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T
		0.046	0.085	0.146		0.035	0.065	0.112		0.045	0.082	0.141		0.035	0.064	0.111		0.097	0.177	0.307

C<sub>1</sub>: Cloth bag

C<sub>2</sub>: Polythene bag

C<sub>3</sub>: Metal box

T<sub>0</sub>: Untreated (Control); T<sub>1</sub>: Castor oil; T<sub>2</sub>: Neem oil; T<sub>3</sub>: Aonla oil; T<sub>4</sub>: Til oil; T<sub>5</sub>: Linseed oil; T<sub>6</sub>: Karanj oil; T<sub>7</sub>: Akhrot oil; T<sub>8</sub>: Ajwain oil; T<sub>9</sub>: Carbendazim (control)

irrespective of treatments was maintained in polythene bag followed by metal box. The effect of polythene and metal box was significant as compared to cloth bag. The germination can be maintained above IMSCS only upto 12 months in all treatments and containers. After that it falls below the standard germination percentage (75) except the overall mean of neem oil treatment (75) and bavistin (75.33). Raja and Sasikala (2018) found that the seeds treated with anti-oxidant,  $\alpha$ -tocopherol (Vitamin - E) @ 1% for 18 h and stored in polylined gunny bag have recorded the higher germination (95%) and seedling vigour upto six months compared to control. Study was in accordance with Srinivasan *et al.* (2016) and Pouyesh *et al.* (2016). Reddy *et al.* (2017) reported that neem oil treatment (5 ml/kg seed) has resulted in significantly higher seed germination in sorghum.

**Shoot length (cm):** Among all the treatments (T<sub>9</sub>) carbendazim (10.73) was found better followed by (T<sub>2</sub>) neem oil (9.76). Among containers, polythene bag (10.21) found statistically at par with metal box (9.61). Interaction effect of cloth bag with (T<sub>9</sub>) carbendazim (10.98) was found superior than others (Table 2). Samuel *et al.* (2008) reported that maize seeds treated with neem leaf extract controlled *Aspergillus* spp, *Fusarium* spp and *Rhizopus* spp effectively and recorded highest germination (100%), maximum root and shoot length with highest vigour index. The study was in accordance with that of Varaprasad *et al.* (2005) and Rajput *et al.* (2011).

**Root length (cm):** Among all treatments, (T<sub>9</sub>) carbendazim (10.65) proved better than others

followed by (T<sub>2</sub>) neem oil (10.19). Among containers, polythene bag (9.87) was found superior followed by metal box (9.78). Interaction effect of polythene bag with (T<sub>9</sub>) carbendazim (10.83) was found superior than others (Table 3). Rajput *et al.* (2011) reported that, neem oil (15%) spray increased root length by 28.7 and shoot length by 34.0 cm and weight of inoculated shisham seedling (2.30 and 2.97 g) proving to be best, followed by neem seed decoction, neem seed without coat and neem leaf extract as compared to untreated and inoculated shisham plants (0.332 and 0.766 g). All the treatments decreased the disease intensity as compared to untreated control, neem oil proved to be best by controlling 85 per cent. The results showed that all neem products decreased the disease intensity. The study was in accordance with that of Samuel *et al.* (2008) and Shashibhaskar (2012).

**Seedling dry weight (mg):** Among treatments, (T<sub>9</sub>) carbendazim (7.97) proved better followed by (T<sub>2</sub>) neem oil (7.77). Among containers, polythene bag (7.50) was found superior followed by metal box (7.35). Interaction effect of metal box with (T<sub>9</sub>) carbendazim (8.10) was found superior than others (Table 4). Varaprasad *et al.* (2005) reported that soil application of castor cake (*Ricinus communis* L.) at 5 g kg<sup>-1</sup> soil resulted in significantly higher shoot height, shoot weight, root weight and root volume of brinjal seedlings (Cv. Bhagyamati). The study was in accordance with that of Mahesh Babu *et al.* (2008).

