EFFECT OF ORGANIC SEED TREATMENT ON STORABILITY OF WHEAT

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ABSTRACT

An experiment was carried out to know the effect of seed treatment with plant products and deltamethrin on storability of wheat seeds at the Department of seed Science and Technology, College of Agriculture, Junaagdh Agricultural University, Junagadh. The results revealed that the botanicals were significantly superior and maintaining higher seed viability and vigour up to 20 months of storage when compared to untreated control and deltamethrin. Among all the botanicals, significantly the highest germination (94.67%) was recorded in the treatment T_7 (Neem Leaf Powder @ 5g/kg of seed) after 20 months of storage and it was at par with treatment T_6 (Neem Leaf Powder @ 5g/kg of seed). In addition to that T_3 (Sweet Flag Rhizome Powder @ 2g/kg seed), T_2 (Sweet Flag Rhizome Powder @ 5g/kg seed) and T_5 (Neem Seed Kernel Powder @ 2g/kg of seed) recorded a germination percentage of 86.00, 85.67 and 85.67 per cent (Above ISTA standard, > 85 % in wheat), respectively, after 20 months of storage. These treatments also had higher seed vigour index (length and mass) after 20 months of storage.

KEY WORDS: Botanicals, seed treatment, storability, wheat

INTRODUCTION

In India, wheat is the second most important cereal crop next to rice and a key crop of the green revolution and post green revolution era. India stands second among wheat producing countries with respect to area and production. Wheat attained its premier position by virtue of its unique protein gluten, which is responsible for bread making properties of wheat flour.

In storage, viability and vigour of the seeds is regulated by many physico-chemical factors like moisture content of seed, atmospheric relative humidity, temperature, initial seed quality, physical and chemical composition of seed, gaseous exchange, storage structure, packaging materials (Doijode, 1988). Storage of seed till next sowing season is essential part of seed industry. In general, cereals are more susceptible to storage pests and wheat is no exception. Because of its high protein content wheat, seed is attacked by storage pest and other microflora. The rice weevil (*Sitophilus oryzae*), causes considerable damage to the seed during storage and deteriorate the quality of seed. Apart from this, fungi associated with stored seeds are chiefly responsible for deterioration of seed quality. In order to prevent the quantitative and qualitative losses due to storage pests and diseases, several methods such as storage in safe conditions and containers with safe moisture levels and seed treatment with suitable chemicals or plant products *etc.* are being adopted.

An era of synthetic chemicals came with the several insecticides and fungicides, which successfully manage the infestation caused by insects, fungi and other microflora. But, the descriptive use of chemicals and their residual toxicity

adversely affects the non target animals including human beings besides affecting the seed quality. Hence, the safe and feasible approach is the treatment of seeds with botanicals which are safe, eco-friendly, economical and easily available. It will be of immense use to the farming community and seed industry that how the higher seed yield and quality seeds can be produced by using organics and how best seeds can be stored by treating the seeds with botanicals under ambient condition with minimum qualitative and quantitative losses. Information on these aspects in wheat is meagre. Rhizomes of sweet flag *Acorus calamus* L. (Acoracae), possesses insecticidal properties against a wide variety of insect pests. The powder and extracted oil of rhizomes act as stomach/contact poison, anti-feedant and repellent. The toxic and sterilizing effects of vapours of rhizome oil against certain insect pests have also been observed (Schmidt *et al.,* 1991). The insecticidal property of sweet flag was reviewed by Balakumbahan *et al*. (2010). Hence, in the present investigation, sweet flag rhizome powder was evaluated as seed treatment along with other natural organic product like neem seed kernel powder, neem leaf powder and neem oil along with deltamethrin for safe storage of wheat seeds.

