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In vitro evaluation of seed dressing fungicides, bioagent and priming agents against pod blight complex of soybean (*Glycine max* (L.) Merrill) by rolled towel method

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Abstract
The research experiment was conducted in labouratory during *kharif* 2018 to test the efficacy of different seed treatments *viz.,* seed dressing fungicides, bio agent *i.e. Pseudomonas fluorescens* and priming agents (jelly, vermiculite, coco peat and coir pith) against seed borne pathogens associated with the pod blight complex of soybean (Variety JS 335) by using rolled towel method. The results of the experiment revealed the least per cent seed infection of 7.33 per cent was noticed in seed treatment with carboxin 37.5% + thiram 37.5% @ 2 g/ kg of seed and next best treatment was seed treatment with mancozeb 50% + carbendazim 25% @ 2 g/ kg of seed with seed infection of 10 per cent. Among the bioagent and priming agents tested, T_8 (seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly) recorded the seed infection of 15.67 with germination per cent of 95.67 and vigor index of 972.64 and this treatment was superior over chemicals with respect to per cent germination and vigor index.

Keywords: Soybean, JS 335, seed infection, germination, vigour index, rolled towel

Introduction
Soybean (*Glycine max* L. Merrill., 2n=40) is one of the world's most important legume contributing significantly as an oilseed in terms of total production and international trade. Soybean, otherwise also known as a 'miracle crop' has an average protein content of 40 per cent and is more protein rich than any of the common vegetable or animal food sources. Soybean seeds also contain about 20 per cent oil on a dry matter basis of which 85 per cent is unsaturated and cholesterol free. Recent increase in production coincides with increase in demand for meal and oil. Soybean cultivation has expanded as a result of its nutritive and economic importance and diverse domestic usage. It is also a prime source of vegetable oil in the international market.

Soybean is a major oilseed and pulse crop and its plant parts easily succumb to different biotic stresses. Among them major constrains for soybean cultivation is the pod blight disease. Even though many seed and soil borne diseases do occur in the crop, pod blight has more important due to severe crop losses. Pod blight is a complex disease in which more than one pathogen is involved and also nature of damage and symptoms are decided by pathogens association. The disease is usually caused by fungal spp. Among the fungal diseases infecting soybean crop, pod blight complex disease caused by *Colletotrichum truncatum, Colletotrichum gloeosporoides and Macrophomina phaseolina* is one of the most important and destructive disease causing lower production and productivity and higher yield losses in soybean has been reported as the major constraint in the successful cultivation of soybean (Backman *et al.,* 1982 and Sinclair, 1974) [3, 7].

Material and Methods
The present investigation was carried out during *kharif* 2018 in labouratory of Department of Plant Pathology, University of Agricultural Sciences, Dharwad. This method was employed to know the effect of seed-borne inoculum on seed quality parameters of Soybean *i.e.,* to carry out germination and vigor tests of apparently healthy and infected seed lots of soybean and also to see the effect of different seed treatments on seed-borne inoculums as per the International Seed Testing Association Rules (Anon, 1996) [2]. Randomly selected 100 seeds were placed on two layers of moist germination paper, which were placed on a polythene paper and rolled carefully to avoid any excess pressure on seeds which consists of nine treatments including control and each treatment was replicated thrice. These towels were incubated in seed germinator at 20±2ºC for 10 days. The first count was taken on tenth day and

second count on fourteenth day. All morphologically normal seedlings were counted and germination was expressed in percentage.

To find out the seedling vigor, ten seedlings were taken from the germination test at random and the root length was measured from the collar region to the tip of the primary root and the mean root length was expressed in cm. The same seedlings were used for the measurement of shoot length. The shoot length was measured from the collar region to the point of junction of cotyledons. The mean shoot length was expressed in cm. Vigor index was calculated by the following formula, given by Abdul Baki and Anderson (1973) [1].

