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Effect of Drip Fertigation Pigeonpea Resultant Seed on Seed Storage

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Abstract- The present Investigation was carried out to elucidate the storability of drip fertigation resultant seeds of pigeonpea (cv.VBN 3).The laboratory studies were conducted at Agricultural College and Research Institute, Madurai, during 2011. The study on resultant seed storability revealed that, among the 13 treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} were good storers, while T_1, T_2, T_3 and T_{13} were medium storers. Whereas seeds stored in polyethylene bag maintained a germination of 93.0 per cent after nine months of storage and the seed quality characters in terms of physiological and biochemical parameters decreased with ageing irrespective of treatment and containers.

Index Terms- Pigeonpea, Resultant seed, Storage, Containers, Physiological, Biochemical, Quality

I. Introduction

Pigeonpea is the most widely grown crop in the country and has been under cultivation for over three thousand years. With 22 per cent protein, which is almost three times that of cereals, pigeonpea supplies a major share of protein requirement of the predominantly vegetarian population in the country. The biological value improves greatly, when wheat or rice is combined with pigeonpea because of the complementary relationship of the essential amino acids. It is particularly rich in lysine, riboflavin, thiamine, niacin and iron. Pigeonpea is one of the most sensitive seeds susceptible to significant deterioration after year's storage. Pigeonpea like other protenious seeds is more prone to deterioration due to its higher protein content (Powell et al. 2000). Seeds are required to be kept in safe storage since they are harvested in the preceding season and usually used for sowing in the subsequent season often after a time gap of six months or longer. During the aging process, seeds lose their vigor, ability to germinate and ultimately become less viable (Maity et al. 2000). Losses in seed quality occur during field weathering, harvesting and storage. The losses are exacerbated if seeds are stored at high temperatures and or conditions of high relative humidity. Losses in seed quality occur during field weathering, harvesting and storage. Several intrinsic and extrinsic factors influence the viability of seeds during storage. Among intrinsic and extrinsic factors, seed moisture content, relative humidity, temperature of storage, pests and diseases and oxygen availability are more important. Deterioration of seed is a natural process which is inevitable, inexorable and irreversible but the rate of deterioration of seed may differ due to genetic factor (Wittington, 1978), storage environment and period of storage (Reddy, 1985) and seed treatment (Zhang *et al.*, 1989). Polyethylene and aluminum foil materials were moderately effective in preventing moisture uptake and maintaining seed viability, while paper and cloth containers were least effective (Wilson and McDonald, 1992). Seed deterioration is an inexorable and an irreversible process. One of symptom of seed deterioration is membrane deterioration (Copeland and McDonald, 1995). Hence, present studies were undertaken to assess the performance of drip fertigation pigeonpea resultant seed quality on seed storage under ambient conditions.

II. Materials and Methods

The experiment was conducted at Agricultural College and Research Institute, Madurai during 2011. After harvest the pigeonpea resultant seeds were subjected to storage under ambient conditions and present findings clearly brought out the better performance of resultant seeds from drip fertigation treatments. In a laboratory experiment the bulk seeds of resultant seeds were separated based on the drip fertigation treatments wise and seeds were treated with bavistin @ 2 g kg^{-1} along with control and were packed in different storage containers as below after the initial quality evaluations. The drip fertigation treatments details are given below.

Treatment details of resultant seeds

T_1 (F_1FS_1)	:	50 % of SRDF through drip + Foliar spray of 0.5 per cent Zinc sulphate
T_2 (F_1FS_2)	:	50 % of SRDF through drip + Foliar spray of 100 ppm Succinic acid
T_3 (F_1FS_3)	:	50 % of SRDF through drip + Foliar spray of 100 ppm Humic acid
T_4 (F_2FS_1)	:	75 % of SRDF through drip + Foliar spray of 0.5 per cent Zinc sulphate
T_5 (F_2FS_2)	:	75 % of SRDF through drip + Foliar spray of 100 ppm Succinic acid
T_6 (F_2FS_3)	:	75 % of SRDF through drip + Foliar spray of 100 ppm Humic acid
T_7 (F_3FS_1)	:	100 % of SRDF through drip + Foliar spray of 0.5 per cent Zinc sulphate
T_8 (F_3FS_2)	:	100 % of SRDF through drip + Foliar spray of 100 ppm Succinic acid
T_9 (F_3FS_3)	:	100 % of SRDF through drip + Foliar spray of 100 ppm Humic acid

T_{10} (F_4FS_1)	:	150 % of SRDF through drip + Foliar spray of 0.5 per cent Zinc sulphate
T_{11} (F_4FS_2)	:	150 % of SRDF through drip + Foliar spray of 100 ppm Succinic acid
T_{12} (F_4FS_3)	:	150 % of SRDF through drip + Foliar spray of 100 ppm Humic acid
Control	:	Surface irrigation with SRDF of 25:50:25 NPK kg ha^{-1} by two splits.