MATERIALS AND METHODS

The present investigation was carried out in Laboratory of the Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh from the May 2014 to April, 2016. wherein two kg of freshly harvested quality seed of wheat cv. Gujarat Wheat 366 (GW 366) having high germination percentage and low moisture content (below 8%) was taken for each repetition and treated as per following treatments *viz*., T_1 = Control (Untreated), T_2 = Sweet Flag Rhizome Powder @ 2g/kg of seed, T_3 = Sweet Flag Rhizome Powder @ 5g/kg of seed, T_4 = Neem Seed Kernel Powder @ 2g/kg Seed, T_5 = Neem Seed Kernel Powder @ 5g/kg Seed, T_6 = Neem leaf powder @ 2g / kg seed, T_7 = Neem leaf powder @ 5g / kg seed, T_8 = Neem Oil @ 2ml/kg seed, T_9 = Neem Oil @ 5ml/kg seed, and T_{10} = Deltamethrin 2.8 EC @ 0.5 ml/kg of seed. The experiment was carried out using Completely Randomized Design (CRD) repeated three times. After proper mixing or smearing, seeds were packed and kept in laboratory under ambient condition. Observations were recorded at bimonthly interval on germination (%), root length (cm), shoot length (cm), seedling dry weight (g), seed vigour index I, seed vigour index II and seed moisture content (%). The infestation/ damage in the seed (%) and number of insect/pest (live or dead) were also measured. Germination test was carried out using paper towel technique as per the procedure given by ISTA (1999). Germinated seedlings were selected from each replication of the treatment for calculating the seedling vigor index. The seedling vigor index (length and mass) was calculated by using the following formula (Abdul-Baki and Anderson, 1973). The shoot and root length of each of the 10 seedlings were measured in centimeters. Seedling dry weight was measured of all the germinated seedlings after oven drying. The data were statistically analyzed as per the method of Cochran and Cox (1957) for Completely Randomized Design (CRD).

RESULTS AND DISCUSSION

Germination (%)

The results presented in Table 1 indicated that treatments exhibited significant differences for germination per cent after 20 months of storage. Among all the treatments, significantly the highest germination (94.67%) was recorded in the treatment T_7 (Neem Leaf Powder @ 5g/kg of seed) after 20 months of storage and it was at par with treatment T_6 (Neem Leaf Powder @ 5g/kg of seed). In addition to that T_3 (Sweet Flag Rhizome Powder @ 2g/kg seed), T_2 (Sweet Flag Rhizome

Powder @ 2g/kg seed) and T_5 (Neem Seed Kernel Powder @ 2g/kg of seed) recorded a germination percentage of 86.00, 85.67 and 85.67 per cent (Above ISTA standard, > 85 % in wheat), respectively. Significantly the lowest germination (46.67%) was recorded in the treatment T_9 (Neem Oil @ 5.0 ml/kg of seed) after 20 months of storage.

Root length (cm)

The results presented in Table 2 indicated that treatments exhibited significant differences for root length after 20 months of storage. Among all the treatments, highest root length (6.09 cm) was recorded in the treatment T_2 (Sweet Flag Rhizome Powder @ 2g/kg seed), while lowest root length (4.73 cm) was recorded in T_5 (Neem Seed Kernel Powder @ 5g/kg of seed) after 20 months of storage.

Shoot length (cm)

The results presented in Table 3 indicated that treatments exhibited significant differences for shoot length after 20 months of storage. Among all the treatments, significantly the highest shoot length (4.53 cm) was recorded in the treatment T_9 (Neem Oil @ 5.0 ml/kg of seed), while significantly the lowest shoot length (3.69 cm) was recorded in the treatment T_7 (Neem Leaf Powder @ 5g/kg of seed) after 20 months of storage.

Seedling dry weight (g)

The results presented in Table 4 indicated that treatments exhibited significant differences for seedling dry weight after 20 months of storage. Among all the treatments, significantly the highest seedling dry weight (4.36 g) was recorded in the treatment T_7 (Neem Leaf Powder @ 5g/kg of seed). Significantly the lowest seedling dry weight (2.33 g) was recorded in the treatment T_9 (Neem Oil @ 5.0 ml/kg of seed) after 20 months of storage.