Vigor Index = Seed germination (%) × Seedling length (Shoot +Root length (cm))

Table 1: Details of the experimentation

Treatment	Treatment details
T_1	Seed treatment with carboxin 37.5% + thiram 37.5% @ 2 g/ kg of seeds
T_2	Seed treatment with mancozeb 50% + carbendazim 25% @ 2 g/ kg of seeds
T_3	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + jelly
T_4	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed
T_5	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + vermiculite
T_6	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coco peat
T_7	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith
T_8	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly
T_9	Untreated control

Results and Discussion

Efficacy of different seed treatments *viz.,* seed dressing fungicides, bio agent *i.e. Pseudomonas fluorescens* and priming agents (jelly, vermiculite, coco peat and coir pith) were tested for their efficacy against seed borne pathogens associated with the pod blight complex of soybean (variety JS335) by using rolled towel method, as explained in 'Material and Methods' and results are presented in table 2.

The results indicated that all the treatments were significantly superior over untreated control. From the data, it is clear that the least per cent seed infection of 7.33 per cent was noticed in T_1 (seed treatment with carboxin 37.5% + thiram 37.5% @ 2 g/ kg of seed) with per cent germination of 91.67 and vigour index of 785.11 which is found to be on par with T_2 (seed treatment with mancozeb 50% + carbendazim 25% @ 2 g/ kg of seed) with infection of 10 per cent, per cent germination of 89.33 and vigour index of 708.04. However, treatments T_1 and T_2 were found significantly superior over other treatments with respect to per cent seed infection.

Among the bioagent and priming agents tested, T_8 (seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly) recorded the seed infection of 15.67 per cent with per cent germination of 95.67 and with vigour index of 972.64, which is found to be on par with T_5 (seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + vermiculite) and T_7 (seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith). However T_8 *i.e.* seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly was found significantly superior to seed treatment with chemicals(T_1 and T_2) with respect to vigour index though found on par with respect to per cent seed germination and significantly inferior with respect to per cent seed infection.

All treatments with seed dressing fungicides, bioagent and priming agents showed significant increase in seed germination, vigour index and per cent infection compared to untreated seeds (control). Seed treatment with carboxin + thiram and mancozeb 50% + carbendazim 25% showed least per cent infection. Whereas, seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly recorded higher per cent germination and vigour index .

Seed priming (or) osmo-conditioning is a method of pre-sowing hydration treatment for improvement of seedling establishment. Primed seeds will be handled similar to conventional seeds and the process was performed by a seed company. On-farm seed priming seems to be a robust, widely applicable technology and its effects are generally independent of the crop variety used. This is important, because priming was used to add value to the benefits achieved by using improved modern varieties or by adoption of other improved technologies such as fertilizer or better crop protection Seed treatment with bio-control agents along with priming agents may serve as an important means of managing many of the soil and seed-borne diseases, the process often known as bio-priming. However, this may not give additional benefits under optimum conditions. Hence, an attempt was made in the present investigation to know the effect of different priming agents *viz.,* jelly, vermiculite, coco peat/peat mass and coir pith along with bio-agent in the management of fungi involved in pod blight complex. Out of the different priming agents along with the bio agent tested, *Pseudomonas fluorescens* + coir pith + jelly showed the best results with least seed infection of 15.67 per cent. When compare to chemicals, though this treatment was found significantly inferior with respect to per cent seed infection, exhibited significantly superior vigour index and found on par with respect to per cent seed germination clearly indicating the significance of bio priming. Hence this treatment was further tested under field conditions along with the seed dressing fungicides. The present investigations are in agreement with El-Mohamedy and Abd El-Baky (2008), where they reported enhanced efficacy of bio control agents with bio-priming, seed coating with bio-control agents *T. harzianum*, *B. subtilis* and *P. fluorescnes* enhanced their effectiveness in controlling root rot disease incidence compared to other treatments. Similar observations have been recorded by Harman *et al.* (1989) [5], who reported increased plant stand in soils infested with *F.graminarum* and *Pythium ultimum* by priming of wheat seeds with. They further reported that, in field trial stands of peas were not significantly enhanced by seed treatment with *P. fluorescnes* strains in the absence of priming but were improved by *P. fluorescnes* + vermiculite. Rao *et al.* (2009) [6] reported the enhanced efficacy of *Psudomonas fluorescnes* by bio-priming the sunflower seeds for the effective and eco-friendly management of Alternaria blight of sunflower and the best results were obtained in the plots treated with *Psudomonas fluorescnes* (0.8%) in jelly + hexaconozole foliar spray.

