

EFFECT OF FUNGICIDE TREATMENTS AND CONTAINERS ON SEED QUALITY AND STORABILITY OF FORAGE SORGHUM

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SUMMARY

The present investigation was carried out at Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar to assess the effect of fungicides treatments and storage containers on seed quality and storability in sorghum. The seeds of forage sorghum variety HJ 541 were treated with seventeen different fungicides and stored in three containers *viz.* cloth bag, polythene bag and metal box. All the treatment combinations were evaluated for seed quality parameters *viz.* germination, shoot length, root length, seedling dry weight, vigour indices (I and II) and seed mycoflora percentage. All the treatments showed better performance as compared to untreated control. The fungicide carboxin + thiram (2 g/kg of seed) performed better than others and among containers polythene bag was proved better followed by metal box for storability at ambient condition. Seed quality parameters found decreased and seed mycoflora increased with the passage of time in all the containers and treatments with the progress of storage period.

Key words : Forage sorghum, fungicides, container, seed quality and storability

Sorghum belonging to family Poaceae is an important food and fodder crop of India. It is the fifth major cereal crop in the world after wheat, rice, maize and barley. Non availability of quality seeds resulted to a reduction in production caused by the use of low-quality seeds and adaptation in the field is reduced (Jyoti and Malik, 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). Every seed is a habitat for different types of the mycoflora which containing both saprophytic and pathogenic microbes, they may be internally and externally (Utobo *et al.* 2011). 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). Seed is a living body and it loses its viability even under optimum storage conditions because it is a natural and continues process (Kapoor *et al.*, 2010; Hartmann *et al.*, 2016). As the controlled conditions required more cost, then seed treatment is the best alternative approach to maintain the seed quality (Shaban, 2013). The loss of seed viability varies from

one species to another and even among the same species. There was many seed borne pathogens which associated with Sorghum *viz.*, *Gloeocercospora sorgi*, *Fusarium moniliforme* *Sphacelotheca sp.*, *Ascochyta sorghina* and *Esephidium turcicum*. Among all of these most serious one is *Fusarium moniliforme* also reported as in rice and maize. This pathogen causes causing stalk rot, top rot and moldy ears which reduced sorghum stand. It may depreciate yield to a great extent (Osunlaja, 2005). (Abdulsalaam and Shenge, 2011) Isolated seven fungal genera growing on unwashed seed samples of stored sorghum *viz.*, *Helminthosporium sp.*, *Aspergillus sp.*, *Fusarium sp.*, *Rhizoctonia sp.*, *Penicillium sp.*, *Sclerotium sp.* and *Curvularia sp.* Seed treatments with fungicides not only control the seed-borne disease but also improve seed health and plant stand (Tanweer, 1982). Therefore, seed treatment with different fungicides 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). Seventeen different treatments including fungicides were given to seeds (T_0 - Untreated, T_1 - Carbendazim 75% WP @ 2 g/kg seed, T_2 - Tebuconazole 2 DS @ 2 g/kg seed, T_3 - Difenoconazole 25% EC @ 2 ml/kg seed, T_4 - Propiconazole 25% EC @ 2 ml/kg seed, T_5 - Tricyclazole 75% WP @ 2 g/kg seed, T_6 - Flusilazole 40% EC @ 2ml/kg seed, T_7 - Azoxystrobin 23% SC @ 2 ml/kg seed, T_8 - Kitazine 48% EC @ 2ml/kg seed, T_9 - Propineb 70% WP @ 2 g/kg seed, T_{10} - Dimethomorph 50% WP @ 2 g/kg seed; T_{11} - Chlorothalonil 78.2% WP @ 2 g/kg seed; T_{12} - Thiram 50% WP @ 2 g/kg seed; T_{13} - Captan 70 % + Hexaconazole 5% WP @ 2 g/kg seed; T_{14} - Carbendazim 12 % + Mancozeb 63 % WP @ 2 g/kg seed; T_{15} - Famoxadone 16.6 % + Cymoxanil 22.1 % SL @ 2 ml/kg seed; T_{16} - Flusilazole 12.5 % + Carbendazim 25 % SE @ 2 g/kg seed; T_{17} - Carboxin 37.5 % + Thiram 25% WP @ 2 g/kg seed) and kept in different containers (C_1 : Cloth bag, C_2 : Polythene bag and C_3 : 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 $25 \pm 1^\circ\text{C}$. 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

