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Effect of Pre-Sowing and Invigoration Treatment for Better Crop Establishment of Mungbean

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Abstract: ***A study was conducted to evaluate the possibility of integration of different pre-sowing seed treatments with an objective to ensure rapid and uniform field emergence under a wide range of adverse conditions. Fresh and revalidated seed lots of mungbean cv WGG 37 were subjected to invigoration with Hydration (2 h) and drying at RT, 2% $CaCl_2$ and surface drying, Hydration with GA_3 @ 50 ppm and surface drying, Hydration and drying followed by dry dressing with Thiram @ 0.25%, 0.5% KNO_3 hydration and drying and untreated control, as pre sowing treatment .Seed invigoration with Hydration and drying followed by dry dressing with Thiram @ 0.25% before sowing was found very effective for crop establishment with vigorous seedlings, per cent increase seed germination over control, final stand, field emergence index and finally seed yield. A positive interaction between mean germination, vigour, final stand and seed yield indicated long-term effects of seed invigoration on plant growth and development. The present results clearly demonstrate that the seed quality and crop productivity of revalidated seed lots can be improved by pre-sowing and invigoration treatments.***

Keywords: Germination, Invigoration, Mungbean, Seedling vigour, Stand establishment.

1. Introduction

In South East Asian Countries mungbean *(Vigna radiata L.)* is an important crop. It is known as good source of dietary protein. In India it is a third important crop after chickpea and pigeon pea, grown in all seasons and the area of cultivation in India is 3.63 m ha and the production is 1.05 m tones and occupies an area of 14.68 % of the total pulse grown and contributes 8.06 % of total pulse production (1.3 mt per annum). Mungbean being pertinacious nature of seed absorbs water vapour very rapidly in humid atmospheric regions. Prevailing of high temperature accelerates the ageing of seed, thereby rapid decline in germination and viability. To improve the emergence and stand establishment of many field crops is a constant goal, especially for those crops with less genetic and physiological vigour under tropical climatic and soil constraints. One way for achieving good crop stand, capacity of legumes is seed priming which is a technique in which germination processes begin but radicle emergence does not occur [30], [13]. Seed priming found effective for legumes that is, yields of legume crops were increased considerably by priming seeds before sowing [23], [26], [13]. According to Basu (5), seed invigouration implies to an improvement in seed performance by any post-harvest treatment that focused on improvement in germinability, storability and better field performance. One method of improving seed germination performance both in the field and in the glasshouse has been through the use of pre-sowing treatments such as priming [15]. Seed invigoration treatments have been developed to improve seed performance during germination and seedling early growth. Seed priming or osmopriming is a water based process that is carried out on seeds to increase uniformity of germination and emergence, and enhance plant establishment. It entails the partial germination of seeds by soaking them in water (or in a solution of salts) for specified period of time, and then re-dry them just before radicle emerges [6]. Priming stimulates many of the metabolic processes involved with the early phases of germination. As part of the germination process have been initiated due to priming, seedlings from primed seed grow faster, grow more vigorously, and perform better in adverse conditions [4], [7] the duration of the emergence period decreases with priming, leading to more uniform plant stand [22], [4].

Studies indicate that some benefits are associated with pre-sowing treatments for seed vigor enhancement, but there is dearth of information about the germination performance of primed seeds. So it is necessary to develop suitable techniques in order to improve mungbean seed germination capacity to evaluate the effects of different priming treatments on seed germination behavior of mungbean seed lots both under laboratory as well as field conditions to find out the most promising technique. Improved seed invigoration techniques are being used in many parts of the world to reduce the germination time, synchronize germination, improve germination rate and increase seedling stand [20], [21]. Different pre-sowing seed treatments have successfully been integrated for vigor enhancement [30].Seed invigoration treatments have been developed to improve seed performance during germination and seedling early growth [24].The objective of this study was to develop an efficient seed invigoration treatment and to ensure rapid and uniform field emergence under a wide range of conditions.

2. Methodology

2.1 Seed material

Seeds of Mungbean cultivar WGG-37 of fresh seed lot with germination above MSCS (75%) and Revalidated seed lot with germination marginally below MSCS (68%) were obtained. Experiments were conducted on mungbean *(Vigna radiata L.)* during summer (Kharif) seasons (2005 and 2006) in sandy loam soil. FRBD was employed in field of plot size five rows of 4m length with a spacing of 30 x 10 cm in three replications. The seeds were sterilized by using 30% sodium hypochlorite for five minutes and then washed three times with distilled water. Selection of suitable priming compounds was made on the basis of findings of different research workers (10,14,2,19,9).The treatments used were: Untreated control, Hydration (2h) and drying at RT below

25°C, 2% $CaCl_2$ at RT and surface drying, Hydration with 50 ppm GA_3 and surface drying at RT, Hydration (2h) followed by dry dressing with Thiram@ 0.25%, 0.5 % KNO_3 hydration and drying at RT. A non-soaked and non-dried treatment was included as a control.