**Vigour index-I:** Among treatments, (T<sub>9</sub>) carbendazim (1653) found best followed by (T<sub>2</sub>) neem oil (1501). Among containers, polythene bag

TABLE 3  
Effect of seed treatment with plant oils and containers on root length (cm) in sorghum seeds

Treatment	3 Months				6 Months				9 Months				12 Months				15 Months			
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean
T <sub>0</sub>	14.44	15.60	14.75	14.93	12.28	12.70	12.21	12.40	11.54	11.50	11.57	11.54	10.48	10.82	10.54	10.61	9.24	9.38	9.32	9.31
T <sub>1</sub>	15.00	14.82	15.71	15.18	13.17	13.70	13.25	13.37	12.39	12.45	12.30	12.38	11.54	11.26	11.27	11.36	9.47	9.91	9.77	9.72
T <sub>2</sub>	15.10	15.91	14.94	15.32	14.36	14.12	14.07	14.18	12.34	12.54	11.50	12.13	11.88	12.08	12.13	12.03	10.04	10.24	10.30	10.19
T <sub>3</sub>	15.84	14.93	14.69	15.15	13.27	13.01	12.90	13.06	12.21	12.26	12.27	12.25	11.18	11.48	11.01	11.22	9.35	9.65	9.51	9.50
T <sub>4</sub>	14.47	15.08	14.94	14.83	12.90	12.81	12.95	12.89	12.36	12.31	12.81	12.49	11.31	11.44	11.11	11.29	9.81	9.94	9.61	9.79
T <sub>5</sub>	14.77	15.29	15.00	15.02	13.03	13.29	13.11	13.14	12.03	12.30	12.09	12.14	11.28	11.48	11.70	11.49	10.12	9.98	9.52	9.87
T <sub>6</sub>	15.27	14.88	14.82	14.99	12.49	12.97	13.13	12.86	12.56	12.73	12.42	12.57	11.42	11.57	11.05	11.35	9.59	9.40	9.55	9.51
T <sub>7</sub>	15.02	15.25	14.76	15.01	12.90	12.76	14.23	13.30	12.26	12.45	12.44	12.38	11.31	11.37	11.51	11.40	9.47	9.44	9.70	9.54
T <sub>8</sub>	14.50	15.20	14.91	14.87	13.64	12.95	13.09	13.23	12.36	12.27	12.56	12.40	10.90	11.77	11.53	11.40	9.73	9.94	9.70	9.79
T <sub>9</sub>	15.25	15.54	15.17	15.32	14.17	14.84	14.33	14.45	12.97	13.64	13.36	13.32	11.84	12.33	12.27	12.15	10.34	10.83	10.77	10.65
Mean	14.97	15.25	14.97		13.22	13.32	13.33		12.30	12.45	12.33		11.31	11.56	11.41		9.72	9.87	9.78	
C. D. (P=0.05)		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T
		0.04	0.074	0.127		0.039	0.071	0.124		0.044	0.08	0.139		0.039	0.071	0.124		0.024	0.044	0.076

TABLE 4  
Effect of seed treatment with plant oils and containers on seedling dry weight (mg) in sorghum seeds