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

Tret.	3 Months				6 Months				9 Months				12 Months				15 Months			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
T_0	86.00	85.00	86.00	85.67	81.00	82.00	81.00	81.33	78.00	79.00	78.00	78.33	76.00	75.00	75.00	75.33	71.00	72.00	70.00	71.00
T_1	89.00	90.00	89.00	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
T_2	87.67	89.33	89.00	88.67	82.00	87.00	85.00	84.67	78.00	81.00	82.00	80.33	80.00	80.00	81.67	80.56	75.00	76.33	74.00	75.11
T_3	88.00	90.00	88.00	88.67	84.00	87.00	84.00	85.00	81.00	85.00	80.00	82.00	81.00	79.00	80.00	80.00	75.00	75.00	76.00	75.33
T_4	89.00	91.00	90.00	90.00	85.00	86.00	86.00	85.67	79.00	84.00	84.00	82.33	78.00	79.00	79.00	78.67	76.00	75.00	75.00	75.33
T_5	89.00	90.00	90.00	89.67	81.00	84.00	83.00	82.67	79.00	84.00	82.00	81.67	78.00	79.00	79.00	78.67	76.00	76.00	75.00	75.67
T_6	87.00	87.67	87.67	87.44	83.00	82.00	84.00	83.00	83.00	84.00	81.00	82.67	81.00	81.00	80.00	80.67	76.00	76.33	76.00	76.11
T_7	89.00	89.00	90.00	89.33	86.00	86.00	87.00	86.33	82.00	83.00	81.00	82.00	79.00	81.00	80.00	80.00	76.00	78.00	77.00	77.00
T_8	89.00	90.00	87.67	88.89	80.67	84.00	84.00	82.89	80.00	84.00	80.00	81.33	77.00	79.00	78.00	78.00	75.67	76.33	75.00	75.67
T_9	87.00	88.67	87.00	87.56	84.00	86.00	83.00	84.33	81.00	80.00	83.00	81.33	81.00	82.00	80.00	81.00	75.00	76.00	75.00	75.33
T_{10}	88.00	90.67	89.00	89.22	85.33	87.00	82.00	84.78	80.00	83.00	84.00	82.33	80.00	82.00	79.00	80.33	74.00	78.00	75.33	75.78
T_{11}	89.00	91.00	90.00	90.00	84.00	83.00	84.00	83.67	82.67	81.00	84.00	82.56	79.00	79.00	78.00	78.67	75.67	75.67	78.00	76.44
T_{12}	89.00	90.00	89.00	89.33	85.00	85.00	85.00	85.00	84.00	80.00	79.00	81.00	80.00	82.00	81.00	81.00	76.00	76.00	77.00	76.33
T_{13}	88.00	87.33	87.00	87.44	83.00	87.00	84.00	84.67	80.00	84.00	81.00	81.67	80.00	79.00	81.00	80.00	76.00	78.00	76.00	76.67
T_{14}	91.00	90.00	90.00	90.33	86.00	87.00	87.00	86.67	83.00	83.33	82.67	83.00	81.00	82.00	82.00	81.67	79.00	80.00	79.33	79.44
T_{15}	87.00	88.00	90.00	88.33	86.00	84.00	83.00	84.33	80.00	83.00	84.00	82.33	78.00	80.00	80.00	79.33	75.00	79.33	77.00	77.11
T_{16}	88.00	87.00	89.00	88.00	81.00	81.00	82.00	81.33	79.00	80.00	81.00	80.00	78.00	80.00	79.00	79.00	77.00	78.00	78.00	77.67
T_{17}	90.00	91.33	90.00	90.44	86.00	88.00	88.00	87.33	86.00	85.00	86.00	85.67	83.00	82.67	82.33	82.67	80.00	81.00	80.00	80.33
Mean	88.37	89.22	88.80	89.14	83.78	85.06	84.28	84.37	81.04	82.57	81.93	82.25	79.44	80.20	79.78	79.71	75.69	76.78	76.15	76.15
CD		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT
(P=0.05)		0.386	0.944	1.636		0.405	0.992	1.718		0.413	1.011	1.751		0.429	1.05	1.819		0.482	1.181	2.045

C_1 : Cloth bag

C_2 : Polythene bag

C_3 : Metal box

T_0 : Untreated (Control); T_1 : Carbendazim 75% WP; T_2 : Tebuconazole 2 DS; T_3 : Difenoconazole 25% EC; T_4 : Propiconazole 25% EC; T_5 : Tricyclazole 75% WP; T_6 : Flusilazole 40% EC; T_7 : Azoxystrobin 23% SC; T_8 : Kitazine 48% EC; T_9 : Propineb 70% WP; T_{10} : Dimethomorph 50% WP; T_{11} : Chlorothalonil 78.2% WP; T_{12} : Thiram 50% WP; T_{13} : Captan 70 % + Hexaconazole 5% WP; T_{14} : Carbendazim 12 % + Mancozeb 63 % WP; T_{15} : Famoxadone 16.6 % + Cymoxanil 22.1 % SL; T_{16} : Flusilazole 12.5 % + Carbendazim 25 % SE; T_{17} : Carboxin 37.5 % + Thiram 25% WP.

weight was assessed after the final count in the standard germination test (7th 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).

$$\begin{aligned} \text{Seed Vigour Index I} &= \text{Seed germination (\%)} \\ &\times \text{Average seedling length (cm)} \\ \text{Seed vigour Index II} &= \text{Seed germination (\%)} \\ &\times \text{Average dry seedling weight (mg)} \end{aligned}$$

Seed mycoflora (%)

Seed health test was conducted by blotter method as recommended by ISTA (Anon., 1999). A set of 400 seeds treated with fungicides/ plant oils from the each container were tested for seed mycoflora. Twenty five seeds each in three replications were placed equidistantly in a circle (sixteen in outer circle, eight in middle circle and one at the centre) in Petri dish of 9 cm diameter containing two moist blotters. The blotters were dipped in sterilized distilled water before placing seeds on to prevent contamination. Sufficient moisture was maintained by wetting blotters with sterilized distilled water. The seeds were incubated for seven days in an incubator at 25° ± 1°C temperature, with 12 hours light and 12 hours dark alternate cycles. After seven days, the seed were examined by a low power stereo binocular microscope and different fungi found on the seeds were recorded and expressed in percentage. The type of mycoflora growing on each seed was identified and their percentage frequency (PF) of occurrence was calculated by applying the following formula:

$$\text{PF} = \frac{\text{Number of seeds on which fungus appears}}{\text{Total number of seeds}} \times 100$$

RESULTS AND DISCUSSION

Significant differences were observed among the different fungicidal seed treatments storability of sorghum seeds. The probable reason for the differences in storability of seeds might be due to variations in their effectiveness in combating the seed

borne pathogens and also might be due to the persistence of these fungicides on the seed surface during storage for longer time. The decline in germination percentage and vigour index may be attributed to ageing effect leading to depletion of food reserves and decline in synthetic activity of embryo apart from death of seed because of fungal invasion, insect damage, reduced dry matter accumulation in seedling, decrease in seedling growth, fluctuating temperature as well as relative humidity and storage containers in which seeds are stored.