SRDF : Seed crop Recommended Dose of Fertilizer

Storage Containers
C1- Cloth bag
C2- High Density Polyethylene (HDPE) bag

Then the seed samples were drawn at tri monthly intervals and evaluated for the following seed and seedling characters upto nine months. The following Physiological and biochemical seed characters were evaluated *viz.,*

Physiological seed characters

Seed Germination (%) for seedling characters, the germination test was conducted using three replications of 100 seeds from each sample in rolled towel papers as per procedure described by ISTA (1999 b).

Vigour index: vigour index were determined by Abdul Baki and Anderson (1973).
In order to calculate Vigour Index formula were used:
V. I. = Germination percentage (Normal seedling) X Seedling length (cm)

Biochemical seed characters

Electrical conductivity (dSm^{-1})

Pigeonpea seeds were washed with deionised water and the electrical conductivity was measured in duplicate after Presley (1958) with modification as detailed below using Elico conductivity meter (cell constant 1) and expressed in dSm^{-1}. After measuring the EC, the seed leachate was used for the following assessment**.**

• Leachate amino acids (µg g^{-1})	:	Method described by Moore and Stein, (1948).
• Lipid Peroxidation (OD value)	:	Lipid peroxide formation in pigeonpea was studied by the Thiobarbituric acid (TBA) colour reaction outlined by Bernheim *et al*., (1948).

The data pertaining to the experiment were subjected to statistical analysis by analysis of variance method as suggested by Gomez and Gomez (1984).

III. Results and Discussion

The storage of seed assumes paramount importance in a seed production programme. The storability of seed is influenced by several factors. Besides the chemical composition (Maranvilla and Clegg, 1977), seed treatments and the containers used for storage also decide the shelf life of seeds under ambient conditions (Vijayakumar *et al.*, 1991). Hence in the present study the drip fertigation resultant pigeonpea seeds were evaluated initially and at tri monthly intervals up to 9 months through different physiological and biochemical seed quality parameters.The moisture content of the seed plays a prime role in determination of storability of any seed and it increased with advance in storage period (Copeland and Mcdonald, 1995). However the fluctuation in moisture content of the present study irrespective of containers was increased to a tune of 9.0 to 9.9 per cent in cloth bag. This slighter increase in seed moisture within nine months might be due to lower level of environmental fluctuations of relative humidity and temperature during the storage period as supported by Agrawal (1995). The seed germination is the basic factor that decides the storability of seeds in all kinds of crop (Abdalla and Roberts, 1969). The germination percentage of the seeds harvested from drip fertigation resultant seeds did show significant difference due to drip fertigation treatment and containers and their interaction effect. Among the seed treatments, the following treatments were better T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} and recorded the maximum germination (89.0 %). However the minimum germination was observed with T_1, T_2, T_3 and T_{13} (86.0 %). Among the containers, polyethylene bags showed significant maximum germination of 93.0 per cent followed by cloth bag 83.0 per cent (Table 1). Similar results were reported by Renugadevi (2004) reported that clusterbean seeds treated with bavistin @ 2g/kg of seed and packed in 700 gauge polyethylene bag maintained the seed quality characters upto 18 months with 88 per cent germination which was 18 per cent higher than MSCS level of seed germination. The same results were observed by Shenbaganathan (2002) in greengram. Similar results were reported by Gharib *et al.* (2009) who revealed that application of 86 kg N/ha coupled with the 7 or 14 days irrigation intervals resulted in significantly higher seed storability up to 12 month in wheat.

The vigour index values determined were relatively higher in seedlings derived from the following treatments T_4, T_5, T_6, T_7,T_8, T_9, T_{10}, T_{11} and T_{12} and recorded higher values ranging between (4524 to 4644) vigour index and were all relatively higher compared to T_1, T_2, T_3 and T_{13}. Relatively higher values were recorded by seeds derived from the T_4, T_5, T_6, T_7, T8, T_9, T_{10}, T_{11} and T_{12} seed stored in polyethylene bag than those from the seeds stored in cloth bags in the present study (Figure 1). This was in confirmation with the results of Periasamy (1994) who revealed that pigeonpea seeds of ICPH 8 hybrid and its parents dried to 8 per cent moisture content, treated with thiram + BHC 50 % WDP and packed in 700 gauge polyethylene container can be stored upto 8 months with high viability and vigour under ambient condition. The lower value for the vigour parameters of the seeds in cloth bag might be due to increase in moisture content and increased rate of deteriorative process occurring with the senescence of seeds due to ageing in storage.