Treatment	3 Months				6 Months				9 Months				12 Months				15 Months			
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean
T <sub>0</sub>	12.40	12.00	12.20	12.20	10.00	10.00	10.10	10.03	9.00	9.30	8.50	8.93	8.37	7.80	7.70	7.96	6.30	6.30	6.20	6.27
T <sub>1</sub>	12.70	12.00	11.40	12.03	11.70	11.70	11.30	11.57	10.30	10.00	11.00	10.43	9.07	8.30	8.30	8.56	7.20	7.50	7.30	7.33
T <sub>2</sub>	13.50	13.50	13.50	13.50	12.40	12.00	12.70	12.37	10.70	11.00	10.90	10.87	8.90	9.00	8.80	8.90	7.80	7.70	7.80	7.77
T <sub>3</sub>	12.60	13.80	13.40	13.27	10.30	10.10	11.30	10.57	9.00	10.70	9.00	9.57	8.00	9.30	8.00	8.43	7.00	8.00	7.00	7.33
T <sub>4</sub>	11.90	12.10	12.10	12.03	10.80	11.30	11.00	11.03	11.00	10.70	10.00	10.57	8.30	8.70	8.70	8.57	7.70	7.80	7.60	7.70
T <sub>5</sub>	13.20	12.70	13.40	13.10	11.80	12.20	10.00	11.33	9.70	9.70	10.30	9.90	8.00	9.00	8.30	8.43	7.00	8.00	7.70	7.57
T <sub>6</sub>	11.90	13.10	12.70	12.57	11.30	12.20	11.30	11.60	10.00	9.80	10.70	10.17	8.30	8.00	7.80	8.03	7.30	7.40	7.30	7.33
T <sub>7</sub>	12.80	12.80	12.20	12.60	11.30	12.00	11.80	11.70	10.30	10.30	10.30	10.30	8.30	8.00	7.70	8.00	7.70	7.30	7.10	7.37
T <sub>8</sub>	11.90	12.80	13.10	12.60	11.30	11.80	11.30	11.47	11.00	10.70	10.00	10.57	7.00	8.00	8.40	7.80	7.00	7.20	7.40	7.20
T <sub>9</sub>	14.10	14.10	14.20	14.13	13.00	13.30	13.60	13.30	11.20	11.00	10.90	11.03	9.00	9.30	9.33	9.21	8.00	7.80	8.10	7.97
Mean	12.70	12.89	12.82		11.39	11.66	11.44		10.22	10.32	10.16		8.32	8.54	8.30		7.30	7.50	7.35	
C. D. (P=0.05)		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T
		0.052	0.095	0.164		0.052	0.095	0.164		0.052	0.095	0.164		0.054	0.099	0.172		0.052	0.095	0.164

C<sub>1</sub> : Cloth bag

C<sub>2</sub> : Polythene bag

C<sub>3</sub> : Metal box

T<sub>0</sub> : Untreated (Control); T<sub>1</sub> : Castor oil; T<sub>2</sub> : Neem oil; T<sub>3</sub> : Aonla oil; T<sub>4</sub> : Til oil; T<sub>5</sub> : Linseed oil; T<sub>6</sub> : Karanj oil; T<sub>7</sub> : Akhrot oil; T<sub>8</sub> : Ajwain oil; T<sub>9</sub> : Carbendazim (control)

(1479) and metal box (1437) were found statistically at par. Interaction effect of polythene bag with (T<sub>9</sub>) carbendazim (1669) was found superior (Table 5). The combined effect of carbendazim in the polythene bag was found best among all the interactions. Geetha and Shivaprakasam (1993) reported that paddy seeds treated with carbendazim was recorded significantly higher germination (95.34%), dry weight (175 mg) and vigour index (2054) while, these were 88.45 per cent, 145 mg and 1341 respectively in control at the end of five months of storage. The study was in accordance with that of Padule *et al.* (1999) in sorghum.

**Vigour index-II :** Among treatments, (T<sub>9</sub>) carbendazim (616) was found better followed by (T<sub>2</sub>) neem oil (583). Among containers, polythene bag

(552) and metal box (542) were found statistically on a par with each other. Interaction effect of metal box with (T<sub>9</sub>) carbendazim (632) was found superior over others (Table 6). The effect of polythene bag was significant over cloth bag and metal box irrespective of all plant oil treatments. Reddy *et al.* (2017) reported that neem oil treatment (5 ml/kg seed) has resulted in significantly higher seed germination, seedling vigour index-I, seedling vigour index-II. The similar findings were obtained by Gowda *et al.* (2018). Nataraj *et al.* (2011) revealed that sunflower hybrid seeds stored in polythene bag (700 gauge) recorded higher germination (80%), vigour index (1869), total dehydrogenase activity (1.258) and lower electric conductivity of leachate (194.53 d S/m) compared to cloth bag. Study was also in accordance with that of Kumar *et al.* (2014).