Germination (%)

All the treatments except control maintained germination above Indian Minimum Seed Certification Standards (IMSCS) in all the containers at the end of storage period (15 months). However, the seed treated with fungicide (T₁₇) carboxin + thiram (80.33) were found better which was statistically at par with (T₁₄) carbendazim + mancozeb (79.4). Among containers, polythene bag (76.7) was found better than others. Interaction effect of polythene bag with (T₁₇) carboxin + thiram (81) was found at par with seed stored in metal box with (T₁₇) carboxin + thiram (80) and better than others at the end of storage period. Ram et al. (2020) also reported that after the storage of 15 months, the maximum germination percentage was maintained in polythene bag followed by metal box. Patil and Sajjan (2011) found that among the different seed treatments, sorghum seeds treated with vitavax power (carboxin + thiram) @ 3 g/kg seeds recorded markedly more germination per cent (73.75 %) and seedling vigour index (3716) which was at par with the seed treatment with captan @ 3 g/kg seeds (72.50 % and 2381), where as less in control (65.25 % and 1891) at end of storage period (up to nine months). Results were in compliance with the earlier findings of Kumar *et al.* (2019), Patil and Sajjan (2011) in sorghum, Raiker *et al.* (2011) and Biradar (2001) in green gram.

Shoot length (cm)

The shoot length was found better in seed treated with, (T₁₇) carboxin + thiram (11.22) followed by (T₁₄) carbendazim + mancozeb (10.67). Among containers, polythene bag (10.15) found better than others. Interaction effect of polythene bag with (T₁₇) carboxin + thiram (11.33) was found at par with seed stored in metal box with (T₁₇) carboxin + thiram

TABLE 2
Effect of seed treatments with fungicides and containers on shoot length (cm) in sorghum seeds

Tret.	3 Months				6 Months				9 Months				12 Months				15 Months			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
T ₀	17.35	17.63	17.48	17.49	15.83	15.56	15.59	15.66	13.79	13.53	14.39	13.90	11.30	11.62	11.99	11.64	8.30	9.96	9.14	9.13
T ₁	18.67	19.25	18.58	18.83	17.01	17.17	17.23	17.13	13.71	14.34	16.36	14.80	13.98	13.84	13.96	13.93	10.20	10.84	10.10	10.38
T ₂	18.21	18.29	19.24	18.58	17.19	17.79	16.91	17.30	15.00	14.61	14.64	14.75	13.15	13.07	12.61	12.94	9.48	9.96	9.61	9.68
T ₃	16.37	18.42	18.42	17.74	17.69	16.67	16.21	16.86	13.39	14.60	14.01	14.00	11.99	13.10	12.61	12.57	8.99	10.10	9.61	9.57
T ₄	18.77	18.91	19.06	18.91	16.24	17.35	16.44	16.68	13.94	14.62	14.24	14.27	12.54	13.12	12.84	12.84	9.54	10.12	9.84	9.84
T ₅	17.45	18.15	17.84	17.81	16.33	16.27	16.23	16.28	14.03	14.18	14.03	14.08	12.63	12.68	12.63	12.65	9.63	9.68	9.63	9.65
T ₆	18.43	18.91	18.06	18.47	17.39	17.95	17.06	17.47	13.42	15.89	14.03	14.45	13.08	13.93	12.93	13.32	9.58	10.14	9.79	9.83
T ₇	18.79	18.20	19.02	18.67	16.12	17.11	16.12	16.45	13.82	14.54	13.92	14.09	12.42	13.04	12.52	12.66	9.42	10.04	9.52	9.66
T ₈	16.87	18.79	17.75	17.80	15.53	16.86	16.32	16.24	13.23	14.77	14.12	14.04	11.83	13.27	12.72	12.61	9.09	10.19	9.72	9.67
T ₉	17.54	18.45	18.36	18.12	16.04	16.53	16.21	16.26	13.74	14.33	14.01	14.03	12.34	12.83	12.61	12.59	9.34	9.83	9.61	9.59
T ₁₀	16.82	17.90	18.18	17.63	15.46	16.68	16.66	16.27	13.16	14.57	14.46	14.06	11.76	13.07	13.06	12.63	9.16	10.34	9.90	9.80
T ₁₁	16.84	18.68	18.91	18.14	15.46	16.64	16.33	16.14	13.16	14.51	14.13	13.93	11.76	13.01	12.73	12.50	9.02	10.01	9.73	9.59
T ₁₂	17.41	18.81	18.40	18.21	16.03	16.60	15.94	16.19	13.73	14.41	13.74	13.96	12.33	12.91	12.34	12.53	9.33	9.91	9.34	9.53
T ₁₃	17.05	19.01	18.25	18.10	15.67	16.75	16.55	16.32	13.37	14.48	14.35	14.07	11.97	12.98	12.95	12.64	8.97	9.98	10.31	9.75
T ₁₄	19.22	19.37	19.14	19.24	17.91	18.02	18.56	18.16	15.48	14.54	14.94	14.99	14.04	14.05	14.09	14.06	10.53	10.83	10.63	10.67
T ₁₅	17.50	19.01	17.99	18.17	16.07	16.30	16.94	16.44	13.77	14.13	13.74	13.88	12.37	12.63	12.34	12.45	9.37	9.63	9.57	9.52
T ₁₆	17.56	18.47	18.21	18.08	17.24	16.33	17.44	17.00	14.24	13.94	14.62	14.27	12.04	12.72	12.63	12.47	9.25	9.87	9.31	9.48
T ₁₇	19.50	19.61	19.43	19.51	19.03	19.28	19.06	19.12	14.64	16.33	15.28	15.42	14.13	14.26	14.13	14.18	11.13	11.33	11.19	11.22
Mean	17.80	18.66	18.46		16.57	16.99	16.77		13.87	14.57	14.39		12.54	13.12	12.87		9.46	10.15	9.81	
CD		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT
(P=0.05)		0.187	0.459	0.795		0.168	0.411	0.712		0.231	0.565	0.979		0.011	0.027	0.047		0.119	0.293	0.507

C₁: Cloth bag C₂: Polythene bag C₃: Metal box
T₀: Untreated (Control); T₁: Carbendazim 75% WP; T₂: Tebuconazole 2 DS; T₃: Difenoconazole 25% EC; T₄: Propiconazole 25% EC; T₅: Tricyclazole 75% WP; T₆: Flusilazole 40% EC; T₇: Azoxystrobin 23% SC; T₈: Kitazine 48% EC; T₉: Propineb 70% WP; T₁₀: Dimethomorph 50% WP; T₁₁: Chlorothalonil 78.2% WP; T₁₂: Thiram 50% WP; T₁₃: Captan 70% + Hexaconazole 5% WP; T₁₄: Carbendazim 12% + Mancozeb 63% WP; T₁₅: Fomoxadone 16.6% + Cymoxanil 22.1% SL; T₁₆: Flusilazole 12.5% + Carbendazim 25% SE; T₁₇: Carboxin 37.5% + Thiram 25% WP.

