RESEARCH ARTICLE Indian Journal of Agricultural Research, Volume 59 Issue 10: 1619-1626 (October 2025)

Quantify the Storage Span of Bio Primed Seed using Biocontrol Agents and Liquid Biofertilizers in Moong Bean (*Vigna radiata* L.)

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ABSTRACT

Background: The present investigation was carried out on "to quantify the storage span of bio primed seed using biocontrol agents and liquid biofertilizers in moong bean (*Vigna radiata L.*) was conducted at Seed Testing Laboratory, Department of Seed Science and Technology, ANDUAT, Kumarganj, Ayodhya, U.P. during 2023 and 2024.

Methods: Seed biopriming generally refers to use of salutary microorganisms to influence germination potential. An experiment was carried out on two varieties of green gram *i.e.*, NDM-1 (Collect from ANDUAT, Kumarganj, Ayodhya, U.P) and Sikha (collect from IIPR, Kanpur, U.P) and seed biopriming with two different biocontrol agents (*Pseudomonas fluorescens* and *Trichoderma viridae*) used in different concentration and two different liquid biofertilizers (*Azospirillum* and *Phosphobacteria* @20% respectively) following complete randomised design with four replication during two season (2023 and 2024) at different storage period *i.e.,* 3, 6 and 9 months. The experiment comprised of seven biopriming along with hydropriming and control. Seed had been treated with control (T_0), seeds soaked in distil water/hydropriming (T_1); PF @ 25% (T_2); PF @ 50% (T_3); PF @ 75% (T_4); TV @ 25% (T5); TV @ 50% (T_6); TV @75% (T_7); liquid ASP @ 20% (T_8); liquid PB @ 20% (T_9). Treated seed were grown with the help of between paper method at Seed Testing Laboratory, ANDUAT Kumarganj, Ayodhya, U.P.

Result: A study on long term storage of bio primed seed revealed that seeds bio primed with *T. viridae* 50% for 6 hrs able to store better in cloth bag which registered 88.5% and 87% germination show V_1 and V_2 respectively, 91% and 90% seed viability recorded in V_1 and V_2 respectively at 9 months of storage.

Key words: Biocontrol agents, Biopriming, Liquid biofertilizers Moong bean, Storage.

INTRODUCTION

Green gram, popularly known as, is a major pulse crop in India. It may be planted as both a *kharif* and summer crop. India contributes more than 70% of worlds green gram production. In India during 2024-25, about 33.24 lakh ha area was covered under green gram as against 30.39 lakh ha during the same period in 2023-24. The important green gram producing state in the country is Rajasthan followed by Karnataka, Maharashtra, Madhya Pradesh Bihar and Andhra Pradesh. Mung bean plays an important role as a food security crop because of its nutritional quality as well as ability to survive in harsh environmental conditions such as arid and semiarid lands. They are mainly grown for human food, in the form of boiled dry beans, stew and flour while sprouts and immature pods as a vegetable (Yvonne *et al.,* 2016). Agriculturally, mung beans are particularly valuable as a soil-enriching crop and are useful as cover crops and as green manure. Pulses can remain edible for several years if stored correctly. However, they are harder to store than cereals and are more susceptible to damage from insects and microorganisms. This leads to not only quantitative losses but also a decline in nutritional value due to vitamin loss and protein quality deterioration. There are two primary storage methods: bag and bulk. Bags can be stored outdoors or in warehouses, while bulk grain is kept in bins or silos of various sizes. Primed seeds are known to emerge faster, grow more vigorously and result in higher yields, which is especially important in unfavourable environmental conditions such as drought (Mamun *et al.,* 2018). The main benefit of priming is the increase in the rate of germination at any temperature and the uniform emergence of seedlings from primed seeds at a faster rate than non-primed seeds due to limited adverse environmental exposure. This is due to the shortening of the lag phase or metabolic phase of the germination process. Biopriming could serve as a viable

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How to cite this article: Kumari, A., Vimal, S.C., Mishra, S., Gupta, S. and Yadav, H.K. (2025). Quantify the Storage Span of Bio Primed Seed using Biocontrol Agents and Liquid Biofertilizers in Moong Bean (*Vigna radiata* L.). *Indian Journal of Agricultural Research.* **59(10):** 1619-1626. doi: 10.18805/IJARe.A-6421.