Seed Vigour Index I

The results presented in Table 5 indicated that treatments exhibited significant differences for seed vigour index I after 20 months of storage. Among all the treatments, significantly the highest seed vigour index I (898.86) was recorded in the treatment T_2 (Sweet Flag Rhizome Powder @ 2g/kg seed) after 20 months of storage and it was at par with treatment T_3 (Sweet Flag Rhizome Powder @ 2g/kg seed), T_7 (Neem Leaf Powder @ 5g/kg of seed), T_4 (Neem Seed Kernel Powder @ 2g/kg of seed) and T_6 (Neem Leaf Powder @ 5g/kg of seed) with a seed Vigour Index I of 892.22, 845.59, 845.26 and 844.82, respectively. Significantly the lowest seed vigour index I (478.99) was recorded in the treatment T_9 (Neem Oil @ 5.0 ml/kg of seed) after 20 months of storage.

Seed Vigour Index II

The results presented in Table 6 indicated that treatments exhibited significant differences for seed vigour index II after 20 months of storage. Among all the treatments, significantly the highest seed vigour index II (413.19) was recorded in the treatment T_7 (Neem Leaf Powder @ 5g/kg of seed) after 20 months of storage and it was at par with treatment T_6 (Neem Leaf Powder @ 5g/kg of seed) with a seed vigour index II of 399.32. Treatments T_2 (Sweet Flag Rhizome Powder @ 2g/kg seed), T_3 (Sweet Flag Rhizome Powder @ 2g/kg seed), T_4 (Neem Leaf Powder @ 2g/kg of seed) and T_5 (Neem Seed Kernel Powder @ 5g/kg seed) recorded a seed Vigour Index II of more than 300. 00 were also the best treatments. Significantly the lowest seed vigour index II (109.24) was recorded in the treatment T_9 (Neem Oil @ 5.0 ml/kg of seed) after 20 months of storage.

Seed moisture (%)

The results presented in Table 7 indicated that treatments exhibited non-significant differences for seed moisture content after 20 months of storage. Among all the treatments, highest seed moisture content (9.03 %) was recorded in the treatment T_2 (Sweet Flag Rhizome Powder @ 2g/kg of seed), while the lowest seed moisture content (8.01%) was recorded in the treatment T_8 (Neem Oil @ 2.0 ml/kg of seed) after 20 months of storage.

Seed Damage and Number of Insect pest (Live or Dead)

There is no infestation in the seed and no insect pest population as well as seed damage was observed in stored sample during the storage.

The better seed quality parameters observed with botanicals seed treatments may be because of no insect infestation noticed with these treatments. The insects not only eat the storage food in the seed, but also eat the germ, leading to death of the seed and hence, result in poor seed germination and lower vigour (Deshpande *et al*., 2004). The other botanicals *viz*., neem leaf powder, neem seed kernel powder and sweet flag rhizome powder also recorded higher root and shhot length, seedling dry weight as well as seed vigour index (length and mass) over untreated control. These botanicals because of their insecticidal property, prevents the seeds from insect attack and thus, leads to better seed quality parameters (Merwade, 2000; Channabasanagowda *et al*., 2008; Hamane *et al*., 2015). Similar beneficial effect of botonicals in controlling insect attack during storage has been observed in cowpea (Maraddi, 2002) and pea seeds (Umrao and Verma, 2002). Abdul-Rafiu (2006) found that there is no any infestation of storage pest in neem based treatments. Mandali and Reddy (2014) reported that neem formulations were safer seed protectants for long term storage of redgram against *Callosobruchus chinensis.*

The superiority of botanicals might be due to the fact that, these treatments keep the seeds intact as it acts as 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 insecticidal property present in the botanicals also helps in making the seeds incompatible for insects during storage (Maraddi, 2002). Similar beneficial effect of sweet flag rhizome powder in protecting seeds from attack of *Rhizoperta dominica* (lesser grain bore) and *Sitophilus oryzae* (rice weevil) throughout the storage period next to seed treatment with deltamethrin was observed in wheat by Biradar (2000).