TABLE 3
Effect of seed treatments with fungicides and containers on root length (cm) in sorghum seeds

Tret.	3 Months				6 Months				9 Months				12 Months				15 Months			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
T ₀	14.44	15.60	14.75	14.93	12.28	12.70	12.21	12.39	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 ₁	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
T ₂	15.38	15.82	15.33	15.51	13.87	14.13	14.47	14.16	13.26	12.93	13.42	13.20	11.87	12.26	11.94	12.02	9.70	10.76	10.44	10.30
T ₃	14.94	15.91	15.10	15.32	13.21	14.91	13.17	13.76	13.01	13.50	12.87	13.13	11.21	12.08	11.80	11.70	9.71	10.58	10.30	10.20
T ₄	15.02	15.93	15.84	15.60	13.62	13.48	13.23	13.44	13.21	13.28	12.93	13.14	11.51	11.48	11.68	11.56	10.01	10.31	10.18	10.17
T ₅	14.94	16.08	15.23	15.42	13.23	13.68	13.94	13.62	13.03	13.48	13.64	13.38	11.31	11.77	11.78	11.62	9.81	10.27	10.28	10.12
T ₆	15.51	15.69	15.60	15.60	13.49	14.12	14.69	14.10	12.93	13.28	13.21	13.14	11.68	12.18	11.48	11.78	10.18	10.68	9.98	10.28
T ₇	15.65	15.88	15.60	15.71	13.44	13.95	13.70	13.70	12.89	13.42	13.40	13.24	11.09	11.57	11.72	11.46	9.59	10.07	10.22	9.96
T ₈	14.76	15.25	15.02	15.01	13.13	13.64	13.49	13.42	12.93	13.44	13.19	13.19	11.31	11.70	11.51	11.50	9.81	10.53	10.01	10.12
T ₉	14.91	15.66	16.17	15.58	14.23	13.43	13.57	13.74	13.70	13.23	13.27	13.40	11.23	12.44	11.53	11.73	9.73	10.94	10.03	10.23
T ₁₀	15.11	15.93	15.14	15.39	13.09	13.95	13.64	13.56	12.89	13.75	13.34	13.33	11.09	11.78	11.48	11.45	9.59	10.28	9.98	9.95
T ₁₁	15.20	15.60	15.81	15.54	13.56	13.81	14.30	13.89	13.36	13.61	14.02	13.66	11.59	11.85	11.70	11.71	10.09	10.35	10.20	10.21
T ₁₂	15.16	15.41	15.31	15.29	13.39	13.31	13.60	13.43	13.19	13.11	13.30	13.20	11.42	11.77	11.41	11.53	9.92	10.27	9.91	10.03
T ₁₃	15.17	15.16	15.61	15.31	13.61	13.73	13.54	13.63	13.41	13.53	13.24	13.39	11.64	11.62	11.83	11.70	10.14	10.12	10.33	10.20
T ₁₄	15.48	16.65	15.81	15.98	15.06	15.33	14.87	15.09	13.98	14.97	14.12	14.36	13.29	13.30	13.35	13.31	11.12	12.13	11.85	11.70
T ₁₅	15.50	15.82	15.72	15.68	13.67	13.65	13.64	13.65	13.52	13.29	13.04	13.28	11.72	11.47	11.59	11.59	10.22	10.44	10.09	10.25
T ₁₆	15.10	15.27	15.91	15.43	13.45	13.25	13.65	13.45	13.50	12.87	13.01	13.13	11.80	11.21	11.41	11.47	10.30	10.04	9.91	10.08
T ₁₇	16.00	16.77	16.10	16.29	15.41	16.16	15.13	15.57	14.03	15.23	14.19	14.48	13.62	13.55	13.70	13.62	11.78	12.39	12.20	12.12
Mean	15.20	15.78	15.51		13.66	14.00	13.84		13.19	13.45	13.28		11.65	11.95	11.82		10.07	10.58	10.33	
CD		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT
(P=0.05)		0.174	0.425	NS		0.235	0.576	NS		0.179	0.44	NS		0.224	0.549	NS		0.284	0.697	NS

C₁: Cloth bag C₂: Polythene bag C₃: Metal box
T₀: Untreated (Control); T₁: Carbendazim 75% WP; T₂: Tebuconazole 2 DS; T₃: Difenoconazole 25% EC; T₄: Propiconazole 25% EC; T₅: Tricyclazole 75% WP; T₆: Flusilazole 40% EC; T₇: Azoxystrobin 23% SC; T₈: Kitazine 48% EC; T₉: Propineb 70% WP; T₁₀: Dimethomorph 50% WP; T₁₁: Chlorothalonil 78.2% WP; T₁₂: Thiram 50% WP; T₁₃: Captan 70% + Hexaconazole 5% WP; T₁₄: Carbendazim 12% + Mancozeb 63% WP; T₁₅: Fomoxadone 16.6% + Cymoxanil 22.1% SL; T₁₆: Flusilazole 12.5% + Carbendazim 25% SE; T₁₇: Carboxin 37.5% + Thiram 25% WP.

(11.19) but better than others. Kumar *et al.* (2019) found that the chilli seeds stored in metal box treated with fungicides maintained higher seed quality parameters *viz.*, germination, root length, shoot length, mean seedling dry weight and vigour indices as compared to plastic bag and cloth bag. The researcher in the past *viz.* Biradar (2001) and Koche *et al.* (2012) also revealed the similar finding.

