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Effect of organics in enhancing seed storability of chickpea (*Cicer arietinum* L)

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Abstract
The study was conducted undertaken to know the effect organic seed treatment on seed storability of chickpea. Seeds were treated with both organic [Neem seed kernel powder (50 and100 g/kg), Neem leaf powder (50 and 100 g/kg), Neem oil (5 ml/kg), Castor oil (5 ml/kg), Sweet flag rhizome powder (20 g/kg)] and inorganic Insecticides [Malathion dust (5 g/kg) and Thiram (2 g/kg)]. Among the different seed treatments, the seed treatment with castor oil (5ml/kg of seed) has maintained minimum prescribed seed germination (85.67%) up to eighteen months along with the highest seedling vigour index I and II (1870 and 4118), and lowest insect damage (6%) as compared to control (82.67%, 1587, 3326 and 52%). Whereas lower seed germination was observed in control seeds (82.67%) treated with neem seed kernel powder, lower seedling vigour index-I in neem oil (5ml/kg), seedling vigour index-II was observed in control. So castor oil @ 5ml per kg of seeds has found effective in maintaining the seed quality with minimum seed infestation for more than twenty months of storage.

Keywords: Chickpea, botanicals, insecticides, non-edible oil, seed treatment seed quality and seed storage

Introduction
Chickpea is highly nutritious pulse cultivated throughout the world and placed in the third position as the important food crop. It contains 61-62 per cent carbohydrate, 18-22 per cent protein, and 100 gm of chickpea contains calcium-280 mg, iron-12.3 mg, phosphorus-301 mg and 396 calorific value (Anon., 2009) [3], which is the maximum provided by any pulses and it does not contain any anti-nutritional factor. India's grain production has steadily increased due to advances in technology, but the post-harvest loss is constant at 10 per cent. Losses during storage accounts for around 6.58 per cent of the total losses as proper storage facilities are not available. The postharvest losses in India amount to 12 to 16 million metric tonnes of food grains each year, as per the World Bank estimates that could feed one-third of India's poor. The monetary value of these losses amounts to approximately more than Rs. 50,000 crores per year (Singh, 2010) [19].

Post harvest losses account for 9.5 per cent of total pulses production. Among the post harvest operations, storage is responsible for the maximum loss up to 7.5 per cent. Whereas processing, threshing and transport cause 1, 0.5 and 0.5 per cent losses, respectively (Birewar, 1984). Among storage losses, pulses are most susceptible to damage due to insects (5%) (Deshapande and Singh, 2001) [6]. Chickpea seeds suffer heavy qualitative and quantitative losses from the attack of pests during storage, which causes a reduction in weight, nutrition value, market value and germination of seeds. The problem of residues resulting from seed treatment with insecticides beyond the permissible limit for control of insect infestation has forced researchers to look non-toxic protectants. In view of the above, a study was undertaken to evaluate the different organic method of seed treatment for storage of chickpea seeds.

Material and Methods
The laboratory studies were carried out to find out the effect of seed treatment with organic and inorganic materials on seed quality of chickpea during storage. The organic materials neem seed kernel powder and neem leaf powder were prepared manually. The fine powder of this plant material was sieved using 1.0 mm wire mesh sieve. Crude neem oil, crude castor oil, sweet flag rhizome powder, malathion dust and thiram powder have been procured from local market.

The experiment were laid in Completely Randomized Design (CRD) consisted of 10 treatments. T_1: Neem seed kernel powder (50 g/kg), T_2: Neem seed kernel powder (100 g/kg), T_3: Neem leaf powder (50 g/kg), T_4: Neem leaf powder (100 g/kg), T_5: Neem oil (5 ml/kg), T_6: Castor oil (5 ml/kg), T_7: Sweet flag rhizome powder (20 g/kg), T_8: Malathion dust (5 g/kg), T_9: Thiram (2 g/kg) and T_{10}: Control.
The observations were taken at bi-monthly intervals on seed germination (%) and insect damage as per the ISTA procedure (Anon., 1999) [2]. and seedling vigour index (Abdul-Baki and Ander-son, 1973)) [1].
Seedling Vigour index I = Germination (%) x Total seedling length (cm)
Seedling Vigour index II = Germination (%) x seedling dry matter (mg)

Results and Discussion
The different seed physiological quality parameters like germination (%), insect damage (%), seedling vigour index-I, seedling vigour index-II, electrical conductivity, α amylase activity and dehydrogenase activity were discussed below.