Table 2: Efficacy of seed dressing fungicides, bioagents and priming agents against pod blight complex by rolled towel method - Cultivar: JS335

Sl. No.	Treatments details	Per cent seed infection	Germination (%)	Vigour index (mm)
1	Seed treatment with carboxin 37.5% + thiram 37.5% (vitavax Power) @ 2 g/ kg of seed	7.33 (15.89)*	91.67 (74.63)*	785.11
2	Seed treatment with mancozeb 50% + carbendazim 25% (sprint 75 WP) @ 2 g/ kg of seed	10 (18.90)	89.33 (71.06)	708.04
3	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + jelly (1:2)	20 (29.66)	92.67 (75.79)	818.1
4	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed	21.33 (28.65)	89 (70.15)	836.97
5	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + vermiculite (1:2)	18.33 (26.19)	93.67 (75.20)	886.26
6	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coco peat (1:2)	19.67 (28.65)	94 (76.41)	892.70
7	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith (1:2)	18.67 (26.55)	92.33 (72.51)	850.60
8	Seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly (1:2:2)	15.67 (24.72)	95.67 (79.99)	972.64
9	Untreated control	24 (30.32)	82.00 (63.05)	507.33
	S.Em. ±	1.31	1.96	28.89
	CD (1%)	3.93	5.88	117.58

* Arc sine transformed values

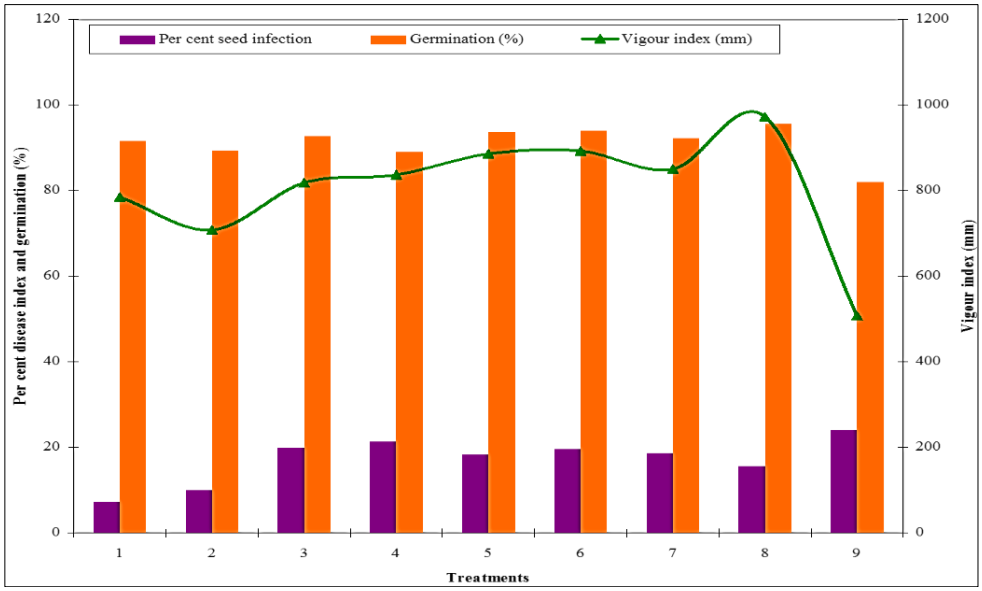

Fig 1: Graph representing efficacy of seed dressing fungicides, bio agent and priming agents against pod blight complex of soybean by rolled towel method

