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Influence of fungicides and bioagents seed treatment on seed yield and quality in soybean [*Glycine max* (L.) Merrill]

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Abstract

An experiment was carried out at 'H' Block, Main Agricultural Research Station, Seed Quality Testing Laboratory, Seed Unit, University of Agricultural Sciences, Dharwad, to study the influence of fungicides and bio agents on yield and quality parameters of soybean var. DSB 21. Among the treatments, seed treatment with *Bacillus subtilis* @ 10g/kg of seed recorded the higher plant height (23.67, 54.27 and 57.64 cm), number of branches per plant (3.33, 4.73 and 5.93) and number of leaves per plant (32.47, 61.13 and 96.33) at 30, 60 and 90 DAS and higher number of pods per plant (94.93), seed yield per plot (3.75 kg) and seed yield per hectare (2168 kg) over other treatments under the study. Higher seed germination (96.33%), seedling vigour index (3766) and lower seed infection (3.67%) was recorded in seed treatment with Carboxin + Thiram @ 3g/kg of seed.

Keywords: *Bacillus subtilis*, carboxin + thiram, seed treatment, soybean

Introduction

Soybean [*Glycine max* (L.) Merrill] is one of the major economically predominant oilseed crops. It is recognized as the most important versatile and fascinating crop of the world. Soybean contains 40 per cent protein, 20 per cent oil, 85 per cent PUFA and 25-30 per cent carbohydrates, minerals, antioxidants, beta-carotene and iso-flavonoids. Hence it is known as a "Wonder crop" and "Golden bean" of the 21st century. Soybean is rich in a lysine amino acid in which most of the cereals are deficit.

At the global level, India ranks fifth in soybean production with low productivity. Hence, there is a need to enhance the production and quality of produce in India to compete in the production and its export at world level. The genuine problems limiting the production of soybean are poor germination and low seed viability. Micro-organisms play major role on quality of seed, of which fungi are in predominant quantity. These fungi are harmful as they minimize the vigour of seed and diminish the growth of plant at its initial stages.

Fungicides or microbial antagonists act as a barrier for seed infection and seed treating with these save the seed from infection by seed borne and soil borne pathogens. Seed treatment is therefore a routine practice to ensure good emergence and better crop stand (Nene and Thapliyal, 1979; Ramos and Ribeiro, 1993) ^[10, 11]. These treatments allow the seed to germinate rapidly in to a healthy seedling (Chang and Kommedahl, 1968; Henis and Chet, 1975) ^[5, 8]. The present study was aimed to know the influence of seed treatment along with fungicides and bioagents on seed yield and quality parameters of soybean.

Materials and Methods

The experiment consists of eight treatments viz., T₁: Untreated control, T₂: Carboxin + Thiram @ 3g/kg of seed, T₃: Carbendazim + Mancozeb @ 2g/kg of seed, T₄: *Trichoderma harzianum* @ 10g/kg of seed, T₅: *Pseudomonas fluorescens* @ 4g/kg of seed, T₆: *Bacillus subtilis* @ 10g/kg of seed, T₇: Tebuconazole @ 2g/kg seed and T₈: Penflufen @ 1g/kg of seed. Laboratory and field experiments were carried out at Seed Quality and Research Laboratory, Seed Unit, Dharwad, Department of Plant Pathology and 'H' Block, Main Agriculture Research Station Farm, Dharwad.

Seed Source

Foundation seeds of soybean variety viz., DSb 21 were collected from the National Seed Project (Crops), University of Agricultural Sciences, Dharwad.

Field Experiment

Growth parameters like plant height, number of branches per plant and number of leaves per plant were recorded at 30, 60 and 90 DAS from the five tagged plants in each treatment. The yield parameters like number of seeds per pod, number of pods per plant and hundred seed weight were recorded at harvest. The seed yield (kg plant^{-1}) was recorded for each treatment and then seed yield per hectare was computed and expressed as kg ha^{-1} .

Lab experiment

The germination percentage was worked out as per the procedure given by ISTA (Anon., 2011) [2], shoot and root length was measured in cm, seedling vigour index was worked out as per the formula given by Abdul-Baki and

Anderson (1973) [1]. Seed infection is determined as the proportion of soybean seed showing any symptom of infection and calculated as:

Seed Infection (%) = $\frac{\text{Number of seeds Infected}}{\text{Total number of seeds sown}} \times 100$.

Results and Discussion

The data on effect of seed treatment on plant growth parameters is given in the Table 1. The impact of seed treatment with fungicides and bioagents on plant growth parameters such as plant height, number of branches per plant and number of leaves per plant was non-significant at 30 days after sowing. However, the higher plant height was observed in seed treatment of *Bacillus subtilis* @ 2g/kg seed (T_6) (23.67 cm) followed by seed treatment with Carbendazim + Mancozeb @ 2g/kg seed (T_3) (23.36 cm) and control (T_1) recorded the lower plant height (19.37 cm). Significantly higher plant height at 60 DAS and 90 DAS (54.27 cm, 57.64 cm) was recorded in T_6 , while it was lowest in T_1 (45.69 cm, 48.27 cm).