Seed deterioration alters the semi-permeability properties of the membrane and membrane integrity (Berjack and Villiers, 1972). The electrical conductivity (dSm^{-1}) increased during storage irrespective of containers and seed treatments (0.199 to 0.250 dSm^{-1}). However, T_1, T_2, T_3 and T_{13} recorded the maximum electrical conductivity values ranging between (0.231

to 0.233 dSm^{-1}). Whereas, minimum electrical conductivity (dSm^{-1}) was observed with T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} (0.222 to 0.224 dSm^{-1}). Among the containers, polyethylene bags showed minimum electrical conductivity (0.219 dSm^{-1}) followed by cloth bag 0.232 dSm^{-1} (Table 2). Similar results was suggested by Krishna (2006) who reported that RDF treatment recorded significantly lesser electrical conductivity compared to those without fertilizer at the end of storage in rice and also by Tammanagouda (2002) observed that greengram seeds stored in polythene bag recorded lower electrical conductivity with increased germination and seedling length at the end of 10 months. The membrane integrity as reflected through leachate amino acids ranged between 48.14 to 48.78 $\mu g.g^{-1}$, lipid peroxidation (0.167 to 0.173) were least affected in treatments T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} compared to T_1, T_2, T_3 and T_{13}. In general, leachate amino acids and lipid peroxidation were relatively higher in cloth bag storage than polyethylene bag (Table 3 & 4). This is in reflection of seed deterioration caused due to impairment of membrane, since ageing of dried seeds in storage is thought to be accompanied by changes in the membrane and alterations in the membrane of aged seeds (Parrish and Leopold, 1978). Several studies support this finding (Punitha, 1996 and Posmyk *et al.,* 2001) Damage to membrane is one of the suggested explanations for loss of viability during ageing (Roberts, 1972).

IV. Conclusion

Studies on storability revealed that, Among the 13 treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} were good storers, while T_1, T_2, T_3 and T_{13} were medium storers. Whereas seeds stored in polyethylene bag maintained a germination of 93.0 per cent after nine months of storage and the seed quality characters in terms of physiological and biochemical characters degraded with ageing.

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Table 1. Influence of pigeonpea seed and containers on germination (%) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C_1)					Polyethylene bag (C_2)				
	P_1	P_2	P_3	P_4	Mean	P_1	P_2	P_3	P_4	Mean
T_1 (F_1FS_1)	93	87	77	65	81	93	92	90	88	91
T_2 (F_1FS_2)	93	87	77	65	81	93	92	90	88	91
T_3 (F_1FS_3)	93	87	77	65	81	93	92	90	88	91
T_4 (F_2FS_1)	96	90	80	68	84	96	95	93	91	94
T_5 (F_2FS_2)	96	90	80	68	84	96	95	93	91	94
T_6 (F_2FS_3)	96	90	80	68	84	96	95	93	91	94
T_7 (F_3FS_1)	96	90	80	68	84	96	95	93	91	94
T_8 (F_3FS_2)	96	90	80	68	84	96	95	93	91	94
T_9 (F_3FS_3)	96	90	80	68	84	96	95	93	91	94
T_{10} (F_4FS_1)	96	90	80	68	84	96	95	93	91	94
T_{11} (F_4FS_2)	96	90	80	68	84	96	95	93	91	94
T_{12} (F_4FS_3)	96	90	80	68	84	96	95	93	91	94
Control	93	87	77	65	81	93	92	90	88	91
Mean	95	89	79	67	83	95	94	92	90	93
Level of significance										
	P	C	T	T X P	P X C	T X C		T X P X C		
SEd	0.425	0.300	0.765	1.531	0.600	1.082		2.165		
CD(P=0.05)	0.842**	0.595**	1.518**	3.036*	1.191**	NS		NS		

