Research Article

Effect of integrated crop management on seed storability in summer mungbean (*Vigna radiata* L.Wilczek)

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Abstract

The experiment was conducted in laboratories of Department of Seed Science & Technology, CCSHAU, Hisar during 2015-16. In present study, seed harvested of mungbean var. MH 421 with sixteen treatment combinations from summer season was stored under ambient condition upto 12 months to assess the effect of integrated crop management on seed storability. Seed obtained from each treatment were evaluated quarterly for their performance for different seed quality parameters *viz*. standard germination, seedling length, seedling dry weight, vigour index-I, vigour index-II and electrical conductivity. The results clearly indicated that treatment RDF + RWM+ RPM showed higher germination percentage (93.67), seedling length (48.33), seedling dry weight (26.20), vigour index-I (4527), and vigour index-II (2454), while control showed lower value for germination percentage (85.33), seedling length (37.67), seedling dry weight (15.57), vigour index-I (3214) and vigour index-II (1329), of freshly harvested seeds as compared to 3,6,9,12 months stored seeds.

Keywords: Mungbean, Seed quality, Germination, Storability, Electrical conductivity

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Introduction

Mungbean (*Vigna radiata* L.Wilzek), also popularly known as green gram, is an ancient and well known legume crop in Asia, particularly in the Indian subcontinent. It is one of the important pulse crops of India, as it is an excellent source of easily-digestible protein of low flatulence, which complements the staple rice diet in the country. Since it is a short duration legume (maturing in 55 to 70 days) fits well into many cropping systems, including rice and sugarcane under both rainfed and irrigated conditions. Seed possesses maximum viability and vigour at physiological maturity [1] thereafter, seeds gradually aged and decline in viability and vigour. Seed deterioration leads to reduction in seed quality, performance and stand establishment which is major problem in agriculture production [2]. Seed ageing cause gradual decline in all vital cellular components causing thereby progressive loss of viability. Lipid auto-oxidation has also been suggested to be one of the cause of seed ageing [3] which involve the production of free radicals. Such problems impart serious threat to agriculture; hence require management to maintain viability and vigour of seed. The climatic condition of humid tropical regions accelerates the seed ageing and the seed viability & vigour is lost during prolonged storage.

Material and Methods

The field experiment was conducted to study the influence of integrated crop management on seed storability in Mungbean during 2015-16 at CCS Haryana Agricultural University, Hisar**.** Seeds of Mungbean variety "MH-421" were collected from Pulses Section, Department of Genetics and Plant Breeding of CCS Haryana Agricultural University, Hisar during summer 2015. Sixteen treatments were comprised viz. T1= RDF (recommended dose of fertilizer), T2= RDF+ Biomix (Rhizobium + PSB), T3= RDF + $ZnSO_4$, T4= 50% RDF + $ZnSO_4$, T5= Biomix, T6= Recommended weed management (RWM), T7= Recommended pest management (RPM), T8= RDF+RWM, T9= RDF + RPM, T10= RWM + RPM, T11= RDF + RWM + RPM, T12= FYM, T13= FYM + 50% RDF, T14= Vermicompost, T15= Vermicompost + 50% RDF, T0= Control. The variety "MH-421" of mungbean with all treatment combinations was grown in the field of research area of G&PB with the recommended cultural practices and above said treatments. The sowing was done in summer 2015. Seed obtained from different treatment combinations were stored under ambient condition upto 12 months and observations were recorded quarterly for different seed quality parameters *viz*. standard germination, seedling length, seedling dry weight, vigour index-I, vigour index-II and electrical conductivity in the laboratories of Department of Seed Science & Technology CCS

Haryana Agricultural University, Hisar.

Table 1 Detail of plot size and doses of different treatments

Plot size	9.6 m^2 (4m X 2.4m)
FYM	15 t/ha (Recommended dose)
Vermicompost	5 t/ha (Recommended dose)
Rhizobium	150ml/ha/15kg seed (seed treatment)
PSB	150 ml/ha/15kg seed (seed treatment)
RDF	N: P_2O_5: K_2O:: 20:40:00
RWM	Pendimethalin@ 4000gm 25 EC / ha+ 1 hoeing at 20-25 days.
RPM	Metasystox@625ml 25 EC /ha at 14-21 days.
$ZnSO_4$	25 kg/ha

Standard germination test which is a viability as well as vigour parameter was executed using between paper (BP) method. One hundred seeds of each variety in three replications placed in between sufficient moistened rolled towel papers and kept at 25˚C in seed germinator. The final count was taken on 8th day and normal seedlings were considered for percent germination [4].