Root length (cm)

Among all fungicides treated seeds, (T₁₇) carboxin + thiram (12.12) proved superior which was statistically at par with (T₁₄) carbendazim + mancozeb (11.70). Among containers, polythene bag (10.58) was statistically at par with metal box (10.33). Interaction effect of containers with fungicide was found non-significance. The results are corroborated with that of Shashibhaskar (2012) and Koche *et al.* (2012).

Seedling dry weight (mg)

Among fungicides treated seeds, (T₁₇) carboxin + thiram (10.3) proved better which was statistically at par with (T₁₄) carbendazim + mancozeb (9.3). Among containers, polythene bag (8.3) was found better than metal box and cloth bag. Interaction effect of polythene bag with (T₁₇) carboxin + thiram

(11) was found better than others. The results are similar to the earlier study conducted by Vidhyasekaran *et al.* (1980) in sorghum, Cicero *et al.* (1992) in maize and Pedireddi *et al.* (2018).

Vigour index-I

Among fungicides treated seeds, (T₁₇) carboxin + thiram (1812) proved better followed by (T₁₄) carbendazim + mancozeb (1660). Among containers, polythene bag (1514) was found statistically at par with metal box (1480). Interaction effect of polythene bag with, (T₁₇) carboxin + thiram (1827) was found superior than others. Santoshreddy *et al.* (2014) found that out of 11 chemical fungicides used as seed treatments, the combination of carboxin 37.5% + thiram 37.5% WS (Vitavax power) @ 0.2 per cent and metalxyl 4% + mancozeb 64% WP (Ridomil gold) @ 0.2 per cent showed highest seedling vigour index (932.02 and 871.70). The results are similar to the earlier study conducted by Subrahmanya *et al.* (1988), Somani *et al.* (1993) in sorghum and Nataraj *et al.* (2011).

Vigour index-II

Among fungicides treated seeds, (T₁₇) carboxin + thiram (830) proved better which was

TABLE 4
Effect of seed treatments with fungicides and containers on seedling dry weight (mg) in sorghum seeds

Tret.	3 Months				6 Months				9 Months				12 Months				15 Months			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
T ₀	12.40	11.97	12.20	12.19	10.00	10.00	10.07	10.02	9.00	9.27	8.50	8.92	8.37	7.80	7.67	7.94	6.33	6.30	6.17	6.27
T ₁	14.13	14.07	14.17	14.12	13.00	13.33	13.67	13.33	11.23	11.00	10.87	11.03	9.00	9.33	9.22	8.00	7.77	8.07	7.94	
T ₂	13.30	12.40	13.27	12.99	12.00	13.00	13.00	12.67	10.00	9.33	9.00	9.44	8.70	8.00	8.23	7.00	9.00	8.00	8.00	
T ₃	12.37	14.67	13.97	13.67	14.00	15.00	12.00	13.67	12.00	11.00	9.00	10.67	10.33	10.67	9.00	10.00	9.33	9.33	8.67	9.11
T ₄	14.93	14.43	14.53	14.63	14.00	14.00	14.00	14.00	10.00	10.00	13.00	11.00	8.00	10.00	10.00	9.33	9.00	7.00	9.00	8.33
T ₅	14.03	14.63	14.13	14.27	13.00	14.00	12.40	13.13	10.00	12.00	10.00	10.67	10.00	8.00	8.00	8.67	7.00	9.00	7.00	7.67
T ₆	14.37	14.93	14.43	14.58	13.00	13.67	11.00	12.56	10.00	13.00	10.00	11.00	9.33	10.00	8.00	9.11	9.00	9.00	7.00	8.33
T ₇	14.47	14.20	14.00	14.22	12.00	11.67	12.17	11.94	10.00	10.00	9.33	9.78	9.00	8.00	7.67	8.22	5.00	8.00	6.67	6.56
T ₈	13.43	15.53	12.23	13.73	13.00	12.00	13.07	12.69	9.00	10.00	9.00	9.33	7.33	8.00	9.00	8.11	7.00	7.93	7.00	7.31
T ₉	15.03	14.43	13.13	14.20	13.00	11.33	12.90	12.41	12.33	11.17	10.00	11.17	7.67	8.33	10.00	8.67	6.00	8.00	9.00	7.67
T ₁₀	13.23	14.43	14.17	13.94	11.33	12.20	12.00	11.84	10.00	10.67	10.00	10.22	8.00	8.00	10.00	8.67	7.00	7.33	9.00	7.78
T ₁₁	14.13	15.20	14.10	14.48	14.00	14.00	14.00	14.00	9.37	12.00	12.00	11.12	8.00	10.33	8.67	9.00	9.00	8.00	7.00	8.00
T ₁₂	13.23	13.57	13.20	13.33	12.00	13.00	14.00	13.00	11.00	12.37	11.67	11.68	10.00	9.00	10.00	9.67	8.00	9.00	9.00	8.67
T ₁₃	14.07	13.73	13.07	13.62	13.00	13.00	12.00	12.67	8.00	12.00	12.00	10.67	9.00	10.00	10.00	9.67	9.00	8.00	9.00	8.67
T ₁₄	14.37	15.70	15.37	15.14	14.33	14.00	14.33	14.22	12.00	12.33	12.00	12.11	11.00	11.00	10.67	10.89	9.00	10.00	9.00	9.33
T ₁₅	12.30	13.37	14.00	13.22	11.00	10.33	12.00	11.11	11.00	10.00	9.00	10.00	8.00	9.00	9.00	8.67	8.00	7.00	8.00	7.67
T ₁₆	11.97	13.37	14.67	13.33	12.00	14.67	14.00	13.56	11.00	10.67	12.00	11.22	9.00	11.33	10.33	10.22	8.00	10.00	9.00	9.00
T ₁₇	16.10	16.30	17.10	16.50	14.30	15.00	14.47	14.59	12.67	13.27	12.40	12.78	11.00	11.33	11.40	11.24	10.00	11.00	10.00	10.33
Mean	13.77	14.27	13.99		12.72	13.01	12.84		10.48	11.12	10.54		8.99	9.34	9.26		7.87	8.37	8.20	
CD		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT
(P=0.05)		0.234	0.573	0.993		0.208	0.508	0.881		0.327	0.8	1.386		0.238	0.583	1.009		0.279	0.684	1.185