Submitted: 23-05-2025 **Accepted:** 19-07-2025 **Online:** 27-08-2025

approach to enhance crop productivity as it improves the performance of plants under sub-optimal conditions (Roy *et al.,* 2022). Storage is an essential component of seed programmes, which primarily aims at maintaining the high-quality standards of the seed from harvest till the time of sowing the crop in the next or successive seasons (Dadlani *et al.,* 2023).

MATERIALS AND METHODS

The experiment material consists of two variety NDM-1 and Sikha of mung bean in a complete randomised design with 04 replication for consecuting 02 Seasons *i.e.,* 2023 and 2024 at Seed Testing Laboratory, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj Ayodhya U.P. Concept of seed biopriming of (Taylor and Harmon, 1990) was adopted and seed biopriming was done in green gram are as follow.

According to different concentration (25%, 50% and 75%) of biocontrol agents and liquid biofertilizers (biofertilizers and biocontrol agents were collected from seed testing laboratory ANDUAT, Kumarganj Ayodhya U.P. Biofertilizers are in liquid form and biocontrol agents in liquid form) was suspended in one litre sterilized distilled water.

The seeds weighing 1 kg were immersed in the aforementioned solution and allowed to soak for six hours.

The seeds, once soaked, were removed and laid out on blotter paper to dry.

The seeds were immediately planted to evaluate their effectiveness in the field.

Seeds that were hydrated and left untreated acted as the control group.

Treatment includes *Pseudomonas fluorescens*, *Trichoderma viridae*, liquid *Phosphobacteria* and liquid *Azospirillum*, seeds with hydration priming and absolute control. The seed after biopriming and drying back to original moisture were packed in cloth bag and kept under ambient storage for a period of 9 months for two years. The 100 bio primed seeds were grown with the help of between paper method. The between paper method is a seed germination technique that involves placing seeds between two moist paper towels and rolling them into a towel. The rolled towels are then placed in a germination cabinet or room.

Observation taken

The populations of biological agents were tested at monthly intervals. The physical, physiological and seed health tests

Table 1: Effects of seed biopriming on seed germination on two varieties of mung bean during 2023 and 2024.

Treatments	3 months			6 months			9 months		
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
V_1T_0	88.50	88.50	88.50	86.75	85.75	86.25	84.00	81.00	82.50
V_1T_1	90.25	91.00	90.63	87.75	89.50	88.63	87.25	85.75	86.50
V_1T_2	89.50	92.25	90.88	88.75	88.25	88.50	86.00	85.50	85.75
V_1T_3	93.00	91.25	92.13	88.25	89.75	89.00	86.25	86.75	86.50
V_1T_4	91.50	92.00	91.75	88.00	91.00	89.50	85.25	86.50	85.88
V_1T_5	91.75	90.75	91.25	90.75	89.25	90.00	88.50	87.75	88.13
V_1T_6	93.50	92.50	93.00	91.25	91.00	91.13	88.75	88.25	88.50
V_1T_7	89.75	90.50	90.13	87.75	90.25	89.00	85.00	87.25	86.13
V_1T_8	91.25	91.75	91.50	89.75	90.50	90.13	84.75	86.25	85.50
V_1T_9	92.00	90.25	91.13	87.25	88.75	88.00	85.75	86.00	85.88
Grand mean	91.10	91.08	91.09	88.63	89.40	89.01	86.15	86.10	86.13
V_2T_0	88.00	86.50	87.25	85.50	85.00	85.25	83.00	79.50	81.25
V_2T_1	88.75	90.00	89.38	86.50	88.50	87.50	83.75	84.75	84.25
V_2T_2	90.00	91.00	90.50	87.75	88.25	88.00	85.00	84.25	84.63
V_2T_3	89.75	90.25	90.00	87.25	89.00	88.13	85.25	85.75	85.50
V_2T_4	89.25	89.75	89.50	87.00	89.50	88.25	84.25	86.00	85.13
V_2T_5	92.25	89.00	90.63	89.75	89.25	89.50	87.50	85.00	86.25
V_2T_6	92.50	92.00	92.25	90.25	89.75	90.00	87.75	86.25	87.00
V_2T_7	90.25	90.75	90.50	87.75	88.75	88.25	84.50	85.25	84.88
V_2T_8	90.50	91.25	90.88	88.75	87.75	88.25	86.00	85.50	85.75
V_2T_9	89.00	90.50	89.75	88.00	86.75	87.38	85.50	84.00	84.75
Grand mean	90.03	90.10	90.06	87.85	88.25	88.05	85.25	84.63	84.94
	S.E	CD (5%)		S.E	CD (5%)		S.E	CD (5%)	
V	0.240	0.681		0.196	0.556		0.252	0.713	
T	0.537	1.522		0.438	1.243		0.562	1.595	
V × T	O.759			0.620			0.795		