Seedling length (root + shoot) was measured on ten randomly selected normal seedlings taken from three replications of standard germination and recorded in centimetres. Average of the ten seedlings was taken for final calculation. These ten seedlings whose length was measured were dried in hot air oven for 24 hours at 80 ±1˚C. The dried seedlings of each replication were weighed and average seedling dry weight of each genotype was calculated and expressed in milligrams. The seedling vigour indices were calculated by the method [5] as follows:

Vigour Index-I = Standard germination (%) × Average seedling length (cm)
Vigour Index-II = Standard germination (%) × Average seedling dry weight (mg)

Electrical conductivity of the seed leachates was measured to know the status of membrane permeability. Fifty normal and undamaged seeds of each genotype were taken randomly (replicated thrice) and soaked in 100 ml beakers each containing 75 ml of distilled water. The seeds were immersed completely in water and beakers were covered with aluminium foil. Thereafter, these samples were kept at 25˚C for 24 hours. The electrical conductivity of seed leachates was measured by conductivity meter [4] and expressed in uS/cm/seed.

Results and Discussion

The results on germination percentage as influenced by integrated crop management during storage period (0 to 12 months) are presented in **Table 2**. Germination percentage decline progressive with the advance in storage period. The germination percentage recorded for RDF+ RWM+ RPM at the beginning and end of storage period was 93.67% and 75.33%. Germination percentage differed significantly due to different treatments at all months of storage (0 to 12 months). At initial month of storage higher germination percentage (93.67%) was recorded in RDF+RWM+RPM and lower germination percentage (85.33%) was recorded in control. At third month of storage period higher germination (90.67%) was recorded in RDF+RWM+RPM and lower (82.00%) in control. At the six months of storage period maximum germination (86.33%) was observed with the treatment RDF+RWM+RPM and minimum (77.00%) with control.

At the end of nine months of storage period the higher germination (82.33%) was recorded with RDF+RWM+RPM and lower (71.00%) with control. At the end of storage period (12 month) the maximum germination (75.33%) was observed with RDF+RWM+RPM and minimum (64.33%) with control. The results on seedling length was also differed significantly during storage period are presented in **Table 3**. At initial month of storage higher seedling length (48.33) was recorded with the treatment RDF+RWM+RPM and lower seedling length (37.67) was recorded with the treatment control.

At the third month of storage period maximum seedling length (46.67) was observed in RDF+RWM+RPM and the minimum seedling length (35.00) was observed with control. The highest seedling length (44.67cm) was observed with RDF+RWM+RPM and the lowest seedling length (33.33) was observed with control after the storage period of six months. At the end of nine months of storage period the higher seedling length (41.67) was recorded with RDF+RWM+RPM and lower seedling length (31.33) was recorded with control. At the end of storage period (12 months) the maximum seedling length (38.67) was recorded with RDF+RWM+RPM and minimum seedling length (27.33) with control.

Table 2 Effect of integrated crop management and storage on standard germination (%) in summer mungbean