Table 2. Influence of pigeonpea seed and containers on Electrical conductivity (dSm^{1}) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C_1)					Polyethylene bag (C_2)				
	P_1	P_2	P_3	P_4	Mean	P_1	P_2	P_3	P_4	Mean
T_1 (F_1FS_1)	0.210	0.225	0.245	0.268	0.237	0.210	0.219	0.230	0.239	0.225
T_2 (F_1FS_2)	0.212	0.226	0.246	0.269	0.238	0.212	0.221	0.232	0.241	0.227
T_3 (F_1FS_3)	0.212	0.225	0.245	0.268	0.238	0.212	0.221	0.232	0.241	0.227
T_4 (F_2FS_1)	0.194	0.220	0.240	0.263	0.229	0.194	0.212	0.223	0.232	0.215
T_5 (F_2FS_2)	0.198	0.221	0.241	0.264	0.231	0.198	0.212	0.222	0.231	0.216
T_6 (F_2FS_3)	0.193	0.223	0.238	0.261	0.229	0.193	0.213	0.224	0.233	0.216
T_7 (F_3FS_1)	0.190	0.221	0.241	0.264	0.229	0.190	0.214	0.224	0.233	0.215
T_8 (F_3FS_2)	0.194	0.222	0.242	0.265	0.231	0.194	0.215	0.226	0.235	0.218
T_9 (F_3FS_3)	0.193	0.221	0.242	0.265	0.230	0.193	0.216	0.224	0.233	0.217
T_{10} (F_4FS_1)	0.194	0.221	0.241	0.264	0.230	0.194	0.212	0.223	0.232	0.215
T_{11} (F_4FS_2)	0.192	0.223	0.242	0.265	0.231	0.192	0.213	0.224	0.233	0.216
T_{12} (F_4FS_3)	0.194	0.221	0.241	0.264	0.230	0.194	0.216	0.227	0.236	0.218
Control	0.213	0.226	0.246	0.269	0.239	0.213	0.222	0.235	0.242	0.228
Mean	0.199	0.223	0.242	0.265	0.232	0.199	0.216	0.227	0.235	0.219
Level of significance										
	P	C	T	T X P	P X C	T X C		T X P X C		
SEd	0.003	0.002	0.005	0.009	0.004	0.006		0.013		
CD(P=0.05)	0.005*	0.004**	0.009**	0.018*	0.007**	NS		NS		

Table 3. Influence of pigeonpea seed and containers on Leachate aminoacids (μg.g^{-1}) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C_1)					Polyethylene bag (C_2)				
	P_1	P_2	P_3	P_4	Mean	P_1	P_2	P_3	P_4	Mean
T_1 (F_1FS_1)	45.23	48.93	51.15	53.21	49.63	45.23	49.72	48.87	51.40	48.81
T_2 (F_1FS_2)	45.38	49.08	51.30	53.36	49.78	45.38	49.83	48.93	51.55	48.92
T_3 (F_1FS_3)	45.45	49.15	51.37	53.43	49.85	45.45	49.90	49.00	51.62	48.99
T_4 (F_2FS_1)	44.52	48.22	50.44	52.13	48.83	44.52	49.07	48.07	50.69	48.09
T_5 (F_2FS_2)	44.45	48.15	50.37	52.43	48.85	44.45	48.90	48.00	50.62	47.99
T_6 (F_2FS_3)	44.20	47.88	50.12	52.18	48.60	44.20	48.75	47.96	50.37	47.82
T_7 (F_3FS_1)	44.90	48.60	50.82	52.89	49.30	44.90	49.35	48.45	50.34	48.26
T_8 (F_3FS_2)	44.27	47.97	50.18	52.26	48.67	44.27	48.80	47.98	50.44	47.87
T_9 (F_3FS_3)	44.16	47.86	50.15	52.15	48.58	44.16	48.61	47.71	50.33	47.70
T_{10} (F_4FS_1)	44.37	48.07	50.28	52.36	48.77	44.37	48.82	47.92	50.54	47.91
T_{11} (F_4FS_2)	44.72	48.40	50.61	52.69	49.11	44.72	49.15	48.25	50.87	48.25
T_{12} (F_4FS_3)	44.52	48.22	50.43	52.51	48.92	44.52	49.02	48.07	50.69	48.08
Control	45.37	49.07	51.28	53.36	49.77	45.37	49.82	48.92	51.54	48.91
Mean	44.73	48.43	50.65	52.69	49.13	44.73	49.21	48.32	50.85	48.28
Level of significance										
	P	C	T	T X P	P X C	T X C		T X P X C		
SEd	0.228	0.161	0.411	0.821	0.322	0.581		1.161		
CD(P=0.05)	0.452**	0.319**	0.814**	1.628*	0.639**	1.151*		NS		

Table 4. Influence of pigeonpea seed and containers on Lipid peroxidation (OD value) during storage