were carried out with the seed samples drawn at trimonthly interval. After 7 days of germination 10 seedling of each replication and treatment were randomly selected for recording the seed quality parameters except seed moisture content. The observation was recorded on eight qualitative characters, *viz.*, seed moisture content (%), seed germination (%), seedling length (cm), seedling dry weight (gm) vigour index I, vigour index II and seed borne diseases. The data were analysed using analysis of variance, following the method by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The data can be recorded and analysed for seed quality parameters of mung bean. Different parameters are as follows.

Seed moisture content (%)

The seed moisture content (Mc) is the amount of water in the seed. It is usually expressed as a percentage or weight basis in seed-testing laboratory. The seed moisture content is the most vital parameter which influence the seed quality and storage life of the seed. The seed moisture content recorded with the help of digital moisture meter. Seed moisture content showed a significant difference due to seed biopriming treatment and period of storage. Minimum moisture content observed during 3 months of storage as compared to 9 months (Fig 1).

Seed germination (%)

Germination was significantly influenced by seed biopriming storage period and their interactions. Irrespective of cloth bag and period of storage, during both two season (2023 and 2024) seed bio primed with TV @ 50% for 6 hrs *i.e.,* T_6 could maintain the germination percentage 88.50% and 87.00% in both the varieties V_1 and V_2 respectively, when compared with other treatment. The reduction in germination over the period of storage was maximum. Germination percentage recorded at 3 months of storage is 91.09% and 90.06% in both the varieties V_1 and V_2 respectively was found to decrease to 86.13% and 84.94% in both the varieties V_1 and V_2 respectively at 9 months of storage. Non primed seeds recorded lower germination 82.50% in V_1 while 81.25% in V_2 at 9 months of storage (Table 1). The biosynthesis of pumpkin seeds with a combination of *Azospirillum*, *Phosphobacteria* and *Pseudomonas fluorescens* treatment improves the growth, yield and quality of plants (Sivakalai and Krishnaveni, 2017).

Table 2: Effect of seed biopriming on seedling length on two varieties of mung bean during 2023 and 2024.