3. Results and Discussion

All treatments enhanced germination percentage, seedling vigour, field emergence index, final plant stand and seed yield irrespective of fresh/revalidated seed lots (Table 1, 2 & Fig. 1). Among the treatments, hydration (2h) followed by dry dressing with Thiram @ 0.25% improved the performance of mungbean seeds significantly by improving the germination percentage, seedling vigour, field emergence index, field emergence, final plant stand and seed yield and a similar trend was also observed with seed treatment, 2% $CaCl_2$ & surface drying. Hydration (2h) followed by dry dressing with Thiram @ 0.25 % improved final plant stand (138) resulted higher yield (516 g), while the treatment was more effective for revalidated seed lot as compared to the fresh lot. Hydration (2h) followed by dry dressing with Thiram @ 0.25 % improved seedling vigour in revalidated seed lot resulted maximum seed yield. The treatment, hydration (2h) followed by dry dressing with Thiram @ 0.25% was more effective in revalidating the carryover seed compared to the fresh seed in increasing seedling vigour, crop stand and seed yield .Period of soaking should not be beyond the required time for initiating the growth of embryo, which otherwise, would result in deterioration of seed due to an aerobic condition [15]. Prolonged soaking in water may also result in the leakage of the essential soluble constituents of seed into the leachate, which seriously reduces the percentage of germination [15]. Pre-sowing seed hydration treatment mobilizes seed resources that are utilized for rapid and synchronous germination and other quality traits. The physiology and biochemistry of seed hydration as a result of seed conditioning are largely unknown, but may involve changes in membrane integrity, breakdown of seed reserves and production of bioactive substances and other metabolites needed for improved seed performance [20]. Penazola *et al.* [25] also supported this hypothesis by showing that hydration and dehydration is a viable alternative to improve performance in medium quality seed lots. This is primary attributed to enlargement of embryo and also by creating free space between endosperm and embryo as reported in tomato [11].

Pre-sowing priming treatments have been used in integration with other invigoration techniques in order to protect the seeds from abiotic and biotic stresses during critical phase of seedling establishment. Furthermore, different pre-sowing seed treatments have successfully been integrated for vigour enhancement [8].The results suggest that physiological changes produced by pre-soaking seed treatment could enhanced the starch hydrolysis and made more sugars available for embryo growth, vigorous seedling production and, later on, improved allometric, seed yield and quality attributes. The present study shows that soaking, hydration-dehydration and drying treatments can effectively be integrated for vigour enhancement in both fresh and revalidated seeds. However, soaking was most successfully integrated with dry dressing (Thiram @ 0.25%) in fresh and revalidated seed and performed better than other treatments. Such an additional response was very high in revalidated seed compared to the fresh seed lot. A positive interaction between mean germination, vigour, final stand and seed yield indicated long-term effects of seed invigoration on plant growth and development (Fig.1). The enhanced plant height may also be due to the improved and faster plant emergence in invigorated seeds which might have created cooperative competition among the plants for light and resulted in taller plants. The results are in agreement with the results of Harris *et al.* [12], who observed taller plants with seed invigoration. The hydration-dehydration treatment confers increased resistance on the resultant plant to heat and drought [17], besides leaching of inhibitors [29] and enhancement of nucleic acid and protein synthesis [28], resulting in better field performance of hydrated seeds.

Thus the present study demonstrated the performance of mungbean seeds improved significantly by seed treatment i.e. hydration (2h) followed by dry dressing with Thiram (@ 0.25%) which resulted in early field emergence, better plant stand and seed yield over other treatments. The treatment would be more effective for invigorating the revalidated seeds compared to the fresh seeds. The present results clearly indicate that the seed quality and crop productivity of revalidated seed lots can be improved by pre-sowing and invigoration treatments. It is easy and cost effective technology for resource poor farmers of third world countries.

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Table1: Pre-sowing seed treatment for seed invigoration and better crop establishment on fresh and revalidated seed lots of mungbean