Treatment	Container (C) and storage periods in months (P)									
	Cloth bag (C_1)					Polyethylene bag (C_2)				
	P_1	P_2	P_3	P_4	Mean	P_1	P_2	P_3	P_4	Mean
T_1 (F_1FS_1)	0.144	0.167	0.213	0.239	0.191	0.144	0.160	0.187	0.212	0.176
T_2 (F_1FS_2)	0.144	0.167	0.213	0.239	0.191	0.144	0.160	0.187	0.210	0.175
T_3 (F_1FS_3)	0.145	0.168	0.215	0.240	0.192	0.145	0.161	0.188	0.213	0.177
T_4 (F_2FS_1)	0.137	0.160	0.195	0.232	0.181	0.137	0.153	0.180	0.193	0.166
T_5 (F_2FS_2)	0.134	0.157	0.192	0.229	0.178	0.134	0.150	0.177	0.190	0.163
T_6 (F_2FS_3)	0.137	0.160	0.195	0.232	0.181	0.137	0.153	0.180	0.193	0.166
T_7 (F_3FS_1)	0.136	0.159	0.194	0.231	0.180	0.136	0.152	0.179	0.192	0.165
T_8 (F_3FS_2)	0.131	0.154	0.189	0.226	0.175	0.131	0.147	0.174	0.187	0.160
T_9 (F_3FS_3)	0.134	0.157	0.192	0.229	0.178	0.134	0.150	0.177	0.190	0.163
T_{10} (F_4FS_1)	0.135	0.158	0.193	0.230	0.179	0.135	0.151	0.178	0.191	0.164
T_{11} (F_4FS_2)	0.136	0.159	0.194	0.231	0.180	0.136	0.152	0.179	0.192	0.165
T_{12} (F_4FS_3)	0.134	0.157	0.192	0.229	0.178	0.134	0.150	0.177	0.190	0.163
Control	0.145	0.168	0.213	0.240	0.192	0.145	0.161	0.188	0.212	0.177
Mean	0.138	0.161	0.199	0.233	0.183	0.138	0.154	0.181	0.197	0.167
Level of significance										
	P	C	T	T X P	P X C	T X C		T X P X C		
SEd	0.0003	0.0002	0.0005	0.0010	0.0004	0.0007		0.0014		
CD(P=0.05)	0.0006**	0.0004**	0.0010**	0.0020**	0.0008**	0.0014**		0.0028**		

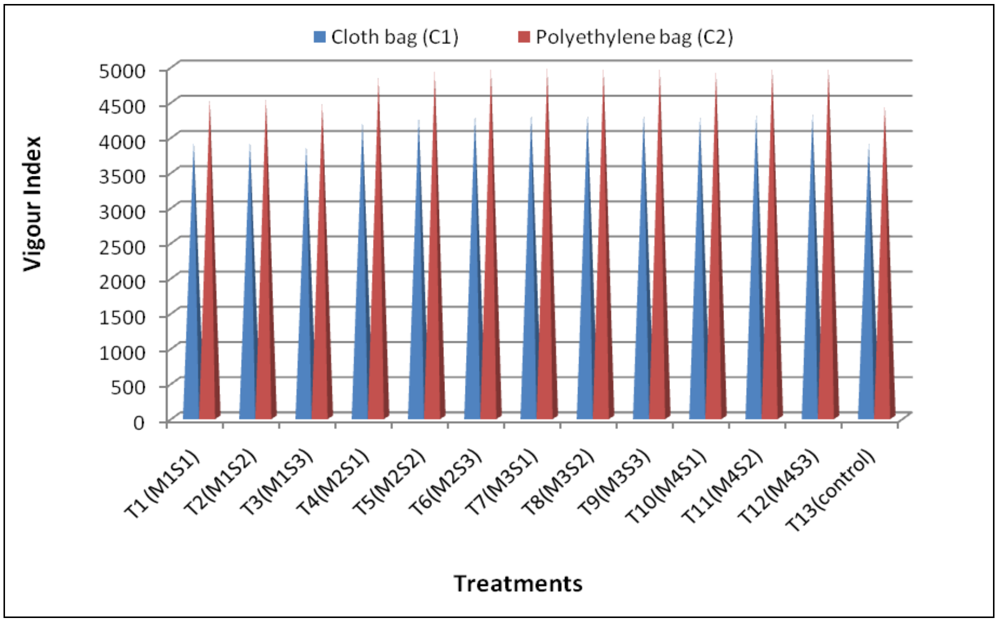

Figure 1. Influence of pigeonpea seed and containers on vigour index during storage