Treatments	3 months			6 months			9 months		
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
V_1T_0	32.22	32.59	32.41	26.98	27.48	27.23	22.26	22.96	22.62
V_1T_1	33.81	37.11	35.46	29.14	28.89	29.01	23.51	23.66	23.59
V_1T_2	37.92	37.75	37.84	31.21	31.84	31.53	26.93	26.70	26.82
V_1T_3	38.06	36.78	37.42	27.96	29.81	28.89	24.56	24.96	24.76
V_1T_4	36.66	38.49	37.58	28.59	29.55	29.07	22.7	23.38	23.04
V_1T_5	36.84	37.11	36.98	30.38	31.36	30.87	25.85	25.73	25.79
V_1T_6	39.93	38.94	39.44	33.03	33.35	33.19	28.74	28.25	28.50
V_1T_7	38.57	36.41	37.5	31.38	30.93	31.15	27.05	25.73	26.39
V_1T_8	36.33	35.15	35.74	28.74	29.73	29.23	26.85	26.74	26.80
V_1T_9	34.13	34.88	34.51	30.48	30.95	30.71	26.85	25.40	26.13
Grand mean	36.45	36.52	36.49	29.79	30.39	30.09	25.53	25.35	25.44
V_2T_0	28.56	30.98	29.77	24.52	24.96	24.75	19.48	20.25	19.86
V_2T_1	30.52	31.89	31.21	28.81	28.71	28.76	22.74	22.90	22.82
V_2T_2	34.84	34.63	34.73	29.39	29.89	29.64	24.55	24.28	24.41
V_2T_3	33.23	33.21	33.22	28.31	28.38	28.34	23.25	23.85	23.55
V_2T_4	30.64	34.31	32.48	27.95	28.28	28.11	21.30	22.55	21.93
V_2T_5	34.84	34.39	34.62	29.20	30.15	29.68	23.41	23.13	23.27
V_2T_6	35.63	36.16	35.90	31.18	32.04	31.61	27.01	25.33	26.17
V_2T_7	34.75	34.70	34.73	25.93	29.44	27.68	23.43	22.50	22.96
V_2T_8	32.73	32.59	32.66	26.07	27.01	26.55	22.15	24.63	23.39
V_2T_9	30.78	31.56	31.17	28.93	29.68	29.30	23.53	24.23	23.88
Grand mean	32.65	33.44	33.05	28.03	28.85	28.44	23.08	23.36	23.22
	S.E	CD (5%)		S.E	CD (5%)		S.E	CD (5%)	
V	0.422	1.196		0.472	1.338		0.350	0.994	
T	0.943	2.673		1.005	2.992		0.784	2.222	
V × T	1.333			1.492			1.108		

Seedling length (cm)

Seedling length was significantly influenced by seed biopriming storage period and their interactions. Irrespective of cloth bag and period of storage, during both two season (2023 and 2024) seed bio primed with TV @ 50% for 6 hrs *i.e.*, T_6 could maintain the seedling length 28.50 cm and 26.17 cm in both the varieties V_1 and V_2 respectively, when compared with other treatment. The reduction in seedling length over the period of storage was maximum. Seedling length recorded at 3 months of storage is 36.49 cm and 33.05 cm in both the varieties V_1 and V_2 respectively was found to decrease to 25.44 cm and 23.22 cm in both the varieties V_1 and V_2 respectively at 9 months of storage. Non primed seeds recorded lower seedling length

Table 3: Effect of seed biopriming on seedling dry weight on two varieties of mung bean during 2023 and 2024.

Treatments	3 months			6 months			9 months		
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
V_1T_0	0.140	0.183	0.163	0.138	0.140	0.143	0.118	0.123	0.123
V_1T_1	0.195	0.250	0.225	0.158	0.170	0.165	0.138	0.145	0.145
V_1T_2	0.205	0.233	0.220	0.175	0.153	0.168	0.128	0.158	0.145
V_1T_3	0.188	0.260	0.225	0.158	0.160	0.163	0.135	0.148	0.143
V_1T_4	0.205	0.243	0.228	0.175	0.175	0.180	0.138	0.133	0.138
V_1T_5	0.175	0.205	0.190	0.165	0.148	0.160	0.128	0.158	0.145
V_1T_6	0.258	0.368	0.315	0.218	0.195	0.208	0.153	0.160	0.160
V_1T_7	0.173	0.275	0.225	0.170	0.153	0.163	0.125	0.143	0.138
V_1T_8	0.185	0.313	0.253	0.173	0.168	0.173	0.135	0.145	0.143
V_1T_9	0.190	0.250	0.223	0.143	0.143	0.143	0.118	0.135	0.128
Grand mean	0.191	0.258	0.227	0.167	0.161	0.167	0.132	0.145	0.141
V_2T_0	0.173	0.173	0.178	0.130	0.130	0.133	0.103	0.113	0.110
V_2T_1	0.175	0.215	0.198	0.155	0.163	0.163	0.128	0.128	0.130
V_2T_2	0.165	0.220	0.195	0.148	0.143	0.148	0.120	0.138	0.133
V_2T_3	0.178	0.248	0.215	0.145	0.150	0.150	0.133	0.125	0.133
V_2T_4	0.205	0.233	0.223	0.173	0.158	0.168	0.140	0.130	0.138
V_2T_5	0.218	0.188	0.205	0.158	0.133	0.148	0.118	0.135	0.130
V_2T_6	0.240	0.343	0.293	0.195	0.170	0.183	0.148	0.155	0.155
V_2T_7	0.188	0.263	0.230	0.165	0.138	0.155	0.125	0.143	0.135
V_2T_8	0.220	0.285	0.253	0.168	0.148	0.160	0.133	0.133	0.135
V_2T_9	0.233	0.250	0.245	0.133	0.128	0.133	0.110	0.123	0.120
Grand mean	0.200	0.242	0.224	0.157	0.146	0.154	0.126	0.132	0.132
	S.E	CD (5%)		S.E	CD (5%)		S.E	CD (5%)	
V	0.003	0.001		0.002	0.007		0.002	0.006	
T	0.007	0.019		0.005	0.014		0.005	0.014	
V × T	0.009			0.007			0.007		

