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INFLUENCE OF FUNGICIDE TREATMENT ON SEED QUALITY PARAMETERS OF THE SOYBEAN

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Abstract

One of the basic needs in agriculture is quality seed, quality seed is characterised by high viability and vigour. Oil seeds are very sensitive to the harsh environmental conditions. It is hypothesized that their oil content readily oxidize, which deteriorate the seed health in storage. Seed treatment with fungicides improves seed health, plant stand and crop yield. Seeds of the soybean treated with fungicide xelora @ 2.5 ml/kg foliage spraying with Opera @ 750 ml/ha at 40 and 60 DAS. There was significant difference in the seedling length, leaf area and seedling vigour index after 15 DAS. Two foliar application of fungicide opera @ 750 ml/ha carried on 40^{th} and 60^{th} DAS. The chlorophyll a content and internal CO_2 did not differ significantly but photosynthetic rate, stomatal conductance transpiration rate, chlorophyll b and total chlorophyll differed significantly between treatment. The higher yield was noticed in the foliar application of opera @ 750ml/ha. The yield was higher in fungicide applied plot (16.24 Q/ha) compared to the control (14.30 Q/ha). However there was 10.85% and 16.23% increase in the yield over control followed by foliar application of opera @ 750 ml/ha in first and second season respectively. Over all data indicated that there was increase in yield in fungicide applied plot. This increase was mainly because of application of fungicide opera.

Key words : Strobilurin group of fungicides, Xelora, Opera, seed treatment and foliage application.

Introduction

One of the basic needs in agriculture is quality seed, quality seed is characterised by high viability and vigour (Yaklich *et al*., 1979). These two characters cannot be differentiated in storage, especially in seed lots of crop species like soybean {*Glycine max* (L.) Merr.} that rapidly deteriorate under ambient storage in subtropical and tropical environments, with high temperatures and humidities (Delouche, 1975; Arulnandhy *et al*., 1984). Viability and vigour tend to decline as seed ages.

Oil seeds are very sensitive to the harsh environmental conditions. It is hypothesized that their oil content readily oxidize, which deteriorate the seed health in storage (Kausar *et al*., 2009). Seed storage conditions can determine germination characteristics and vigor potential of seeds (Mc Donald, 1999). Various factors such as weather conditions during seed producing stage, pests and diseases, seed oil and moisture content, mechanical damages, storage time and relative humidity of store can affect vigor of seeds (Krishnan *et al*., 2003; Marshal and Levis, 2004). Seed aging is a function not only depends on time but also depends on temperature, moisture content of seed and relative humidity of the storage room. Consequently the seed storage environment greatly influences the period of seed survival. Seed viability and vigor loss is either due to seed aging or effect of adverse environmental factors (McDonald, 2004). Also, decrease in seed vigor is due to decrease in germination indexes, yield and also can increase susceptibility to environmental stress.

There is a loss of growth and vigor in stored seeds which ultimately cause a decrease in total number of germinating seeds. One of the major constraints of soybean cultivation is the non availability of high vigor seeds at the time of sowing (Gupta and Aneja, 2004). Seeds usually loose their germinability during period of prolonged storage (Gidrol *et al*., 1989) even under optimal conditions.

Seed treatment with fungicides not only controls the seed-borne diseases but also improves seed health, plant stand and crop yield (Tanweer, 1982). Strobulurin group

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of fungicides improves the rate of germination, germination percentage, seedling growth, seedling vigour index, leaf area, physiological parameters and pigment synthesis in the plant. Evaluation of seed quality parameters of the fungicide treated soybean seeds with comparison of the control seeds. This is important to judge the effect of seed treatment with fungicide (Xelora) on enhancement of the seed quality parameters. With this background present study was designed with the objective of influence of seed treatment with fungicide (Xelora) on seed quality parameters of the soybean and application of the fungicide (Opera) as foliar spray improves the plant growth and yield.

Materials and Methods

Field experiments were conducted during *kharif* 2013-14 and 2014-15 to study effect of fungicide on plant growth and effect of seed treatment of fungicide on productivity of soybean. Experiment comprised of 2 treatment: 1. No fungicide (Control) 2. Seed treatment with xelora @ 2.5 ml/kg + foliage spraying with Opera @ 750 ml/ha at 40 and 60 DAS, laid out in randomized block design with three replications. Variety used for the experiment was DSB- 21. Seeds were obtained from the All India Co-ordinated Research Project on soybean, Main Research Station, Dharwad. Healthy and bold seeds were dibbled with a spacing of 30 cm × 10 cm to a depth of 3 cm.

Treatment details

1. No fungicide (Control)

2. Seed treatment with xelora @ 2.5 ml/kg + foliage spraying with Opera @ 750 ml/ha at 40 and 60 DAS.

Seed quality parameters like root length, shoot length, plant height, leaf area and seedling vigour index was taken after 15 days after sowing. Seedling vigour index was calculated by using the formula:

Seedling vigour index = Germination % × Seedling length.

Chlorophyll pigment analysis also did after 15 days after sowing by using DMSO method. Physiological parameters like photosynthetic rate, stomatal conducatance, internal CO_2 and transpiration rate was measured by using IRGA after first foliar spray with fungicide opera.