Use of botanicals as seed treatment is advisable because of their safety to human health. The botanicals also have same insecticidal property as that of chemicals and can maintain the viability and vigour of seed for long period. The main advantage of treating seeds with botanicals over chemicals is that, the seeds treated with botanicals if left can be reused for consumption purpose after washing with water, whereas, it could not be possible in seeds treated with chemicals which has residual toxic effect on the human beings and animals (Channabasanagowda *et al*., 2008).

CONCLUSION

From the results and discussion, it can be concluded that wheat seed may be stored under ambient storage condition packed with cloth bag with seed treatment of Neem Leaf Powder @ 2-5g/kg of seed or Sweet Flag Rhizome Powder @ 2-5g/kg of seed or Neem Seed Kernel Powder @ 2 g/kg seed for a period of 20 months without deterioration in germination and seedling vigour.

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Table 1: Effects of various organic seed treatments on germination (%)

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	99.33	96.67	92.67	90.00	98.00	83.00	73.00	65.67	60.00	61.00	55.67	59.67
T_2	99.00	98.00	91.00	80.33	98.00	98.00	91.33	94.00	95.00	**85.67**	81.00	82.33
T_3	97.67	97.67	91.00	83.67	96.67	98.00	95.67	91.33	93.00	**86.00**	80.00	78.67
T_4	98.33	98.00	97.67	93.33	93.33	86.67	96.67	74.67	95.33	**85.67**	82.67	72.33
T_5	87.00	98.00	96.00	92.00	94.33	96.67	96.67	84.33	84.00	83.00	78.67	73.33
T_6	97.33	90.00	93.67	90.33	97.33	98.00	92.67	82.00	92.00	**94.00**	86.34	78.67
T_7	95.00	92.67	87.67	93.66	95.33	90.67	92.00	92.67	94.00	**94.67**	87.00	79.33
T_8	92.67	95.33	89.67	89.00	94.33	82.67	71.33	66.33	63.33	62.67	48.00	36.67
T_9	97.00	92.33	84.67	66.00	86.33	81.00	64.00	63.67	55.00	**46.67**	46.67	35.33
T_{10}	97.67	96.00	93.33	94.67	98.00	96.67	91.33	78.67	84.33	81.00	78.33	74.67
Mean	**96.10**	**95.47**	**91.74**	**87.30**	**95.17**	**91.14**	**86.47**	**79.33**	**81.60**	**78.03**	**72.44**	**82.9**
S. Em. ±	1.37	0.83	0.84	2.55	1.27	1.58	1.97	2.18	3.49	1.86	1.96	4.11
C.D. at 5%	4.06	2.47	2.51	7.57	3.77	4.69	5.85	6.48	10.38	5.52	5.81	12.21
CV %	2.46	1.51	1.59	5.06	2.31	3.00	3.95	4.76	7.41	4.13	4.68	10.60