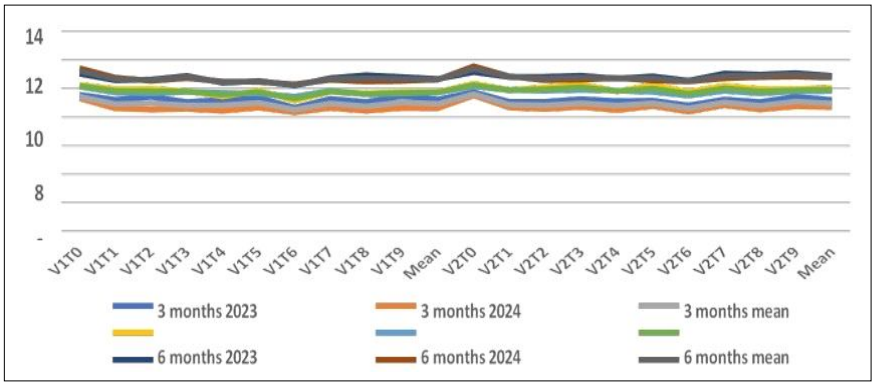


Fig 1: Moisture content (%).

22.62 cm in V_1 while 19.86 cm in V_2 at 9 month of storage (Table 2). Similarly, Vishwas *et al.* (2017) evaluated that seed priming with *Rhizobium* + *Pseudomonas* @ 10% for 12 hours recorded significantly higher germination percent (87%), speed of germination (77.11), shoot length (20.33 cm), root length (16.14 cm), seedling length (34.92 cm), seedling fresh weight (1200.3 mg), dry weight (150.4 mg), seedling vigour index I (2225.37),which is followed by seed priming with *Rhizobium* @ 10% for 12 hour (T_3) and lowest was recorded in T_0 (control).

Seedling dry weight (gm)

Seedling dry weight was significantly influenced by seed biopriming storage period and their interactions. Irrespective of cloth bag and period of storage, during both two season (2023 and 2024) seed bio primed with TV @ 50% for 6 hrs *i.e.,* T_6 could maintain the seedling dry weight 0.160 g and 0.155 g in both the varieties V_1 and V_2 respectively, when compared with other treatment. The reduction in seedling dry weight over the period of storage was maximum. Non primed seeds recorded lower seedling dry weight 0.123 gm in V_1 while 0.110 gm in V_2 at 9 months of storage (Table 3). Similarly, Sajjan *et al.* (2021) evaluated *in-vitro* investigation of biopriming on seed quality parameters in green gram *Vigna radiata* (L.). Results showed that the seed bio primed with *Rhizobium leguminosarum* @ 20 per cent recorded higher seed germination percentage (90.50%), shoot length (19.27 cm), root length (12.38 cm), seedling length (31.65 cm), seedling dry weight (373.0 mg).