Treatments	Fresh	3 Month	6 Month	9 Month	12 Month
RDF	90.33(71.92)	87.00(68.84)	82.00(64.87)	76.6761.09)	71.33(57.61)
RDF+BIOMIX	93.00(74.65)	89.67(71.23)	85.33(67.46)	81.00(64.14)	74.67(59.76)
RDF+$ZNSO_4$	90.67(72.19)	88.67(70.30)	83.33(65.88)	77.33(61.55)	72.33(58.24)
50%RDF+$ZNSO_4$	87.33(69.15)	86.00(68.00)	80.33(63.65)	74.67(59.76)	69.33(56.35)
BIOMIX	86.33(68.29)	85.33(67.46)	81.33(64.38)	75.00(59.98)	69.67(56.56)
RWM	86.00(68.01)	85.67(67.73)	80.33(63.65)	74.67(59.76)	68.67(55.94)
RPM	88.00(69.72)	85.00(67.19)	80.00(63.41)	74.33(59.54)	68.33(55.73)
RDF+RWM	92.33(73.90)	88.00(69.72)	84.33(66.66)	80.33(63.65)	73.00(58.67)
RDF+RPM	91.67(73.20)	87.67(69.42)	83.33(65.88)	79.33(62.94)	72.33(58.24)
RWM+RPM	88.33(70.00)	86.33(68.28)	81.00(64.13)	75.33(60.20)	69.00(56.14)
RDF+RWM+RPM	93.67(75.40)	90.67(72.19)	86.33(68.28)	82.33(65.12)	75.33(60.20)
FYM	86.00(68.01)	83.67(66.14)	78.00(62.01)	72.33(58.24)	66.00(54.31)
FYM+50%RDF	86.67(68.56)	84.33(66.67)	78.67(62.47)	73.00(58.67)	66.67(54.71)
V.COMPOST	87.00(68.84)	84.00(66.40)	78.33(62.24)	72.67(58.46)	66.33(54.51)
V.COMPOST +50%RDF	85.67(67.73)	84.67(66.92)	79.00(62.70)	73.67(59.10)	67.00(54.92)
CONTROL	85.33(67.46)	82.00(64.87)	77.00(61.32)	71.00(57.40)	64.33(53.31)
Mean	88.65(70.44)	86.17(68.21)	81.17(64.31)	75.85(60.60)	69.65(56.58)
Range	67.46-75.40	64.87-72.19	61.32-68.28	57.40-65.12	53.31-60.20
CD@5%	1.48	0.81	0.65	0.79	0.52

Value in parentheses are transformed values

Table 3 Effect of integrated crop management and storage on seedling length (cm) in summer mungbean

Treatments	Fresh	3 Month	6 Month	9 Month	12 Month
RDF	43.33	42.33	40.67	37.67	33.67
RDF+BIOMIX	47.67	45.00	43.67	40.67	37.33
RDF+$ZNSO_4$	43.67	42.33	41.00	38.00	34.33
50%RDF+$ZNSO_4$	42.67	40.33	38.67	35.33	32.67
BIOMIX	42.33	41.00	37.67	35.00	32.00
RWM	42.00	41.33	38.33	34.33	31.67
RPM	44.33	42.67	38.00	34.00	31.00
RDF+RWM	46.00	44.33	42.67	39.00	36.67
RDF+RPM	45.67	43.67	42.00	38.33	36.00
RWM+RPM	43.33	42.00	39.33	37.00	32.67
RDF+RWM+RPM	48.33	46.67	44.67	41.67	38.67
FYM	39.00	37.67	34.67	32.67	28.67
FYM+50%RDF	40.00	38.00	35.33	33.67	29.67
V.COMPOST	41.33	38.33	35.00	33.33	29.33
V.COMPOST +50%RDF	42.00	40.67	35.67	34.00	30.00
CONTROL	37.67	35.00	33.33	31.33	27.33
Mean	43.08	41.33	38.79	36.00	32.61
Range	37.67-48.33	35.00-46.67	33.33-44.67	31.33-41.67	27.33-38.67
CD@5%	1.54	0.80	0.84	0.87	0.84

The data on seedling dry weight (mg) as influenced by different treatment combinations are present in **Table 4**. Seedling dry weight declined progressively from initial month to twelve months of storage period. Seedling dry weight was observed maximum with the treatment RDF+RWM+RPM (26.20) and minimum was observed with control (15.57) in freshly harvested seeds. At the end of third month of storage period the higher seedling dry weight was recorded with the treatment RDF+RWM+RPM (25.13) while lower was recorded with control (13.47). After the six months of storage, the maximum seedling dry weight was observed in RDF+RWM+RPM (24.17) while minimum was observed in control (12.20). At the nine months of storage the maximum seedling dry weight was recorded with the treatment RDF+RWM+RPM (23.10) and the minimum value for seedling dry weight was recorded with control (11.17). At the end of storage period the higher seedling dry weight was observed with the treatment RDF+RWM+RPM (19.40) whereas lower seedling dry weight was observed in control (8.20).

The data on vigour index-I as influenced by different treatment combinations differed significantly and presented in **Table 5**.