Table 1: Effect of seed treatment on plant growth at 30, 60 and 90 DAS

Treatments	30 DAS			60 DAS			90 DAS		
	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Plant height (cm)	Number of branches per plant	Number of leaves per plant
T_1	19.37	2.73	26.07	45.69	3.67	52.63	48.27	4.67	85.07
T_2	21.65	3.13	30.07	49.64	4.53	58.17	54.00	5.33	91.60
T_3	23.36	3.27	32.07	52.89	4.60	59.80	55.33	5.80	95.40
T_4	21.22	2.93	28.67	48.93	4.47	55.47	52.51	5.27	91.20
T_5	22.10	3.20	31.87	51.70	4.60	58.20	55.03	5.73	94.40
T_6	23.67	3.33	32.47	54.27	4.73	61.13	57.64	5.93	96.33
T_7	20.12	2.73	27.40	48.27	3.73	54.27	49.45	4.93	86.20
T_8	20.87	2.87	28.13	48.32	3.93	55.03	49.51	5.13	87.07
Mean	21.55	3.03	29.59	49.96	4.28	56.84	52.72	5.35	90.91
S. Em $\pm$	0.89	0.15	1.56	1.69	0.39	1.76	1.92	0.16	2.62
C. D. @ (5%)	NS	NS	NS	5.12	5.25	5.35	5.82	0.49	7.96

Number of branches per plant was non-significant at 30 DAS. However, more number of branches per plant was observed in T_6 (3.33) followed by T_3 (3.13) and T_1 recorded the least number of branches per plant (2.73). At 60 DAS and 90 DAS (4.73, 5.93) significant variation in number of branches per plant was observed in T_6 while it was lowest in T_1 (3.67, 4.67).

There was no significant variation in number of leaves per plant at 30 DAS. However, more number of leaves per plant was recorded in T_6 (32.47) and least in T_1 (26.07). At 60 DAS and 90 DAS (4.73, 5.93) significant variation in number of leaves per plant was observed in T_6 while it was lowest in T_1 (3.67, 4.67).

In general, crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between desired storage organs of plant. The data on effect of seed treatment on yield parameters was given in the Table 2. In the present study highest number of pods per plant, seed yield per plot and seed yield per hectare was recorded in T_6 (94.93, 3.75 kg/plot and 2168 kg/ha) and least was recorded in T_1 (71.87, 3.22 kg/plot and 1861 kg/ha). The number of seeds per pod and hundred seed weight was non-significant. However, highest number of seeds per pod and hundred seed weight was recorded in T_6 (3.17, 13.94 g) and lowest was recorded in T_1 (2.52, 12.93 g) respectively. Sushma (2003) [12] and Gawade *et al.* (2009) [6] have also reported similar effect in different crops.

Table 2: Effect of seed treatment on yield parameters at harvesting

Treatments	Number of pods/plant	Number of seeds/pod	100 weight (g)	Seed yield/plot (kg)	Seed yield/ha(kg)
T_1	71.87	2.52	12.93	3.22	1861
T_2	91.73	2.76	13.65	3.44	1989
T_3	93.67	2.96	13.91	3.57	2068
T_4	86.07	2.73	13.44	3.37	1948
T_5	92.53	2.86	13.88	3.47	2010
T_6	94.93	3.17	13.94	3.75	2168
T_7	76.60	2.61	13.26	3.32	1919
T_8	82.53	2.67	13.36	3.34	1933
Mean	86.24	2.78	13.55	3.43	1987
S.Em $\pm$	2.55	0.15	0.39	0.10	57.81
C. D. @ (5%)	7.73	NS	NS	0.30	175.34

Highest seed quality parameters viz., seed germination, root length, shoot length, seedling vigour index I were recorded in T₂ (96.33%, 20.43 cm, 18.66 cm, 3766) and lowest in T₁ (90.00%, 16.87 cm, 15.94 cm, 2953) (Fig: 1, 2 & 3) respectively. The variation in seed germination percentage and seedling length may be attributed to plant growth

promotional effect of seed primers especially bioagents that may produce growth regulatory substances (hormones) upon seed imbibition. These findings are in agreement with the findings of Bapurayagouda (2010) ^[4], Jin and Tylkowska (2005) ^[9].

Fig 1: Effect of seed treatment on seed germination (%) and seed infection (%) in soybean var. DSb 21.

The decline in germination percentage may be attributed to ageing effect leading to depletion of food reserves and decline in synthetic activity of embryo apart from death of seed because of fungal invasion, insect damage, fluctuating temperature, relative humidity. Similar results were reported by Vidhyasekaran *et al.* (1980) ^[14] in sorghum and millet, Ashokan *et al.* (1981) ^[3] in finger millet. The combi fungicides have both systemic and contact in its action hence these chemicals protect the seed from soil borne and seed borne organisms and reduces the respiration of seeds and improve the performance of seed. These findings in agreement with the findings of Vanangamudi *et al.* (2003) ^[13]. The lowest seed infection was recorded in T₂ (3.67) while highest in T₁ (9.67%).

Fig 2: Effect of seed treatment on root length (cm) and shoot length (cm) in soybean var. DSb 21.

Fig 3: Effect of seed treatment on seedling vigour index I soybean var. DSb 21.

Conclusion

In line with these views, in the present study, the seed treatment with *Bacillus subtilis* @10g/kg of seed recorded highest plant growth and yield parameters. This might be due to the release of plant growth promoting hormones, nutrient mobilization, nutrient uptake and antagonistic activity against pathogens (Hanamanthraju *et al.*, 2010) ^[7]. Under laboratory conditions seed treatment of Carboxin + Thiram @ 3g/kg of seed recorded highest seed quality parameters and lower seed infection. This might be due to chemical treatments act as physical barrier, which reduces leaching of inhibitors from seed covering and restricts the oxygen movement and thus reducing the respiration of embryo resulting in improved seed germination and other quality parameters.

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