C₁: Cloth bag

C₂: Polythene bag

C₃: Metal box

T₀: Untreated (Control); T₁: Carbendazim 75% WP; T₂: Tebuconazole 2 DS; T₃: Difenoconazole 25% EC; T₄: Propiconazole 25% EC; T₅: Tricyclazole 75% WP; T₆: Flusilazole 40% EC; T₇: Azoxystrobin 23% SC; T₈: Kitazine 48% EC; T₉: Propineb 70% WP; T₁₀: Dimethomorph 50% WP; T₁₁: Chlorothalonil 78.2% WP; T₁₂: Thiram 50% WP; T₁₃: Captan 70% + Hexaconazole 5% WP; T₁₄: Carbendazim 12% + Mancozeb 63% WP; T₁₅: Famoxadone 16.6% + Cymoxanil 22.1% SL; T₁₆: Flusilazole 12.5% + Carbendazim 25% SE; T₁₇: Carboxin 37.5% + Thiram 25% WP.

TABLE 5
Effect of seed treatments with fungicides and containers on vigour index-I in sorghum seeds

Tret.	3 Months				6 Months				9 Months				12 Months				15 Months			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
T ₀	2,733	2,824	2,772	2,776	2,276	2,318	2,252	2,282	1,977	1,977	2,025	1,993	1,669	1,705	1,743	1,706	1,250	1,353	1,342	1,315
T ₁	3,019	3,131	3,004	3,051	2,650	2,720	2,682	2,684	2,214	2,322	2,437	2,324	2,048	2,102	2,152	2,101	1,581	1,604	1,583	1,589
T ₂	2,944	3,047	3,077	3,023	2,701	2,713	2,573	2,662	2,204	2,231	2,301	2,245	2,001	2,069	1,972	2,014	1,439	1,438	1,430	1,435
T ₃	2,787	3,055	2,950	2,931	2,596	2,747	2,468	2,603	2,139	2,388	2,150	2,226	1,880	2,016	1,928	1,941	1,396	1,529	1,453	1,460
T ₄	3,007	3,171	3,141	3,106	2,538	2,652	2,551	2,580	2,144	2,343	2,282	2,257	1,876	1,943	1,921	1,914	1,480	1,471	1,462	1,471
T ₅	2,916	3,046	2,977	2,980	2,394	2,515	2,504	2,471	2,272	2,185	2,268	2,242	1,868	1,931	1,928	1,909	1,399	1,484	1,413	1,432
T ₆	2,953	3,033	2,950	2,979	2,563	2,630	2,669	2,621	2,212	2,421	2,206	2,280	2,006	2,089	1,977	2,024	1,395	1,477	1,383	1,419
T ₇	3,065	3,033	3,116	3,071	2,541	2,672	2,594	2,602	2,217	2,292	2,211	2,240	1,858	1,969	1,963	1,930	1,394	1,428	1,461	1,428
T ₈	2,814	3,064	2,873	2,917	2,312	2,562	2,503	2,459	2,093	2,370	2,185	2,216	1,790	1,973	1,939	1,900	1,347	1,484	1,454	1,428
T ₉	2,823	3,024	3,004	2,951	2,542	2,576	2,472	2,530	2,222	2,204	2,264	2,230	1,910	2,021	1,956	1,962	1,354	1,432	1,493	1,426
T ₁₀	2,810	3,067	2,966	2,948	2,436	2,666	2,486	2,529	2,162	2,266	2,335	2,254	1,828	1,988	1,988	1,935	1,383	1,505	1,471	1,453
T ₁₁	2,884	3,085	3,125	3,031	2,437	2,526	2,573	2,512	2,183	2,278	2,365	2,275	1,915	1,940	1,930	1,928	1,382	1,496	1,396	1,424
T ₁₂	2,964	3,011	3,000	2,991	2,501	2,542	2,511	2,518	2,261	2,201	2,136	2,199	1,973	1,999	1,947	1,973	1,405	1,518	1,386	1,436
T ₁₃	2,835	2,984	2,946	2,922	2,430	2,561	2,618	2,536	2,143	2,352	2,236	2,244	1,889	1,993	1,958	1,946	1,378	1,476	1,610	1,488
T ₁₄	3,158	3,242	3,146	3,182	2,835	2,901	2,909	2,882	2,444	2,459	2,402	2,435	2,195	2,216	2,213	2,208	1,638	1,722	1,619	1,660
T ₁₅	2,871	3,065	3,035	2,990	2,559	2,516	2,538	2,537	2,185	2,276	2,250	2,237	1,879	1,928	1,915	1,907	1,429	1,513	1,451	1,464
T ₁₆	2,875	2,935	3,036	2,949	2,486	2,396	2,550	2,477	2,192	2,145	2,238	2,192	1,860	1,891	1,924	1,892	1,474	1,498	1,419	1,463
T ₁₇	3,195	3,322	3,198	3,238	2,961	3,120	3,009	3,030	2,466	2,680	2,534	2,560	2,303	2,290	2,301	2,298	1,791	1,827	1,817	1,812
Mean	2,925	3,063	3,017		2,542	2,630	2,581		2,207	2,299	2,268		1,930	2,003	1,981		1,440	1,514	1,480	
CD		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT
(P=0.05)		25.049	61.357	106.273		5.23	12.811	22.189		25.43	62.291	107.89		8.285	20.293	35.149		15.268	37.398	