Results and Discussion

Seeds of the soybean variety DSB-21 treated with fungicide xelora @ 2.5 ml/kg and sown during *karif* on 20/06/2014 along with control (without seed treatment) for comparison. There was significant difference in the seedling length, leaf area and seedling vigour index after 15 DAS (table 1). Two foliar application of fungicide opera @ 750 ml/ha carried on 40^{th} and 60^{th} DAS. The chlorophyll a content and internal CO_2 did not differ significantly, but photosynthetic rate, stomatal conductance transpiration rate, chlorophyll b and total chlorophyll differed significantly between treatment (tables 2 and 3). The higher yield was noticed in the foliar application of opera @ 750ml/ha (table 4).

Among the treatments the fungicide applied (opera @ 750 ml/ha) plot recorded higher root length (16.89cm), shoot length (36.73cm), seedling length (52.94cm), leaf area (128.95cm^2) and seedling vigour index (4764.60) as compared to the control plants *i.e.* root length (11.55cm), shoot length (31.46cm), seedling length (41.93cm), leaf area (68.83cm^2) and seedling vigour index (3356.00) at 15 days after sowing (table 1). The fungicide applied plot recorded higher total chlorophyll (0.191 mg g^{-1} fr. wt) but in control (0.163 mg g^{-1} fr. wt) and higher chlorophyll a recorded in fungicide applied plot (0.096 mg g^{-1} fr. wt) but in control (0.084 mg g^{-1} fr. wt) (table 2). Among the physiological parameters like photosynthetic rate, stomatal conductance and transpiration rate showed significant difference. The higher photosynthesis rate (32.72 µmol CO_2/m^2/sec), stomatal conductance (0.56 µmol CO_2/ m^2/sec) and transpiration rate (7.84 µmol H_2O/ m^2/sec) recorded in fungicide applied plants compared to the control (table 3). All the parameters as mentioned above were higher in fungicide applied plot in both the years (2013-14 and 2014-15). When compared to the yield, the yield was higher in fungicide applied plot (20.74 Q/ha) compared to the control (14.30 Q/ha). However, thus there was 10.85% increase over control (14 Q/ha) followed by foliar application of opera @ 750 ml/ha (20.52 Q/ha) in 2013-14 and 16.23% increase over control (14.6 Q/ha) followed by foliar application of opera @ 750 ml/ha (20.97 Q/ha) in 2014-15. Over all data indicated that there was increase in yield in fungicide applied plot. This increase was mainly because of application of fungicide opera.

The reason for higher yield *viz*. increased plant height, leaf area, chlorophyll content and physiological parameters have positive influence on yield and these parameters increased because of application of fungicide. Total biomass was increased up to 10% in pyraclostrobin applied at R_3 compared with the control (Swoboda and Pedersen, 2009). Similarly, Kanungo and Guruprasad (2015) evaluated the effect of strobilurin: Opera (Pyraclostrobin + Epoxiconazl) on Soybean var. JS-335. Enhancements in growth were observed in Opera fungicide spayed plants with the concentration from 0.05% to 0.3%

Table 1 : Effect of fungicide (Xelora) seed treatment on seedling growth.

After 15 days of sowing																		
	Root length (cm)						Shoot length (cm)						Seedling length (cm)					
	2013-14		2014-15		Pooled		2013-14		2014-15		Pooled		2013-14		2014-15		Pooled	
	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT
Average	11.3	15.9	11.80	17.88	11.55	16.89	28.20	34.66	31.46	38.80	29.83	36.73	40.6	49.2	43.26	56.68	41.93	52.94
Std. dev	1.18	3.38	1.47	3.08	1.33	3.23	2.43	2.73	2.75	2.82	2.59	2.78	2.16	2.91	1.67	3.51	1.91	3.21
Cal. t value	2.659		4.01		3.33		3.67		4.20		3.93		4.88		7.74		6.31	
Table t value	2.31		2.31		2.31		2.31		2.31		2.31		2.31		2.31		2.31	
Result	S		S		S		S		S		S		S		S		S	

After 15 days of sowing												
	Leaf area(cm^2)						Seedling vigour index					
	2013-14		2014- 15		Pooled		2013-14		2014- 15		Pooled	
	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT
Average	65.86	122.5	71.79	135.39	68.83	128.95	3251.2	4428	3460.80	5101.20	3356.00	4764.60
Std. dev	14.27	16.67	14.69	14.81	14.48	15.74	197.19	274.39	133.70	316.12	165.44	295.25
Cal. t value	5.77		6.82		6.30		7.788		10.69		9.24	
Table t value	2.31		2.31		2.31		2.31		2.31		2.31	
Result	S		S		S		S		S		S	

C: Control (Without fungicide treatment) FT: Fungicide applied (Seed treatment with xelora + foliage spraying with Opera)

Table 2: Effect of fungicide application on Chlorophyll content of the leaf.