Table 2: Effects of various organic seed treatments on root length

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	13.15	12.78	13.34	9.89	14.11	6.01	6.03	6.69	6.36	5.57	3.81	3.29
T_2	12.25	12.16	13.15	7.83	15.89	6.21	6.03	6.66	6.39	**6.09**	3.17	3.22
T_3	13.11	12.73	12.98	11.15	14.56	7.21	6.24	7.07	6.97	6.06	3.05	3.14
T_4	12.87	12.61	13.09	10.99	13.46	5.71	5.96	6.41	6.34	5.79	4.04	3.66
T_5	12.42	11.9	12.23	12.09	14.75	6.41	5.96	6.84	6.60	**4.73**	3.07	3.59
T_6	13.06	13.07	13.59	12.49	14.78	6.68	6.78	6.76	6.54	5.17	3.31	3.01
T_7	12.85	12.89	12.71	12.48	14.96	6.37	6.27	6.28	6.39	5.23	3.94	3.24
T_8	13.61	13.17	13.58	11.58	14.89	6.52	5.64	6.14	6.37	5.44	4.30	3.40
T_9	12.86	12.3	12.72	12.11	14.86	5.68	5.84	6.26	6.44	5.72	4.47	3.20
T_{10}	13.6	12.83	13.12	12.62	15.11	6.1	6.38	6.59	6.71	5.71	3.63	3.53
Mean	**12.98**	**12.64**	**13.05**	**11.32**	**14.74**	**6.29**	**6.11**	**6.57**	**6.51**	**5.55**	**3.67**	**3.33**
S. Em. ±	0.31	0.32	0.31	0.34	0.19	0.13	0.19	0.14	0.24	0.13	0.23	0.34
C.D. at 5%	NS	NS	NS	1	0.56	0.39	0.58	0.42	NS	0.39	0.69	NS
CV %	4.17	4.42	4.15	5.16	2.2	3.63	5.5	3.77	6.36	4.07	10.94	15.05

Table 3: Effects of various organic seed treatments on shoot length

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	6.43	6.16	6.58	5.10	6.61	4.76	4.34	4.51	4.76	4.30	3.22	3.06
T_2	6.71	5.61	5.81	4.40	6.81	6.30	4.81	4.40	4.71	4.41	2.81	2.64
T_3	6.46	5.98	6.16	4.45	6.09	6.27	4.70	4.01	4.58	4.31	3.26	2.66
T_4	5.93	5.33	5.96	4.43	6.90	5.97	4.32	0.04	5.22	4.08	2.90	2.48
T_5	6.17	4.96	5.11	4.45	7.25	5.61	5.16	4.28	5.00	4.35	2.85	2.87
T_6	7.62	6.25	6.49	4.70	7.08	5.49	5.22	3.80	4.21	3.82	3.04	2.97
T_7	6.86	5.81	5.77	5.15	7.07	6.05	4.64	3.62	4.21	**3.69**	3.30	3.39
T_8	7.15	6.10	6.45	4.47	7.44	6.29	3.79	3.61	4.42	4.17	3.99	3.96
T_9	7.77	6.28	6.52	4.81	6.80	5.82	4.17	3.48	5.45	**4.53**	3.34	2.35
T_{10}	7.19	6.12	6.51	4.30	7.46	6.50	3.17	4.43	4.72	4.47	3.01	2.32
Mean	**6.83**	**5.86**	**6.14**	**4.63**	**6.95**	**5.91**	**4.43**	**3.62**	**4.73**	**4.21**	**3.17**	**2.87**
S. Em. ±	0.19	0.22	0.12	0.03	0.08	0.13	0.22	0.28	0.33	0.17	0.17	0.18
C.D. at 5%	0.57	0.65	0.37	0.10	0.24	0.37	0.65	NS	NS	0.51	0.52	0.55
CV %	4.85	6.49	3.49	1.31	2.02	3.69	8.68	12.04	12.23	7.09	9.59	8.70