TABLE 5  
Effect of seed treatment with plant oils and containers on vigour index-I in sorghum seeds

Treatment	3 Months				6 Months				9 Months				12 Months				15 Months			
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean
T <sub>0</sub>	2,734	2,858	2,740	2,777	2,277	2,317	2,252	2,282	1,976	1,977	2,025	1,993	1,656	1,683	1,690	1,676	1,246	1,354	1,331	1,310
T <sub>1</sub>	2,825	2,835	2,947	2,869	2,423	2,529	2,477	2,476	2,133	2,193	2,176	2,167	1,838	1,885	1,840	1,855	1,312	1,442	1,419	1,391
T <sub>2</sub>	2,864	3,056	2,956	2,959	2,723	2,638	2,489	2,617	2,208	2,230	2,010	2,149	2,025	2,081	2,005	2,037	1,459	1,588	1,455	1,501
T <sub>3</sub>	2,912	2,837	2,842	2,864	2,425	2,461	2,364	2,417	2,125	2,186	2,148	2,153	1,825	1,860	1,820	1,835	1,291	1,447	1,425	1,388
T <sub>4</sub>	2,657	2,825	2,796	2,759	2,325	2,488	2,423	2,412	2,121	2,220	2,174	2,171	1,851	1,852	1,804	1,836	1,320	1,449	1,428	1,399
T <sub>5</sub>	2,721	2,941	2,734	2,799	2,394	2,460	2,433	2,429	1,996	2,220	2,123	2,113	1,803	1,864	1,864	1,844	1,332	1,464	1,390	1,395
T <sub>6</sub>	2,858	2,900	2,869	2,876	2,380	2,415	2,478	2,424	2,104	2,192	2,167	2,154	1,877	1,854	1,846	1,859	1,316	1,434	1,453	1,401
T <sub>7</sub>	2,770	2,916	2,928	2,871	2,457	2,462	2,575	2,498	2,059	2,234	2,179	2,157	1,761	1,841	1,867	1,823	1,298	1,446	1,386	1,376
T <sub>8</sub>	2,747	2,833	2,803	2,794	2,416	2,459	2,482	2,453	2,008	2,196	2,189	2,131	1,745	1,875	1,852	1,824	1,348	1,496	1,434	1,426
T <sub>9</sub>	3,019	3,096	3,037	3,051	2,650	2,721	2,683	2,684	2,214	2,322	2,437	2,325	2,066	2,146	2,125	2,112	1,642	1,669	1,650	1,653
Mean	2,811	2,910	2,865		2,447	2,495	2,465		2,094	2,197	2,163		1,845	1,894	1,871		1,356	1,479	1,437	
C. D (P=0.05)	C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T	
	19.68	35.93	62.24		14.76	26.94	46.67		13.26	24.22	41.96		12.76	23.29	40.35		11.11	20.29	35.16	

TABLE 6  
Effect of seed treatment with plant oils and containers on vigour index II in sorghum seeds