C₁: Cloth bagC₂: Polythene bagC₃: Metal box

T₀: Untreated (Control); T₁: Carbendazim 75% WP; T₂: Tebuconazole 2 DS; T₃: Difenoconazole 25% EC; T₄: Propiconazole 25% EC; T₅: Tricyclazole 75% WP; T₆: Flusilazole 40% EC; T₇: Azoxystrobin 23% SC; T₈: Kitazine 48% EC; T₉: Propineb 70% WP; T₁₀: Dimethomorph 50% WP; T₁₁: Chlorothalonil 78.2% WP; T₁₂: Thiram 50% WP; T₁₃: Captan 70% + Hexaconazole 5% WP; T₁₄: Carbendazim 12% + Mancozeb 63% WP; T₁₅: Famoxadone 16.6% + Cymoxanil 22.1% SL; T₁₆: Flusilazole 12.5% + Carbendazim 25% SE; T₁₇: Carboxin 37.5% + Thiram 25% WP.

statistically at par with (T₁₄) carbendazim + mancozeb (741). Among containers, polythene bag (639) was found statistically at par with metal box (631). Interaction effect of polythene bag with, (T₁₇) carboxin + thiram (880) was found superior than others. The results are in the same pattern as reported by Padule *et al.* (1999) in sorghum, Nataraj *et al.* (2011) in sunflower and Khatun *et al.* (2015).

Seed mycoflora

Fungi are one of the factors in storage seeds which reduce seed viability. Seed borne fungal diseases are the most limiting factor. Treated sorghum seed developed less mycoflora particularly *Alternaria*, *Helminthosporium*, *Curvularia* and *Penicillium* while more association of *Aspergillus*, *Fusarium* and *Mucor* were observed with the seeds during storage period in different containers. Fungicide carboxin + thiram, carbendazim + mancozeb and carbendazim were found most effective against the four genera *viz.* *Alternaria*, *Helminthosporium*, *Curvularia* and *Fusarium* of sorghum seed in all the three containers.

Among the fungicides treated seeds, less incidence of all the eight fungal genera was found in seeds treated with (T₁₇) carboxin + thiram (0.19%) followed by (T₁₄) carbendazim + mancozeb (0.33%) in polythene bag as compared to other treatments. The fungicides carboxin + thiram, carbendazim +

mancozeb and carbendazim were found most effective against the four genera *viz.* *Alternaria*, *Helminthosporium*, *Curvularia* and *Fusarium* in all the three containers.

However lesser mycoflora developed in treated seeds stored in polythene bag (1.00%) compared to metal box (1.31%) and cloth bag (1.58%) after the 15 months of storage (Table 7). Koche *et al.* (2012) reported that seed treatment with thiram + carbendazim 3g kg⁻¹ seed was found superior in controlling the seed borne mycoflora (0.50 to 0.0%), increasing seed germination, shoot length, root length and seedling vigour index. The results are in conformity with the findings of Raut and Wangikar (1989) in sorghum and Padule *et al.* (1999).

CONCLUSION

It can be concluded that sorghum seeds may be stored in polythene bag with seed treatment of carboxin + thiram 2 g/kg seed for a period of 15 months without deterioration in germination and seedling vigour.

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TABLE 6
Effect of seed treatments with fungicides and containers on vigour index-II in sorghum seeds

Tret.	3 Months				6 Months				9 Months				12 Months				15 Months			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
T ₀	1,067	1,017	1,049	1,044	809	820	815	814	703	731	663	699	644	593	613	617	449	441	445	445
T ₁	1,257	1,266	1,261	1,261	1,105	1,134	1,162	1,134	932	913	891	912	720	756	765	747	592	590	613	598
T ₂	1,166	1,108	1,181	1,151	1,044	1,105	1,066	1,072	780	755	738	758	696	661	648	668	525	666	611	601
T ₃	1,088	1,319	1,229	1,212	1,177	1,305	1,008	1,163	971	934	720	875	837	854	711	801	700	710	650	687
T ₄	1,329	1,313	1,308	1,317	1,190	1,204	1,204	1,199	790	840	1,092	908	632	790	779	734	684	525	675	628
T ₅	1,249	1,317	1,272	1,279	1,053	1,176	1,029	1,086	839	948	819	869	780	655	633	689	532	675	532	579
T ₆	1,250	1,309	1,266	1,275	1,079	1,120	923	1,041	840	1,079	810	910	756	800	648	735	684	683	535	634
T ₇	1,288	1,264	1,260	1,270	1,032	1,004	1,060	1,032	831	821	756	803	712	648	613	658	380	616	520	505
T ₈	1,196	1,398	1,072	1,222	1,049	1,008	1,099	1,052	721	840	720	760	579	632	720	644	530	595	535	553
T ₉	1,308	1,280	1,143	1,243	1,092	975	1,070	1,046	999	893	831	908	621	667	810	699	450	600	684	578
T ₁₀	1,164	1,309	1,261	1,245	967	1,061	984	1,004	830	854	840	841	640	640	810	697	518	552	702	591
T ₁₁	1,257	1,383	1,269	1,303	1,176	1,163	1,176	1,172	771	972	1,009	917	656	806	684	716	681	624	530	612
T ₁₂	1,178	1,221	1,175	1,191	1,020	1,105	1,190	1,105	927	990	921	946	831	738	820	796	608	693	685	662
T ₁₃	1,238	1,200	1,137	1,192	1,079	1,092	1,044	1,072	640	1,008	971	873	720	809	790	773	684	608	702	665
T ₁₄	1,308	1,413	1,383	1,368	1,233	1,217	1,247	1,232	996	1,028	992	1,005	869	892	832	864	710	793	721	741
T ₁₅	1,070	1,176	1,260	1,169	946	868	996	937	880	829	756	822	624	720	720	688	601	539	634	591
T ₁₆	1,053	1,163	1,305	1,174	972	1,188	1,149	1,103	869	854	971	898	702	895	827	808	617	779	703	700
T ₁₇	1,449	1,489	1,539	1,492	1,230	1,320	1,273	1,274	1,089	1,127	1,067	1,095	913	933	942	929	800	880	810	830
Mean	1,217	1,275	1,243		1,070	1,103	1,083		856	912	865		718	749	743		597	639	631	
CD (P=0.05)		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT		C	T	CXT
		21.68	53.09	91.96		19.59	47.98	83.11		27.72	67.90	117.60		19.78	48.46	83.93		21.59	52.87	91.58