Seed Germination (%)
The seed germination percentage was gradually decreased as the storage period advances. From the initial month of storage to the end of storage period, seeds treated with castor oil (5ml/kg of seed) has recorded significantly higher seed germination (84.00%) percentage at twenty months of storage, whereas lower seed germination (80.00%) was recorded in seeds treated with neem seed kernel powder (50g/kg of seed) (Table 1). Irrespective of the seed treatments decline in germination percentage is due to ageing effect leading to depletion of food reserves and decline in synthetic activity of embryo, apart from the death of seed because of fungal invasion, fluctuating temperature, relative humidity and storage container in which seeds are stored. These results are in accordance with findings of Merwade (2000) [11]; Patil A (2000) [13] in chickpea, Deshapande *et al.* (2004) [7] in black gram, in cowpea Renugadevi *et al.* (2006) [18] and Ravindra *et al.* (2009) [17], and Rajasri and Rao (2012) [15] in Bengal gram.

Insect Damage (%)
In the present study, the seeds treated with castor oil (5ml/kg seed) have shown the lower seed infestation per centage (7.65%) after 20 months of storage, which was on par with malation dust and thiram, where as the maximum seed infestation has been found in control (83.67%). The superiority of castor oil, thiram, malathion and sweet flag rhizome in controlling insect infestation is due to the fact that these treatments keep the seeds intact as these acts as a binding material and covers the minor cracks and aberrations on the seed coat at initial stage thus blocking the fungal invasion. Apart from this, the antifeedant, insect repellant and antifungal and insecticidal property present in these botanicals also help in making the seeds incompatible for insects during storage (Deshpande *et al.*, 2004). Similar beneficial effect of castor oil in protecting seeds from the attack of *Collosobruchus chinenesis* (Bruchid and Pulse beetle) throughout the storage period was observed by Ratnasekera and Rajapakse (2009) [16], Tripathi *et al.* (2009) [21], Dinesh and Deepshikha (2012) [9], Hany (2013) [10] in cowpea, Suma (2013) [20] in maize against *Sitophilus oryzae*. Babu *et al* (1989) [4] observed reduced oviposition by the bruchid by treating mungbean seeds with karanja oil (5 and 10 ml/kg) and castor oil (10 ml/kg).

Table 1: Effect of organic seed treatment on seed germination (%) and Insect Damage (%)

Treatment	Seed germination (%)					Insect Damage(%)				
	6	12	18	20	Mean	6	12	18	20	Mean
T1 – Neem seed kernel powder (50 g/kg)	92.00	86.67	83.67	80.00	85.5	0.00	1.00	43.00	52.00	24.00
T2 – Neem seed kernel powder (100 g/kg)	92.00	87.00	83.00	81.00	85.7	0.00	1.00	31.33	36.33	17.17
T3 – Neem leaf powder (50 g/kg)	92.25	88.67	84.00	81.67	86.64	0.00	1.00	29.67	34.33	16.25
T4- Neem leaf powder (100 g/kg)	91.25	89.33	85.00	80.67	86.56	0.00	0.67	26.33	29.00	14.00
T5 – Neem oil (5 ml/kg)	90.50	85.33	83.67	81.33	85.21	0.00	0.67	13.00	15.33	7.25
T6 – Castor oil (5 ml/kg)	91.25	87.00	85.67	84.00	86.98	0.25	0.33	6.00	7.67	3.56
T7 – Sweet flag rhizome (20 g/kg)	92.50	88.67	83.00	81.33	86.38	0.00	0.33	17.33	19.00	9.17
T8 – Malathion dust (5g/kg)	91.50	88.00	85.33	82.67	86.88	0.00	0.67	8.67	11.67	5.25
T9 – Thiram (2 g/kg)	92.00	88.67	85.00	82.00	86.92	0.00	1.00	13.00	14.33	7.08
T10 - Control	90.00	86.00	82.67	81.67	85.09	1.00	4.00	52.00	83.67	35.17
Mean	90.52	87.50	84.1	81.63	85.94	0.11	1.07	24.03	30.33	13.89
S.Em±	1.169	0.408	0.350	0.577		0.039	0.236	1.337	1.358	
CD (P=0.01)	4.57	1.643	1.407	2.323		0.151	0.948	5.382	5.465	