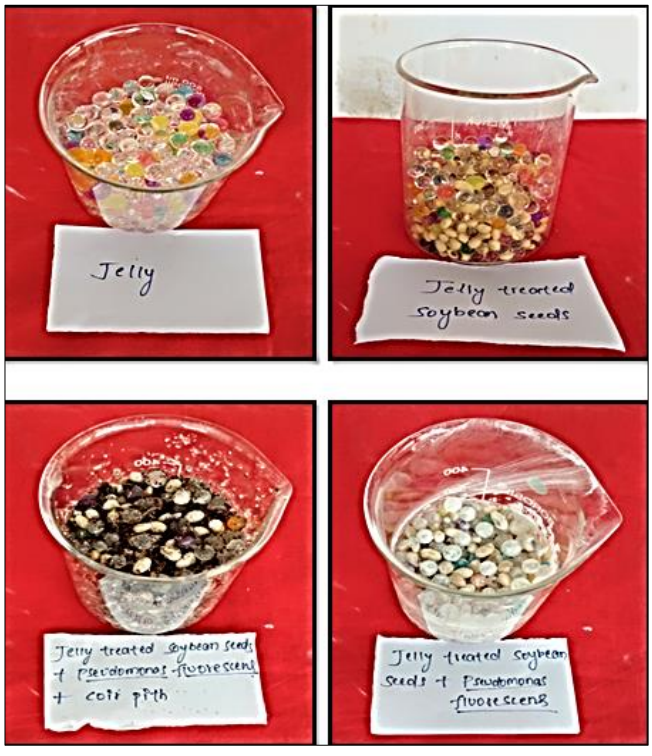

Fig 2: Seed treatment with different priming agents and bio agent

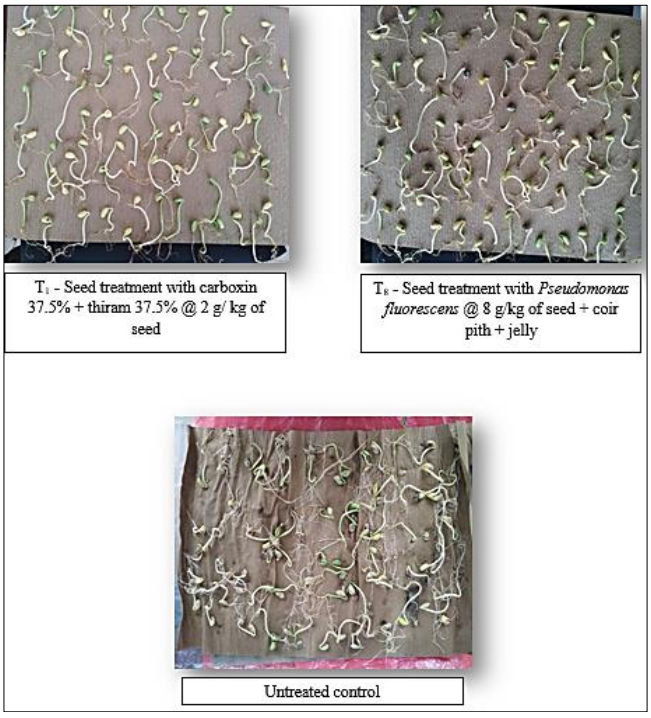

Fig 3: Effective seed dressing fungicides, bio agent and priming agents against pod blight complex of soybean by rolled towel method

Conclusion

In vitro evaluation of different seed treatments *viz.*, seed dressing fungicides, bio agent *i.e. Pseudomonas fluorescens* and priming agents (jelly, vermiculite, coco peat and coir pith) were tested for their efficacy against seed borne pathogens associated with the pod blight complex of soybean (Variety JS335) by using rolled towel method. The least per cent seed infection of 7.33 per cent was noticed in T_1 (seed treatment with carboxin 37.5% + thiram 37.5% @ 2 g/ kg of seed) and next best treatment is T_2 (seed treatment with mancozeb 50% + carbendazim 25% @ 2 g/ kg of seed) with infection of 10 per cent. Among the bioagent and priming agents tested, T_8 (seed treatment with *Pseudomonas fluorescens* @ 8 g/ kg of seed + coir pith + jelly) recorded the seed infection of 15.67 with germination per cent of 95.67 and vigor index of 972.64 and this treatment was superior over chemicals with respect to per cent germination and vigor index.

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