Seedling vigor index I

Seedling vigour index I was significantly influenced by seed biopriming storage period and their interactions. Irrespective of cloth bag and period of storage, during both two season (2023 and 2024) seed bio primed with TV @ 50% for 6 hrs *i.e.,* T_6 could maintain the vigor index I 2520.1 and 2276.0 in both the varieties V_1 and V_2 respectively, when compared with other treatment. The reduction in vigour index I over the period of storage was maximum. Vigor index I recorded at 3 months of storage is 3312.7 and 2978.9 in both the varieties V_1 and V_2 respectively was found to decrease to 2175.8 and 1973.3 in both the varieties V_1 and V_2 respectively at 9 months of storage. Non primed seeds recorded lower vigour I 1862.5 in V_1 while 1613.8 in V_2 at 9 months of storage (Table 4). Singh *et al.* (2015) studied with three mung bean cultivars SML 668, ML 818 and PAU 911 and showed the maximum vigour index I of 2578.8 in seed primed with *Pseudomanas fluorescens*.

Table 4: Effects of seed biopriming on seedling vigour index I on two varieties of mung bean during 2023 and 2024.

Treatments	3 months			6 months			9 months		
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
V_1T_0	2846.5	2883.1	2864.8	2338.4	2354.1	2346.3	1867.2	1857.8	1862.5
V_1T_1	3043.9	3368.5	3206.2	2555	2586.9	2570.9	2048.2	2028.4	2038.3
V_1T_2	3397.2	3481.7	3439.4	2770.5	2806.8	2788.7	2314.8	2280.1	2297.4
V_1T_3	3305.1	3357.4	3331.2	2465.5	2673	2569.3	2117.9	2164.9	2141.4
V_1T_4	3358.3	3539.9	3449.1	2519.9	2688.5	2604.2	1935.2	2021.2	1978.2
V_1T_5	3380.8	3368.8	3374.8	2757	2796.8	2776.9	2288	2257.6	2272.8
V_1T_6	3726.1	3605.6	3665.9	3013.2	3032.4	3022.8	2549.3	2490.8	2520.1
V_1T_7	3463.7	3295.1	3379.4	2753.8	2791.6	2772.7	2298.3	2244	2271.1
V_1T_8	3322.7	3225.3	3274	2575.1	2690.2	2632.7	2274.3	1990.7	2132.5
V_1T_9	3138.3	3146	3142.2	2659.5	2747.5	2703.5	2303.7	2183.7	2243.7
Grand mean	3298.3	3327.1	3312.7	2640.8	2716.8	2678.8	2199.7	2151.9	2175.8
V_2T_0	2509.9	2677.3	2593.6	2102	2121.7	2111.8	1617.6	1610	1613.8
V_2T_1	2714.2	2868	2791.1	2525.7	2540.2	2532.9	1904.5	1939	1921.7
V_2T_2	3136.1	3151.6	3143.8	2577.6	2631.8	2604.7	2086	2041.9	2063.9
V_2T_3	2985.6	2998.1	2991.9	2468.9	2519.3	2494.1	1984.3	2041.3	2012.8
V_2T_4	2732.9	3083.8	2908.4	2430.7	2529.1	2479.9	1791	1938.3	1864.6
V_2T_5	3217.8	3062.1	3140	2622.4	2688.7	2655.5	2049.3	1964.3	2006.8
V_2T_6	3298.6	3327.2	3312.9	2814.4	2876.6	2845.5	2369.1	2183	2276
V_2T_7	3136.9	3149.1	3143	2276.6	2611.2	2443.9	1978.9	1914.6	1946.8
V_2T_8	2961.8	2975.6	2968.7	2316.9	2368.4	2342.6	1905.8	2104.9	2005.3
V_2T_9	2734.4	2856.3	2795.3	2478	2572.5	2525.2	2010.6	2032.7	2021.6
Grand mean	2942.8	3014.9	2978.9	2461.3	2545.9	2503.6	1969.7	1977	1973.3
	S.E	CD (5%)		S.E	CD (5%)		S.E	CD (5%)	
V	42.5	120.6		40.8	115.6		29.6	83.8	
T	95.1	269.7		91.1	258.5		66.1	187.4	
V × T	134.5			128.9			93.5		