Treatments (T)	*Germination (%)*			*Seedling vigour*			*Field emergence index*			*Field emergence*			*Final stand*			*Seed yield(g)/m^{-2}*		
	FS	**RS**	**M**	**FS**	**RS**	**M**	**FS**	**RS**	**M**	**FS**	**RS**	**M**	**FS**	**RS**	**M**	**FS**	**RS**	**M**
T0	67	57	62	1933	1698	1816	2.7	1.3	2	51	28	40	62	51	57	260	224	242
T1	87	83	85	2607	2631	2619	4.7	4.3	4.5	89	87	88	133	121	127	489	433	461
T2	90	87	89	2547	2485	2516	2.7	3.3	3	80	74	77	115	105	110	494	456	462
T3	95	85	90	3043	2789	2916	8.3	3.3	5.8	89	83	86	100	105	103	469	312	391
T4	93	87	90	3017	2809	2913	8	7.7	7.85	88	85	87	147	137	143	534	516	525
T5	88	86	87	2593	2393	2493	3.7	3.3	3.5	79	71	75	123	110	117	468	411	453
M	**87**	**81**	**84**	**2623**	**2468**	**2545**	**5**	**3.8**	**4.44**	**79**	**71**	**75**	**113**	**105**	**109**	**452**	**392**	**422**
	SL	**T**	**I**	**SL**	**T**	**I**	**SL**	**T**	**I**	**SL**	**T**	**I**	**SL**	**T**	**I**	**SL**	**T**	**I**
S.Em±	0.7	1.22	1.72	10	17	24	0.04	0.07	0.1	0.73	1.26	1.78	1.1	1.9	2.6	3.2	5.6	**7.9**
CD (5%)	2.06	3.57	NS	29.08	50.38	88.32	0.12	0.21	0.37	2.13	3.69	6.46	3.15	5.46	9.57	9.45	16.36	28.69

FS: Fresh seed; RS: Revalidated seed; M: Mean; I: Interaction; SL: Seed Lot.

Table 2: Interaction effect of invigoration treatments on germination, seedling vigour, field emergence index, field emergence, final stand and yield of fresh and revalidated seed lots

Treatments	*Germination (%)*	*Seedling vigour*	*Field emergence index*	*Field emergence*	*Final stand*	*Seed yield (g)/ m^{-2}*
FT0	67	1933	2.7	51	62	260
FT1	87	2607	4.7	89	133	489
FT2	90	2547	2.7	80	115	468
FT3	95	3043	8.3	89	100	469
FT4	93	3017	8.0	88	147	534
FT5	88	2593	3.7	79	123	494
RT0	57	1698	1.3	28	51	224
RT1	83	2631	4.3	87	121	433
RT2	87	2485	3.3	74	105	456
RT3	85	2789	3.3	83	105	312
RT4	87	2809	7.7	85	137	516
RT5	86	2393	3.3	71	110	411
S.Em ±	**1.72**	**24.00**	**0.10**	**1.78**	**2.60**	**7.90**
CD (5%)	**NS**	**88.32**	**0.37**	**6.46**	**9.57**	**28.69**

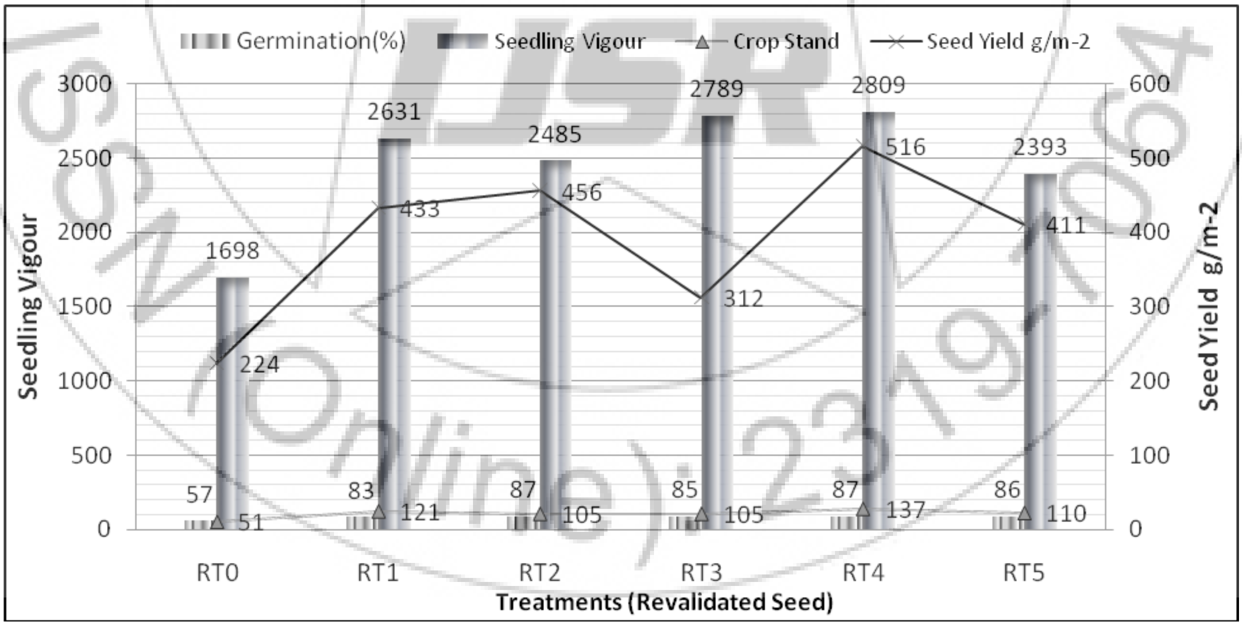

Figure 1: Interaction effect of invigoration treatments on germination, seedling vigour, crop stand and seed yield of revalidated seed lot