Treatment	3 Months				6 Months				9 Months				12 Months				15 Months			
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Mean
T <sub>0</sub>	1,066	1,032	1,037	1,045	810	820	818	816	702	735	663	700	653	608	593	618	447	441	447	445
T <sub>1</sub>	1,118	1,056	999	1,058	971	971	949	964	834	810	902	849	683	634	625	647	516	540	528	528
T <sub>2</sub>	1,188	1,210	1,206	1,201	1,079	1,020	1,029	1,043	881	906	861	883	697	708	683	696	577	583	590	583
T <sub>3</sub>	1,100	1,210	1,179	1,163	855	855	945	885	729	885	735	783	603	707	616	642	499	581	511	531
T <sub>4</sub>	1,011	1,065	1,053	1,043	896	972	917	928	891	885	813	863	622	667	664	651	554	567	567	563
T <sub>5</sub>	1,135	1,130	1,153	1,139	956	1,025	830	937	766	795	834	799	595	678	634	635	497	584	570	550
T <sub>6</sub>	1,047	1,166	1,118	1,110	927	1,013	949	963	800	794	877	824	617	613	580	603	528	548	547	541
T <sub>7</sub>	1,114	1,139	1,094	1,116	949	1,004	979	978	834	851	834	840	625	603	585	604	560	543	518	540
T <sub>8</sub>	1,043	1,118	1,127	1,096	912	991	949	951	865	877	820	854	523	603	641	589	511	538	543	530
T <sub>9</sub>	1,255	1,255	1,278	1,263	1,105	1,131	1,156	1,131	930	913	894	912	720	763	756	746	616	601	632	616
Mean	1,108	1,138	1,124		946	980	952		823	845	823		634	658	638		531	552	545	
C. D. (P=0.05)	C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T		C	T	C X T	
	8.364	15.271	26.45		6.924	12.641	21.895		5.896	10.765	18.645		5.858	10.695	18.524		4.579	8.359	14.479	

C<sub>1</sub> : Cloth bag

C<sub>2</sub> : Polythene bag

C<sub>3</sub> : Metal box

T<sub>0</sub> : Untreated (Control); T<sub>1</sub> : Castor oil; T<sub>2</sub> : Neem oil; T<sub>3</sub> : Aonla oil; T<sub>4</sub> : Til oil; T<sub>5</sub> : Linseed oil; T<sub>6</sub> : Karanj oil; T<sub>7</sub> : Akhrot oil; T<sub>8</sub> : Ajwain oil; T<sub>9</sub> : Carbendazim (control)

## CONCLUSION

Based on the results, it can be concluded that sorghum seed may be stored in polythene bag with seed treatment of carbendazim 2 g/kg seed or neem oil @ 2 ml/kg seed for a period of 15 months without deterioration in germination and seedling vigour.

## ACKNOWLEDGEMENT

First Author Mr. Bittu Ram is thankful to Department of Seed Science & Technology, CCS HAU, Hisar for providing necessary facilities to carry out the experiment during his M. Sc. (Agriculture) degree programme. Thanks are also due to Forage Section, Department of Genetics & Plant Breeding,

CCS HAU, Hisar for providing seed of forage sorghum variety to carry out the research work.

## REFERENCES

- Abd-Alla, M. S., K. M. Atalla and M. A. M. El-Sawi, 2001 : Effect of some plant waste extracts on growth and aflatoxin production by *Aspergillus flavus*. *Annals Agric. Sci.*, **46**: 579-592.
- Abdul Baki, A. A., and J. P. Anderson, 1973 : Vigour determination in soybean seeds by multiple criteria. *Crop. Sci.*, **13**: 630-633.
- Geetha, D. and K. Shivaprakasam, 1993 : Treating rice seeds with fungicides and antagonists to control seed borne diseases. *International Rice Res. News let.*, **18**: 30.
- Gowda, Basave, Bhemanna Huded, Arunkumar Hosmani,