Seedling vigor index II

Seedling vigour index II was significantly influenced by seed biopriming storage period and their interactions. Irrespective of cloth bag and period of storage, during both two season (2023 and 2024) seed bio primed with TV @ 50% for 6 hrs *i.e.,* T_6 could maintain the vigor index II 13.86 and 13.15 in both the varieties V_1 and V_2 respectively, when compared with other treatment. The reduction in vigour index II over the period of storage was maximum. Vigor index II recorded at 3 months of storage is 20.52 and 19.86 in both the varieties V_1 and V_2 respectively was found to decrease to 11.90 and 10.95 in both the varieties V_1 and V_2 respectively at 9 months of storage. Non primed seeds recorded lower vigour II 9.89 in V_1 while 8.72 in V_2 at 9 months of storage (Table 5). Jaisani *et al.* (2016) reported that *in vitro* application of *T. viride*, *T. harzianum* and *T. virens* conidial suspension to chickpea seeds gave significant results.

Seed borne diseases

Seed borne disease was significantly influenced by seed biopriming storage period and their interactions. Irrespective of cloth bag and period of storage, during both two season (2023 and 2024) seed bio primed with TV @ 50% for 6 hrs *i.e.,* T_6 could maintain the seed borne disease 8.63 and 9.00 in both the varieties V_1 and V_2 respectively, when compared with other treatment. The increment in seed borne disease over the period of storage was maximum. Seed borne disease recorded at 3 months of storage is 4.80 and 5.46 in both the varieties V_1 and V_2 respectively was found to increase to 9.89 and 10.36 in both the varieties V_1 and V_2 respectively at 9 months of storage. Non primed seeds recorded highest seed borne disease 11.38% in V_1 while 12.38% in V_2 at 9 months of storage (Table 6). Similarly, Deshmukh *et al.* (2016) studied the effects of different seed treatments with soil amendments were used for controlling root rot incidence. Among them (T_6) FYM with seed treatment of *T. harzianum* 4 g/kg seed + PSB at 25 g/kg seed recorded the lowest root rot incidence (26.0%) followed by (T_3) *R. phaseoli* at 25 g/kg seed + *P. fluorescens* at 10 g/kg seed which recorded 32.0% root rot incidence whereas, maximum incidence of the disease was recorded in the control (83.3%).

Table 5: Effect of seed biopriming on seedling vigour index II on two varieties of mung bean during 2023 and 2024.

Treatments	3 months			6 months			9 months		
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
V_1T_0	12.77	16.16	14.47	12.01	12.01	12.01	9.83	9.94	9.89
V_1T_1	17.25	22.73	19.99	13.79	15.22	14.50	12.01	12.43	12.22
V_1T_2	18.35	21.46	19.91	15.38	13.44	14.41	11.02	13.44	12.23
V_1T_3	17.51	23.75	20.63	13.86	14.33	14.10	11.62	12.77	12.19
V_1T_4	18.88	22.28	20.58	15.42	15.92	15.67	12.20	11.44	11.82
V_1T_5	16.21	18.62	17.42	14.97	13.21	14.09	10.99	13.83	12.41
V_1T_6	24.09	34.01	29.05	20.13	17.73	18.93	13.63	14.10	13.86
V_1T_7	15.57	24.88	20.22	14.89	13.78	14.33	10.61	12.45	11.53
V_1T_8	16.94	28.65	22.8	15.50	15.17	15.33	11.51	12.48	12.00
V_1T_9	17.73	22.63	20.18	12.45	12.64	12.55	10.10	11.60	10.85
Grand mean	17.53	23.52	20.52	14.84	14.34	14.59	11.35	12.45	11.90
V_2T_0	14.15	14.91	14.53	11.10	11.06	11.08	8.50	8.95	8.72
V_2T_1	15.51	19.36	17.44	13.60	14.39	13.99	10.66	10.82	10.74
V_2T_2	14.85	20.03	17.44	12.94	12.58	12.77	10.21	11.58	10.89
V_2T_3	15.96	22.35	19.15	12.66	13.31	12.99	11.3	10.68	10.99
V_2T_4	18.29	20.92	19.61	15.02	14.08	14.56	11.81	11.18	11.49
V_2T_5	20.08	16.74	18.42	14.12	11.82	12.97	10.27	11.48	10.88
V_2T_6	22.44	31.51	26.98	17.57	15.26	16.41	12.93	13.37	13.15
V_2T_7	16.90	23.83	20.37	14.47	12.18	13.32	10.57	12.14	11.36
V_2T_8	19.93	26.01	22.97	14.86	12.97	13.92	11.4	11.34	11.37
V_2T_9	20.69	22.61	21.65	11.7	11.06	11.39	9.42	10.44	9.94
Grand mean	17.88	21.83	19.86	13.81	12.87	13.34	10.71	11.2	10.95
	S.E	CD (5%)		S.E	CD (5%)		S.E	CD (5%)	
V	0.287	0.080		0.188	0.065		0.162	0.056	
T	0.643	1.823		0.421	1.193		0.362	1.026	
V × T	0.909			0.595			0.511		