Table 4 Effect of integrated crop management and storage on seedling dry weight (mg) in summer mungbean

Treatments	Fresh	3 Month	6 Month	9 Month	12 Month
RDF	22.20	21.07	20.12	18.80	15.50
RDF+BIOMIX	24.87	23.57	22.60	21.90	18.40
RDF+$ZNSO_4$	21.40	21.17	20.25	19.20	16.17
50%RDF+$ZNSO_4$	22.32	19.47	18.40	17.53	14.73
BIOMIX	18.83	17.7	16.80	15.30	13.77
RWM	17.60	16.5	15.50	14.00	13.37
RPM	17.93	16.23	14.83	13.30	12.50
RDF+RWM	23.83	22.83	21.83	20.50	17.60
RDF+RPM	22.37	22.2	21.12	19.70	16.80
RWM+RPM	19.26	17.83	17.20	16.40	14.10
RDF+RWM+RPM	26.20	25.13	24.17	23.10	19.40
FYM	17.54	15.23	13.87	12.47	9.80
FYM+50%RDF	16.51	16.13	14.07	13.20	10.80
V.COMPOST	16.40	15.47	14.00	12.80	10.23
V.COMPOST +50%RDF	17.93	16.5	14.27	13.50	11.50
CONTROL	15.57	13.47	12.20	11.17	8.20
Mean	20.05	18.78	17.58	16.43	13.93
Range	15.57-26.20	13.47-25.13	12.20-24.17	11.17-23.10	8.20-19.40
CD@5%	0.33	0.24	0.13	0.23	0.20

Table 5 Effect of integrated crop management and storage on vigour index-I in summer mungbean

Treatments	Fresh	3 Month	6 Month	9 Month	12 Month
RDF	3,915	3,683	3,335	2,888	2,401
RDF+BIOMIX	4,433	4,035	3,726	3,294	2,788
RDF+$ZNSO_4$	3,959	3,754	3,417	2,939	2,484
50%RDF+$ZNSO_4$	3,726	3,469	3,106	2,638	2,265
BIOMIX	3,655	3,499	3,064	2,625	2,229
RWM	3,612	3,541	3,080	2,564	2,174
RPM	3,901	3,627	3,040	2,527	2,118
RDF+RWM	4,248	3,901	3,598	3,133	2,677
RDF+RPM	4,187	3,828	3,500	3,041	2,604
RWM+RPM	3,827	3,626	3,186	2,787	2,254
RDF+RWM+RPM	4,527	4,231	3,856	3,431	2,913
FYM	3,354	3,151	2,704	2,363	1,892
FYM+50%RDF	3,466	3,205	2,779	2,458	1,978
V.COMPOST	3,596	3,220	2,742	2,422	1,946
V.COMPOST +50%RDF	3,598	3,443	2,818	2,505	2,010
CONTROL	3,214	2,870	2,567	2,225	1,758
Mean	3826	3,568	3,157	2,740	2,281
Range	3214-4527	2870-4231	2567-3856	2225-3431	1758-2913
CD@5%	155	73	76	79	66

For freshly harvested seed, the vigour index-I was found maximum with the treatment RDF+RWM+RPM (4527) and minimum value was found in control (3214). At the third month of storage, the value for vigour index-I was highest with the treatment RDF+RWM+RPM (4231) while lowest in control (2870). After the storage of six months maximum vigour index-I was recorded with the treatment RDF+RWM+RPM (3856) while minimum vigour index-I was recorded with control (2567). At the end of nine months of storage period the higher vigour index-I value was found in the treatment RDF+RWM+RPM (3431) and the lower was recorded with control (2225). After the storage of twelve months maximum vigour index-I was observed with the treatment RDF+RWM+RPM (2913) and minimum value for vigour index-I was observed with control (1758).

The data on vigour index-II as influenced by different treatment combinations are present in **Table 6**. The vigour index-II was observed higher with the treatment RDF+RWM+RPM (2454) and lower was observed in control (1329) for the freshly harvested seeds. After the storage of three months the maximum value of vigour index-II was recorded with the treatment RDF+RWM+RPM (2279) and minimum value was recorded with control (1104).