C₁: Cloth bagC₂: Polythene bagC₃: Metal box

T₀: Untreated (Control); T₁: Carbendazim 75% WP; T₂: Tebuconazole 2 DS; T₃: Difenconazole 25% EC; T₄: Propiconazole 25% EC; T₅: Tricyclazole 75% WP; T₆: Flusilazole 40% EC; T₇: Azoxystrobin 23% SC; T₈: Kitazine 48% EC; T₉: Propineb 70% WP; T₁₀: Dimethomorph 50% WP; T₁₁: Chlorothalonil 78.2% WP; T₁₂: Thiram 50% WP; T₁₃: Captan 70% + Hexaconazole 5% WP; T₁₄: Carbendazim 12% + Mancozeb 63% WP; T₁₅: Famoxadone 16.6% + Cymoxanil 22.1% SL; T₁₆: Flusilazole 12.5% + Carbendazim 25% SE; T₁₇: Carboxin 37.5% + Thiram 25% WP.

TABLE 7
Mycoflora average in sorghum seed (variety: HJ 541) treated with fungicides kept in different storage container

Fungicide treatments	Per cent frequency in 3 month			Per cent frequency in 6 month			Per cent frequency in 9 month			Per cent frequency in 12 month			Per cent frequency in 15 month		
	Cloth bag	Polythene bag	Metal box	Cloth bag	Polythene bag	Metal box	Cloth bag	Polythene bag	Metal box	Cloth bag	Polythene bag	Metal box	Cloth bag	Polythene bag	Metal box
T ₀	0.86	0.61	0.66	1.08	0.83	0.91	1.58	0.63	0.77	2.00	1.08	1.41	2.08	1.50	1.80
T ₁	0.30	0.13	0.27	0.50	0.25	0.27	0.41	0.16	0.27	0.97	0.41	0.55	0.86	0.36	0.69
T ₂	0.41	0.19	0.30	0.55	0.27	0.50	0.50	0.33	0.47	0.97	0.61	0.91	1.30	0.66	1.25
T ₃	0.52	0.16	0.19	0.63	0.33	0.44	1.00	0.47	0.83	1.44	0.86	1.16	1.75	1.02	1.41
T ₄	0.52	0.27	0.30	0.52	0.38	0.41	0.88	0.47	0.75	1.30	0.75	1.02	1.66	1.22	1.38
T ₅	0.44	0.16	0.22	0.52	0.30	0.36	0.61	0.38	0.61	0.91	0.55	0.83	1.47	0.97	1.16
T ₆	0.52	0.33	0.44	0.69	0.44	0.63	0.97	0.58	0.91	1.66	0.91	1.50	1.91	1.19	1.86
T ₇	0.44	0.19	0.36	0.58	0.33	0.44	1.30	0.58	0.75	1.58	0.88	1.13	2.30	1.41	1.63
T ₈	0.52	0.25	0.38	0.66	0.33	0.47	1.27	0.58	0.69	2.11	0.80	1.22	2.33	1.50	2.25
T ₉	0.55	0.30	0.33	0.63	0.36	0.41	1.08	0.58	0.69	1.41	0.72	1.02	1.97	1.00	1.55
T ₁₀	0.52	0.13	0.22	0.66	0.25	0.33	1.47	0.61	0.80	1.97	0.88	1.16	2.72	1.61	2.02
T ₁₁	0.52	0.33	0.36	0.69	0.44	0.52	1.19	0.97	1.05	2.00	1.08	1.52	2.86	2.19	2.61
T ₁₂	0.25	0.11	0.22	0.27	0.16	0.27	0.61	0.44	0.55	0.72	0.55	0.72	1.27	1.02	1.19
T ₁₃	0.41	0.13	0.16	0.47	0.19	0.27	0.83	0.36	0.52	1.00	0.47	0.61	1.27	0.72	0.88
T ₁₄	0.22	0.22	0.25	0.27	0.25	0.27	0.22	0.19	0.22	0.38	0.30	0.36	0.41	0.33	0.38
T ₁₅	0.55	0.11	0.22	0.91	0.22	0.69	0.77	0.36	0.50	1.30	0.50	0.97	1.25	0.61	0.69
T ₁₆	0.22	0.13	0.22	0.25	0.16	0.25	0.36	0.25	0.33	0.52	0.41	0.47	0.72	0.58	0.60
T ₁₇	0.16	0.11	0.13	0.22	0.16	0.19	0.16	0.11	0.13	0.27	0.22	0.25	0.27	0.19	0.22
Avg.	0.44	0.21	0.29	0.56	0.31	0.42	0.85	0.45	0.60	1.25	0.67	0.93	1.58	1.00	1.31

C₁: Cloth bagC₂: Polythene bagC₃: Metal box

T₀=untreated (Control); T₁=Carbendazim 75%WP; T₂=Tebuconazole 2DS; T₃=Difenconazole25%EC; T₄=Propiconazole 25%EC; T₅=Tricyclazole 75%WP; T₆=Flusilazole 40%EC; T₇=Azoxystrobin 23%EC; T₈=Kitazine 48%EC; T₉=Propineb 70%WP; T₁₀=Dimethomorph 50%WP; T₁₁=Chlorothalonil 78.2%WP; T₁₂=Thiram 50%WP; T₁₃=Captan 70% + Hexaconazole 5%WP; T₁₄= Carbendazim 12% + Mancozeb 63%WP; T₁₅= Famoxadone 16.6% + Cymoxanil 22.1% SL; T₁₆= Flusilazole 12.5% + Carbendazim 25%SE; T₁₇= Carboxin 37.5% + Thiram 25%WP.

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