Table 6: Effect of seed biopriming on seed borne diseases on two varieties of mung bean during 2023 and 2024.

Treatments	3 months			6 months			9 months		
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
V_1T_0	6.00	6.50	6.25	8.25	8.75	8.50	10.5	12.25	11.38
V_1T_1	5.25	4.75	5.00	7.25	6.50	6.88	8.50	10.25	9.38
V_1T_2	5.50	4.25	4.88	7.00	7.50	7.25	9.75	11.50	10.63
V_1T_3	3.50	4.75	4.13	6.75	6.25	6.50	9.00	10.75	9.88
V_1T_4	4.50	4.50	4.50	7.50	7.25	7.38	9.50	11.25	10.38
V_1T_5	4.75	5.00	4.88	6.00	7.00	6.50	8.00	9.75	8.88
V_1T_6	3.25	4.00	3.63	5.50	6.00	5.75	7.75	9.50	8.63
V_1T_7	5.00	5.00	5.00	7.25	6.50	6.88	8.75	10.5	9.63
V_1T_8	4.75	5.00	4.88	6.50	7.75	7.13	9.50	11.00	10.25
V_1T_9	4.50	5.25	4.88	7.75	6.75	7.25	9.25	10.50	9.88
Grand mean	4.70	4.90	4.80	6.98	7.03	7.00	9.05	10.73	9.89
V_2T_0	6.75	7.50	7.13	9.25	9.50	9.38	11.5	13.25	12.38
V_2T_1	6.25	5.25	5.75	7.50	6.75	7.13	10.25	12.00	11.13
V_2T_2	5.25	4.75	5.00	7.25	7.50	7.38	9.75	11.50	10.63
V_2T_3	5.75	5.75	5.75	7.75	6.75	7.25	9.50	10.50	10.00
V_2T_4	6.00	5.50	5.75	7.50	7.00	7.25	10.0	11.75	10.88
V_2T_5	4.50	6.00	5.25	6.25	6.50	6.38	8.50	10.00	9.25
V_2T_6	4.25	4.25	4.25	6.00	6.25	6.13	8.25	9.75	9.00
V_2T_7	5.50	5.00	5.25	7.00	7.25	7.13	9.25	11.00	10.13
V_2T_8	5.25	4.50	4.88	6.75	7.75	7.25	9.50	11.25	10.38
V_2T_9	5.50	5.75	5.63	7.25	8.00	7.63	9.00	10.75	9.88
Grand mean	5.50	5.43	5.46	7.25	7.33	7.29	9.55	11.18	10.36
	S.E	CD (5%)		S.E	CD (5%)		S.E	CD (5%)	
V	1.00	0.283		0.106	0 .029		0.198	0.055	
T	0.223	0.633		0.237	0.673		0.443	1.255	
V × T	0.316			0.336			0.626		

CONCLUSION

Two-year lab experiment (during storage period) clearly suggests that usefulness of seed biopriming in moong bean by *Pseudomonas fluorescens*, *Trichoderma viridae, Azospirilum* and *Phosphobacter* for enhancing the germination and vigour in moong bean. This will improve plant health and give healthy produce. The best concentration and duration standardized for biopriming was *Trichoderma viridae* @ 50% for 6 hrs.

ACKNOWLEDGEMENT

The authors thank the authorities of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, U.P. India for providing all the facilities to conduct this investigation.

Conflict of interest

All authors declared that there is no conflict of interest.

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