Table 4: Effects of various organic seed treatments on seedling dry weight

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	4.03	4.48	3.63	3.73	3.50	3.26	4.15	3.81	4.29	4.22	2.48	**2.23**
T_2	3.82	4.68	4.09	3.30	3.64	4.30	3.97	4.47	4.56	3.66	3.05	**2.22**
T_3	3.96	4.51	3.67	3.37	4.15	4.29	4.51	3.89	4.31	2.80	3.20	**2.24**
T_4	4.17	4.23	3.70	3.82	3.66	3.74	4.15	3.57	4.13	3.76	3.14	**2.18**
T_5	3.93	4.31	3.83	3.28	3.75	4.50	3.87	3.73	4.03	3.81	3.03	**2.23**
T_6	3.77	4.17	3.37	3.69	3.72	4.38	4.05	4.13	4.09	4.25	3.07	**2.23**
T_7	3.92	4.43	3.97	3.65	3.77	3.87	4.33	4.94	4.51	**4.36**	2.80	**2.23**
T_8	4.05	4.49	3.51	3.56	3.83	4.59	4.10	4.23	3.42	3.25	2.28	**2.23**
T_9	4.10	3.91	3.29	2.99	3.48	3.69	3.61	4.97	2.55	**2.33**	2.47	2.19
T_{10}	4.42	4.77	3.50	4.10	3.97	4.12	4.25	3.81	3.55	4.09	2.94	**2.23**
Mean	**4.02**	**4.40**	**3.66**	**3.55**	**3.75**	**4.07**	**4.10**	**4.16**	**3.94**	**3.65**	**2.84**	**2.22**
S. Em. ±	0.15	0.08	0.07	0.14	0.10	0.14	0.13	0.38	0.11	0.24	0.15	0.02
C.D. at 5%	NS	0.25	0.21	0.42	0.30	0.41	0.39	NS	0.33	0.71	0.45	0.03
CV %	6.41	3.24	3.33	6.88	4.69	5.84	5.56	15.98	4.84	11.26	9.34	8.57

Table 5: Effects of various organic seed treatments on seed vigour index I

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	1947.10	1830.64	1845.93	1348.90	2030.56	894.26	756.72	736.37	668.71	600.59	391.17	378.90
T_2	1875.39	1741.13	1725.38	982.53	2224.60	1226.31	989.89	1040.27	1055.44	**898.86**	484.26	482.45
T_3	1911.28	1827.47	1741.17	1311.96	1996.09	1321.37	1046.32	1011.77	1072.42	**892.22**	505.20	456.29
T_4	1849.03	1758.12	1860.74	1439.28	1940.05	1012.45	994.21	781.38	1103.19	**845.26**	575.25	444.11
T_5	1618.70	1651.95	1665.28	1521.07	2075.07	1161.72	1074.67	937.69	980.57	753.85	466.20	473.71
T_6	2012.50	1739.04	1881.31	1553.58	2128.30	1192.33	1111.89	865.65	988.39	**844.82**	547.91	470.45
T_7	1947.63	1733.61	1619.44	1650.84	2100.19	1126.75	1004.12	917.98	997.32	**845.59**	626.27	525.96
T_8	1924.23	1837.06	1796.04	1428.47	2106.70	1058.90	672.97	645.90	683.53	602.53	377.38	269.89
T_9	2001.11	1715.04	1628.23	1118.38	1870.76	931.81	638.64	619.08	659.23	**478.99**	363.70	196.08
T_{10}	2030.49	1818.88	1831.79	1602.15	2212.19	1218.54	875.04	866.73	963.13	824.86	520.06	436.82
Mean	**1911.75**	**1765.29**	**1759.53**	**1395.72**	**2068.45**	**1114.44**	**916.45**	**842.28**	**917.19**	**758.76**	**485.74**	**413.47**
S. Em. ±	43.46	38.74	29.70	61.42	29.78	28.44	38.27	33.97	59.33	25.16	24.64	26.10
C.D. at 5%	129.11	115.09	88.23	182.46	88.47	84.50	113.69	100.92	176.26	74.73	73.20	77.53
CV %	3.94	3.80	2.92	7.62	2.49	4.42	7.23	6.99	11.20	5.74	8.78	15.54