Seedling vigour index
However, significantly higher seedling vigour index- I (2047) was observed in thiram (2 g/kg of seed), lower seedling vigour index (1791) in neem oil (5 ml/kg of seed) and seedling vigour index-II was highest in Castor oil (5 ml/kg) (4303) and lowest in control (3865). Similarly, the decline in seedling vigour index may be attributed to decrease in germination per cent, seedling length and dry matter accumulation in the seedling. The results are in findings with Patil (2002) [14] in greengram and Deus *et al.* (2009), Ratnasekera and Rajapakse (2009) [16] in greengram, Dinesh and Deepshikha (2012) [9] and Hany (2013) [13].

Table 2: Effect of organic seed treatment on Seedling Vigour Index – I and Seedling Vigour Index – II

Treatment	Seedling Vigour Index – I					Seedling Vigour Index – II				
	6	12	18	20	Mean	6	12	18	20	Mean
T1 – Neem seed kernel powder (50 h/kg)	2456	1951	1551	1427	1846	5054	4270	3692	3344	4090
T2 – Neem seed kernel powder (100 g/kg)	2425	1966	1527	1361	1820	5017	4414	3586	3445	4116
T3 – Neem leaf powder (50 g/kg)	2424	2112	1601	1489	1907	5055	4363	3662	3487	4142
T4- Neem leaf powder (50 g/kg)	2440	2049	1700	1524	1928	5171	3978	3686	3434	4067

T5 – Neem oil (5 ml/kg)	2371	1749	1571	1471	1791	4893	4136	3575	3364	3992
T6 – Castor oil (5 ml/kg)	2237	1924	1870	1771	1951	4928	4252	4118	3912	4303
T7 – Sweet flag rhizome (20 g/kg)	2615	2223	1516	1430	1946	5340	4422	3583	3413	4190
T8 – Malathion dust (5g/kg)	2459	2134	1837	1705	2034	4941	4294	4025	3618	4220
T9 – Thiram (2 g/kg)	2585	2155	1789	1657	2047	5201	4416	4026	3583	4307
T10 - Control	2364	1869	1587	1525	1836	4908	4025	3326	3201	3865
Mean	2307	2012	1654	1535	1877	5051	4257	3728	3480	4129
S.Em±	38.19	30.115	14.341	25.199		100.31	23.19	29.48	65.27	
CD (P=0.01)	149.24	121.18	57.706	101.40		403.63	93.32	118.62	262.62	

Bio-chemical parameters

It includes the parameters like electrical conductivity (dSm^{-1}), α amylase activity (mm) and dehydrogenase activity (OD Value),

Electrical Conductivity

The average initial electrical conductivity was 0.045 dSm^{-1}, which enhanced to 0.881 dSm^{-1} at the end of twenty months of storage indicating increased permeability of membrane and decline in compactness of seeds. The electrical conductivity of the seeds treated with castor oil, malathion and thiram @ 2 g per kg was lowest (0.816 dsm^{-1}) and highest in control (0.996 dsm^{-1}). The other botanicals also reduced the seed permeability thus resulting in lower electrical conductivity when compared to control. Thus, the insecticide and botanicals make the seed antifeedant and unpalatable to insects and reduces the cracks and aberrations of the seed coat and reduce the leaching of the electrolytes. These results are in agreement with Patil (2000) [13] in chickpea; Maheshbabu and Ravi Hunje (2008) [12] in soybean.