After 15 days of sowing																		
	Chlorophyll a(mg/g. fresh wt)						Chlorophyll b (mg/g. fresh wt)						Total chlorophyll (mg/g. fresh wt)					
	2013-14		2014- 15		Pooled		2013-14		2014- 15		Pooled		2013-14		2014- 15		Pooled	
	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT
Average	0.085	0.103	0.084	0.089	0.084	0.096	0.075	0.095	0.082	0.094	0.078	0.095	0.159	0.199	0.166	0.183	0.163	0.191
Std. dev	0.016	0.006	0.009	0.008	0.012	0.007	0.009	0.001	0.007	0.010	0.008	0.006	0.021	0.005	0.010	0.008	0.016	0.007
Cal. t value	7.09		7.87		7.48		13.86		8.98		11.42		7.17		15.51		11.34	
Table t value	2.31		2.31		2.31		2.31		2.31		2.31		2.31		2.31		2.31	
Result	S		S		S		S		S		S		S		S		S	

C: Control (Without fungicide treatment) FT: Fungicide applied (Seed treatment with xelora + foliage spraying with Opera)

Table 3 : Effect of fungicide application on physiological parameter.

After 15 days of sowing												
	Photosynthetic rate (μ mol CO_2 m^{-2} sec^{-1})						Stomatal conductance (m mol $m^{-2}s^{-1}$)					
	2013-14		2014- 15		Pooled		2013-14		2014- 15		Pooled	
	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT
Average	17.76	36.78	16.17	34.67	16.96	35.72	0.32	0.65	0.36	0.70	0.34	0.67
Std. dev	2.91	0.97	4.63	2.90	3.77	1.94	0.01	0.04	0.02	0.05	0.01	0.04
Cal. t value	10.73		6.39		8.56		24.57		10.40		17.48	
Table t value	2.31		2.31		2.31		2.31		2.31		2.31	
Result	S		S		S		S		S		S	

After 15 days of sowing												
	Internal CO_2 (μ mol CO_2 mol^{-1})						Transpiration rate (μ mol H_2O m^{-2} sec^{-1})					
	2013-14		2014- 15		Pooled		2013-14		2014- 15		Pooled	
	C	FT	C	FT	C	FT	C	FT	C	FT	C	FT
Average	162.40	260.61	151.26	258.97	156.83	258.97	5.23	7.69	5.47	7.99	5.35	7.84
Std. dev	23.47	24.42	12.58	19.28	18.02	21.85	0.14	1.15	0.07	0.77	0.10	0.96
Cal. t value	1.22		1.48		1.35		3.70		4.53		4.12	
Table t value	2.31		2.31		2.31		2.31		2.31		2.31	
Result	NS		NS		NS		S		S		S	

C: Control (Without fungicide treatment) FT: Fungicide applied (Seed treatment with xelora + foliage spraying with Opera)

Table 4 : Yield (q ha^{-1}) and comparison of yield of the fungicide treated plot with control plot.

Yield (q ha^{-1})						
	2013-14		2014-15		Pooled	
	C	FT	C	FT	C	FT
Average	14	20.52	14.6	20.97	14.3	20.74
Std. dev	2.09	3.06	2.18	3.13	2.14	3.10
Cat. t value	3.06		2.91		2.99	
Table t value	2.77		2.77		2.77	
Result	S		S		S	

C: Control (Without fungicide treatment)
FT: Fungicide applied (Seed treatment with xelora + foliage spraying with Opera)

	2013-14		2014-15	
Treatment	**Yield Q/ha**	**% increase in yield over control**	**Yield Q/ha**	**% increase in yield over control**
Control	14	0	14.6	0
Foliar treatment	15.52	10.85	16.97	16.23

at 10th and 20th DAE (days after Emergence). Biomass (plant height, fresh weight and dry weight) and yield (number of pods, number of seeds and 100 seed weight) of soybean were enhanced by Opera. Kanungo and Joshi (2015) reviewed that F-500 (pyraclostrobin) strobilurin, a new generation broad spectrum fungicide has been shown to cause changes in the metabolism of plants resulting in higher biomass and yield. Byamukama *et al*. (2013) explained that Pyraclostrobin treated plots had a significantly higher area under green leaves incidence curve compared to non treated maize. Application of pyraclostrobin to maize delayed senescence of the leaves thus contributing to the stay green effect. similar results were also reported by Zilli *et al*. (2009), he evaluated the fungicide carbendazim + thiram increased nodulation upto 50% and increase in grain yield is more than 20%. Solorzano *et al*. (2011) observed yield was greater (≥8%) than the controls. Similarly, Sitansu Pan *et al*. (2010) studied the effect of fungicidal seed treatment on germination, radicle and plumule length of seeds of mungbean, mustard and rice. He explained there was increase in the germination percent, radical and plumule length of mungbean seeds with fungicidal seed treated over untreated control.

Conclusion

Over all data indicated that there was increase in yield in fungicide applied plot. This increase was mainly because of application of fungicide opera. Seed treatment with fungicides improves seed health, plant stand and crop yield. This strobilurin group of fungicide increases the plant growth and yield of the crop by increasing plant height, leaf area, chlorophyll content and photosynthetic rate.

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