Table 6: Effects of various organic seed treatments on seed vigour index II

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	400.40	436.25	336.72	335.83	343.00	270.83	302.91	250.67	257.21	258.08	137.70	133.06
T_2	378.18	458.64	372.33	265.11	356.72	421.40	362.33	420.49	433.54	**313.73**	247.33	182.77
T_3	386.44	440.81	333.67	283.47	401.32	420.09	431.27	355.59	401.05	**241.33**	256.07	176.22
T_4	409.71	414.87	361.37	357.28	348.76	324.41	401.39	266.39	394.08	**321.79**	259.83	157.68
T_5	342.76	422.05	367.36	301.76	354.32	435.04	373.97	313.23	340.03	**315.65**	238.37	163.53
T_6	367.27	374.80	315.57	333.95	361.72	429.24	375.65	338.39	376.53	**399.32**	265.70	175.43
T_7	385.80	410.53	348.90	342.39	359.63	429.24	398.84	456.89	423.64	**413.19**	242.88	176.91
T_8	375.65	428.36	315.00	317.18	360.98	351.97	292.29	280.75	216.60	203.28	109.43	81.77
T_9	397.38	360.85	279.04	198.32	300.57	378.77	230.92	318.10	143.37	**109.24**	116.48	77.37
T_{10}	431.75	441.92	326.99	388.41	372.07	298.66	388.29	300.75	299.79	331.28	230.60	166.51
Mean	**387.53**	**418.91**	**335.70**	**312.37**	**355.91**	**375.96**	**355.79**	**330.12**	**328.58**	**290.69**	**210.43**	**149.13**
S. Em. ±	15.56	7.08	7.57	18.69	11.01	14.70	16.61	29.99	18.49	21.99	12.95	11.34
C.D. at 5%	46.22	21.02	22.49	55.51	32.71	43.67	49.35	89.10	54.94	65.34	38.48	33.69
CV %	6.95	2.93	3.91	10.36	5.36	6.83	8.09	15.74	9.75	13.10	10.66	15.68

Table 7: Effects of various organic seed treatments on seed moisture content (%)

Treatment /Period	2 Month	4 Month	6 Month	8 Month	10 Month	12 Month	14 Month	16 Month	18 Month	20 Month	22 Month	24 Month
T_1	5.70	9.70	9.03	9.04	8.42	7.52	8.07	9.51	7.77	8.84	8.10	7.62
T_2	6.26	9.37	9.04	9.18	8.87	7.45	8.93	8.91	9.14	**9.03**	7.56	7.82
T_3	6.26	9.76	9.69	8.67	8.23	7.48	8.27	10.00	7.92	8.37	7.98	7.77
T_4	6.15	8.89	8.79	8.68	8.90	7.48	8.12	8.97	8.58	8.31	8.06	7.25
T_5	5.59	9.70	9.79	9.11	8.95	8.04	8.27	9.33	8.46	8.92	7.91	7.82
T_6	5.59	9.51	9.03	8.56	8.65	8.17	8.74	8.82	7.95	8.34	7.92	6.73
T_7	6.44	9.15	9.11	9.06	8.23	8.17	8.71	9.20	8.04	8.64	7.36	7.23
T_8	6.60	9.54	8.71	8.82	8.27	7.57	8.12	9.62	7.85	**8.01**	7.52	7.24
T_9	5.66	8.94	8.87	8.39	8.84	7.83	8.80	8.91	8.31	8.32	7.37	7.27
T_{10}	5.63	9.49	9.15	9.49	9.12	8.02	9.01	9.34	8.55	8.49	7.38	6.83
Mean	**5.99**	**9.41**	**9.12**	**8.90**	**8.65**	**7.77**	**8.51**	**9.26**	**8.26**	**8.53**	**7.71**	**7.35**
S. Em. ±	0.09	0.10	0.05	0.06	0.09	0.07	0.06	0.09	0.06	0.34	0.04	0.06
C.D. at 5%	0.28	0.30	0.14	0.19	0.26	0.22	0.19	0.27	0.18	NS	0.13	0.17
CV %	2.70	1.88	0.87	1.25	1.73	1.64	1.28	1.72	1.29	6.98	0.98	1.35

[MS received : May 11, 2017] *[MS accepted : May 22, 2017]*