Dehydrogenase activity (OD Value) and α amylase activity (mm)

Irrespective of treatments, a steady decline in dehydrogenase activity and α amylase activity was observed with progressive increase in the storage period. Highest dehydrogenase activity was observed in castor oil (0.289) indicates the good quality of seed and lowest in neem seed kernel powder a (100g/kg seeds) (0.217). The average α-amylase activity decreases from 24.26 to 16.64 mm at the end of twenty months of storage period over different treatments. Highest alpha-amylase activity was observed in castor oil (18.79mm) which is on par with malathion and thiram and lowest in neem leaf powder (100g/kg) (14.440mm). During germination of seeds α – amylase degrade the starch granules and thereby reducing the dietary bulk and improves digestability of starch (Reinhaneh and Mehdi, 2011) and improves seed germination and vigour. These results are in corroborate with Renugadevi *et al.* (2006) [18], Maheshbabu and Ravi Hunje (2008) [12] and Rajasri and Rao (2012) [15].

Conclusion

The stored seeds need to be protected from the insect attack for maintaining the high seed quality. To protect seeds from storage pests it is recommended to go for seed treatment with insecticides but due to residual effect of insecticides if the seeds unsold and that can be used as feed or food. It is better to find out suitable seed treating organics to protect the seeds from insects. From the present study, it could be concluded that chickpea seeds treated with castor oil 5ml per kg of seeds have maintained the minimum prescribed seed germination and high seedling vigour index with minimum insect damage after 20 months of storage.

Table 3: Effect of organic seed treatment on Dehydrogenase activity (OD Value) and Alpha amylase activity (mm) in chickpea cv. JG-11 during storage

Treatment	Dehydrogenase activity (OD Value)					Alpha amylase activity (mm)					Electrical Conductivity (dsm^{-1})				
	6	12	18	20	Mean	6	12	18	20	Mean	6	12	18	20	Mean
T1 – Neem seed kernel powder (50 h/kg)	0.770	0.405	0.223	0.223	0.405	27.690	22.037	16.523	16.190	20.610	0.550	0.785	0.896	0.906	0.784
T2 – Neem seed kernel powder (100 g/kg)	0.770	0.379	0.217	0.217	0.396	27.140	20.610	17.263	16.260	20.318	0.565	0.790	0.912	0.943	0.803
T3 – Neem leaf powder (50 g/kg)	0.780	0.381	0.247	0.247	0.414	27.330	21.140	16.663	15.000	20.033	0.560	0.821	0.886	0.892	0.790
T4- Neem leaf powder (50 g/kg)	0.760	0.324	0.230	0.230	0.386	26.300	21.467	17.440	14.440	19.912	0.570	0.835	0.895	0.896	0.799
T5 – Neem oil (5 ml/kg)	0.700	0.288	0.234	0.234	0.364	22.330	17.800	15.783	15.710	17.906	0.590	0.824	0.884	0.884	0.796
T6 – Castor oil (5 ml/kg)	0.720	0.319	0.289	0.289	0.404	23.000	19.233	18.850	18.790	19.968	0.573	0.774	0.805	0.816	0.742
T7 – Sweet flag rhizome (20 g/kg)	0.817	0.357	0.257	0.257	0.422	27.900	22.533	17.340	17.100	21.218	0.526	0.805	0.826	0.843	0.750
T8 – Malathion dust (5g/kg)	0.773	0.388	0.269	0.269	0.425	27.500	22.900	18.233	18.170	21.701	0.540	0.748	0.797	0.816	0.725
T9 – Thiram (2 g/kg)	0.782	0.392	0.279	0.279	0.433	27.650	22.950	18.471	18.370	21.860	0.532	0.730	0.807	0.816	0.721
T10 - Control	0.726	0.338	0.234	0.234	0.383	24.070	19.950	16.400	16.400	19.205	0.590	0.889	0.993	0.996	0.867
Mean	0.727	0.357	0.248	0.248	0.395	24.260	21.062	17.297	16.640	19.815	0.582	0.800	0.870	0.881	0.783
S.Em±	0.011	0.014	0.007	0.007		0.331	0.418	0.318	0.309		0.011	0.008	0.005	0.005	
CD (P=0.01)	0.044	0.054	0.029	0.027		1.293	1.683	1.279	1.245		0.045	0.032	0.021	0.021	

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