Table 6 Effect of integrated crop management and storage on vigour index-II in summer mungbean

Treatments	Fresh	3 Month	6 Month	9 Month	12 Month
RDF	2,005	1,833	1,650	1,441	1,106
RDF+BIOMIX	2,313	2,113	1,929	1,774	1,374
RDF+$ZNSO_4$	1,940	1,877	1,688	1,485	1,169
50%RDF+$ZNSO_4$	1,949	1,674	1,478	1,310	1,021
BIOMIX	1,626	1,511	1,367	1,148	959
RWM	1,514	1,414	1,245	1,045	918
RPM	1,578	1,380	1,187	989	854
RDF+RWM	2,200	2,009	1,841	1,647	1,285
RDF+RPM	2,051	1,946	1,760	1,563	1,215
RWM+RPM	1,701	1,540	1,393	1,235	973
RDF+RWM+RPM	2,454	2,279	2,086	1,902	1,462
FYM	1,509	1,275	1,081	902	647
FYM+50%RDF	1,431	1,361	1,107	964	720
V.COMPOST	1,427	1,299	1,097	930	679
V.COMPOST +50%RDF	1,537	1,397	1,127	995	771
CONTROL	1,329	1,104	939	793	528
Mean	1,785	1,626	1,436	1,258	980
Range	1329-2454	1104-2279	939-2086	793-1902	528-1462
CD@5%	38	26	19	27	19

At the end of six months of storage period the highest value of vigour index-II was found with the treatment RDF+RWM+RPM (2086) and lowest value was found with control (939). After the storage period of nine months, the higher vigour index-II value was observed with the treatment RDF+RWM+RPM (1902) while, lower was observed with control (793). At the end of storage period the maximum value for vigour index-II was found with the treatment RDF+RWM+RPM (1462) and minimum was found with the treatment control (528).

The data on electrical conductivity as influenced by different treatment combinations and both the seasons during storage period are present in Table 7. The electrical conductivity was observed minimum with the treatment RDF+RWM+RPM (197) and maximum was observed with the treatment control (401) for freshly harvested seeds. After the storage of three months the lowest value for electrical conductivity was recorded with the treatment RDF+RWM+RPM (212) and highest value was recorded with control (506). At the end of six months of storage period the lower value of electrical conductivity was observed in RDF+RWM+RPM (329) and higher value was observed with the treatment control (624). After the storage period of nine months minimum value for electrical conductivity was found with the treatment RDF+RWM+RPM (418) and maximum value was found with the control (746). At the end of storage, the lowest value of electrical conductivity was recorded in the treatment RDF+RWM+RPM (529) and highest value was recorded with the treatment control (869). This may be due to as the storage period advanced there was a decrease in seed quality parameters gradually [6]. This indicated that natural ageing is inevitable in all the species as well as seeds. After physiological maturity, seeds begin to deteriorate at varying rate depends upon the condition of storage environment [7] who have highlighted the deteriorative changes in seed which include membrane degradation, accumulation of toxic metabolites, decrease enzyme activity, lipid autooxidation, failure to repair mechanism and genetic degradation. Consequences of these factors led to reduced viability and vigour in stored seeds. The decline in germination during ageing is related to degree of deterioration of seeds. The decline in seed germination and vigour during storage were influenced by chronological age of seed rather than initial germination percentage, [8], [9] and [10] also reported decrease in seed germination and vigour during accelerated ageing as well as during storage.

From the above study it can be concluded that seed harvested from RDF+RWM+RPM can be stored upto 12 month under ambient conditions and it maintains its germination above IMSCS.

Table 7 Effect of integrated crop management and storage on electrical conductivity (μS $cm^{-1}g^{-1}$) in summer mungbean

Treatments	Fresh	3 Month	6 Month	9 Month	12 Month
RDF	289	311	427	538	652
RDF+BIOMIX	206	225	347	434	541
RDF+$ZNSO_4$	304	328	412	523	641
50%RDF+$ZNSO_4$	359	372	446	563	679
BIOMIX	327	352	472	578	697
RWM	334	363	489	602	718
RPM	346	383	502	623	729
RDF+RWM	233	248	378	455	558
RDF+RPM	257	272	391	465	571
RWM+RPM	373	328	456	570	686
RDF+RWM+RPM	197	212	329	418	529
FYM	367	479	588	731	852
FYM+50%RDF	326	466	552	700	813
V.COMPOST	357	471	573	716	832
V.COMPOST +50%RDF	312	458	538	688	798
CONTROL	401	506	624	746	869
Mean	311	361	470	584	698
Range	197-401	212-506	329-624	418-746	529-869
CD@5%	7	2	3	3	3

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