- C. Rakesh Mathad, B. N. Raghu and Rekha, 2018 : Effect of organics in enhancing seed storability of chickpea (*Cicer arietinum* L). *Int. J. Chem. Stud.*, **6** (2): 1890-1893.
- ISTA, 2011 : International rules for seed testing. Chapter 5: the Germination test. ISBN 978-3 906549-53-8. International Seed Testing Association, Baserdorf, Switzerland.
- Jyoti and C. P. Malik, 2013 : Seed Deterioation. *Int. J. Life Sci. Biotechnol. Pharma.*, **2**(3): 374-385.
- Kumar, T. P., A. M. Asha, J. B. Maruthi and K. Vishwanath, 2014 : Influence of seed treatment chemicals and containers on seed quality of marigold during storage. *The Bioscan.*, **9**: 937-942.
- Mahesh, H. M. Babu and Ravi Hunje, 2008 : Effect of seed treatment with botanicals on Storability of Soybean. *Karnataka J. Agric. Sci.*, **21**(3): 357-360.
- Masoko, J., J. N. Picard and P. Eloff, 2007 : The antifungal activity of twenty-four southern African Comretum species (Combretaceae). *South Afr J Bot.*, **73**: 173-183.
- Nataraj, K., P. Balakrishna, Roopa Ramegowda, Ananthareddy and U. S. Chandrashekar, 2011 : Influence of storage containers and seed treatment chemicals on quality of new sunflower (*Helianthus annuus*) hybrids during storage. National Seed Congress, January, 29-31, pp-267-280.
- Padule, D. N., P. D. Mahajan, R. R. Perane and R. B. Patil, 1999 : Efficacy of fungicides for increasing storability of grain moulds infected seed of sorghum hybrid CSH 14. *Seed Res.*, **27** (1): 95-99.
- Pouyesh, A. J., A. K. Chaurasia and M. S. Pamiri, 2016 : Influence of seed source, containers and seed treatment with chemical and biopesticide on storability of wheat (*Triticum aestivum* L.). *Int. J. Multidiscip. Res. De.*, **3** (1): 18-21.
- Raj, D., O. S. Dahiya, R. K. Arya, A. K. Yadav and K. Kumar, 2013 : Improvement in germination characters in artificial aged seeds of okara (*Abelmoschus esculantus*) by osmo-conditioning. *Indian J. Agril. Sci.* **83** : 699-702.
- Raja, K. and K. Sasikala, 2018 : Effect of seed treatments and storage containers on viability and vigour of rice (*Oryza sativa* L.) variety ADT (R) 46 seeds. *Int. J. Curr. Microbiol. App. Sci.*, **7**(9): 3087-3096.
- Rajput, N. A., M. A. Pathan, A. M. Lodhi, D. Dou and S. Rajput, 2011 : Effect of neem (*Azadirachta indica*) products on seedling growth of shisham dieback. *Afr. J. Microbiol. Res.*, **5**(27): 4937-4945.
- Reddy, Y. N. P., O. S. Dahiya and S. S. Jakhar, 2017 : Effect of plant oils on seed quality parameters and disease control in chilli seeds infected with *Colletotrichum capsici*. *Mysore J. Agric. Sci.*, **51**(4): 808-813.
- Samuel, T. A., A. M. Hussaini, A. Titilayo and K. Ibrahim, 2008 : Effect of *Fusarian verticilloids*, its metabolites and neem leaf extract on germination and vigour indices of maize (*Zea mays* L.). *Afri. J. Btech.*, **7**(14): 2402-2406.
- Shashibhaskar, M. S., K. S. Vinutha, V. S. N. Nagabhusan and V. Ramanjinappa, 2012 : Seed quality as influenced by seed pelleting and containers during storage in tomato. *Plant Archives.*, **12**(2) : 1101 - 1008.
- Simon, E. N., 1974 : Phospholipids and plant membrane permeability. *New Physiol.*, **73**: 377-420.
- Srinivasan, J., A. Vijayakumar and P. Srimathi, 2016 : Influence of seed treatment, storage containers and storage periods on storability of the female parent of tomato. *IJSN*, **7**(3): 674-679.
- Tripathi, P. and N. K. Dubey, 2004 : Exploitation of natural products as an alternative strategy to control post harvest fungal rotting of fruit and vegetables. *Post harvest Bio and Technol.*, **32**: 235-245.
- Vanangamudi, K., P. Srimathi, N. Natarajan and M. Bhaskaran 2003 : Current scenario of seed coating polymer. Short course on seed hardening and pelleting technologies for rainfed/ garden land ecosystems, Indian Council of Agril. Res., New Delhi , pp. 80-100.
- Varaprasad, K. S., J. S. Prasad, Y. R. Rao, E. Srinivasarao and M. Sankar, 2005 : Comparative efficacy of some oil cakes and extracts against root knot nematode in tomato and brinjal. *Ind. J. Plant Protection*, **33**(2): 268-272.