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Comparison of Near Nano Size and Commercial Grade Botanicals with Shaking and without Shaking on Seed Quality Attributes of Soybean (*Glycine max* L.) cv. CO 3 Seeds

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ABSTRACT

Background: Soybean is important oil seed crop. Poor seed germination is a major constraint for increasing the productivity of soybean. Seed quality enhancement will enhance the germination. Treating the seeds with chemicals may cause harmful effects to ecosystems and also to human beings. Using botanicals for seed treatment is safe. The present study was taken with a view to assess the seed quality of soybean by using different botanicals treatments (ball milled and commercial grade) along with shaking and without shaking.

Methods: Experiment was conducted to evaluate the effect of seed treatment with different ball milled botanicals and commercial grade along with shaking (60 min) and without shaking of soybean seeds on quality attributes. Botanical powders of fenugreek (*Trigonella foenum-graecum* L.) seed, leafs of ashwagandha (*Withania somnifera*), tea (*Camellia sinensis*) and noni (*Morinda citrifolia*) were ball milled for 1 h to bring into near nano size and treated with seeds @ 2 g kg^{-1} for 60 min. Without ball milling was served as commercial grade. Among these two methods (commercial grade and near nano size) highest values were observed in seeds treated with near nano size powder. Generally shaking of seeds with botanicals was performed better than without shaking.

Result: In this experiment, botanical fenugreek seed powder perfrmed well. In interaction, soybean seeds treated with near nano size fenugreek seed powder @ 2 g kg^{-1} with shaking of 60 min showed highest seed quality parameters. The per cent increase over control for germination, shoot length, root length, dry matter production and vigour index were 17.8, 27.7, 43.9, 47.6 and 45.3%, respectively.

Key words: Commercial grade, Fenugreek seed powder, Near nano size, Shaking, Soybean.

INTRODUCTION

Soybean [*Glycine max* (L.) Merill] is a triple beneficiary crop, a unique food, a valuable feed and an industrial raw material and is considered as the miracle crop of twentieth century. Soybean has the potential to supply oil and protein (38-42%) needed by humans (Shi and Cai, 2010). Its protein has great potential as a major source of dietary protein. The oil produced from soybean grains is highly digestible and contains no cholesterol. In addition biodiesel has been produced from soybean oil that reduces greenhouse gas release and is beneficial for agriculture (Shi and Cai, 2010). One of the major constraints in soybean cultivation is the non-availability of high vigour seeds at the time of sowing. Now-a-days, area and production of this crop is increasing gradually, but productivity remains almost constant. Poor seed germination is a major constraint for increasing the productivity of soybean. Treating the seeds with chemicals may cause harmful effect in soil as well as to human beings. Hence, a safe and feasible seed treatment is to use suitable botanicals for maintaining vigour and viability during storage. The powdered plant materials are generally considered as commercial grade materials. Number of crude plant materials (neem leaf powder, red chilli powder, turmeric rhizome powder, *Vinca* leaf powder, *Trigonella* seed powder *etc.*) and pharmaceutical formulations (aspirin, celin, ibucon) have been found very effective for the maintenance of vigour, viability and productivity of wheat, black gram, soybean and okra seeds (De *et al.,* 2003; Mandal *et al.,* 2000 and Kapri *et al.,* 2003). Among the several botanicals available, presence of antioxidant property along with high nutrient content was pharmacologically proved in fenugreek seed powder (Bukhari *et al*., 2008; Toppo *et al*., 2009) and in some other botanicals. Therefore, this botanical could serve as a potential source of natural antioxidants which can be used for seed treatments to improve vigour and viability. Seed is not an absolutely sealed unit. It may have some craks on seed coat. There may be cracks and crevices

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on the seed coat and they may serve as an entry point for finely powdered and ultimately invigourate the seeds effectively with consequent reduction in loss of vigour and viability when compared to the commercial grade materials (Sengupta *et al*., 2005). Seed is being a crucial input, any attempt on the improvement of its performance with near nano size leaf or seed powders will be much useful. The present study was taken with a view to assess the seed quality of soybean by using different botanicals treatments (ball milled and commercial grade) along with shaking and without shaking.

MATERIALS AND METHODS

Seeds of soybean cv. CO 3 used as base material. The fresh leaf samples of noni (*Morinda citrifolia*), tea (*Camellia sinensis*) and ashwagandha (*Withania somnifera*) and seed sample of fenugreek (*Trigonella foenum-graceum*) were ground and ball milled for 1 h using ball mill to get near nano size powder. Seeds were treated with near nano size (2 g kg^{-1}) powders and commercial grade powder along with shaking (one hour) and without shaking and seeds were evaluated for seedling parameters. The data obtained were analysed by the 'F' test of significance following the methods described by Rangaswamy (2002).

RESULTS AND DISCUSSION

Among the botanical treatments, seeds treated with near nano size fenugreek seed powder (particle size was measured) recorded higher germination (%), root and shoot length (cm), vigour index and dry matter production irrespectives of shaking treatments (Table 1, Table 2, Fig 1 and Fig 2 and Fig 3). Among the particle size of botanicals, near nano size powder recorded higher seedling quality parameters compared to commercial grade powder irrespectives of shaking (Table 1, Table 2, Fig 1 and Fig 2). In the interaction soybean seeds treated with near nano size fenugreek seed powder (2 g kg^{-1}) with 60 min shaking recorded higher germination (95 %), root length (16.6 cm),

Table 1: Comparison of seed quality parameters between commercial grade and near nano size botanical powders (with shaking) of soybean cv. CO 3 seeds on germination (%), shoot length (cm), root length (cm) and dry matter production (g 10 $seedling^{-1}$).

T	Germination (%)			Shoot length (cm)			Root length (cm)			Dry matter production (g)		
	CG	NS	Mean	CG	NS	Mean	CG	NS	Mean	CG	NS	Mean
T_1	78 (62.0)	78 (62.0)	78 (62.0)	22.7	22.7	22.7	9.3	9.3	9.3	1.906	1.906	1.906
T_2	90 (71.5)	95 (77.2)	93 (74.6)	28.2	31.4	29.8	15.7	16.6	16.2	2.913	3.639	3.276
T_3	88 (69.9)	94 (75.8)	91 (72.5)	27.8	29.4	28.6	14.6	15.4	15.0	2.815	3.412	3.114
T_4	87 (68.8)	90 (71.5)	89 (70.8)	26.7	28.3	27.5	13.2	14.7	14.0	2.734	3.223	2.979
T_5	86 (68.0)	87 (69.0)	87 (69.0)	25.7	27.4	26.6	12.5	13.7	13.1	2.632	3.112	2.872
Mean	86 (68.0)	89 (70.8)	87 (69.0)	26.2	27.8	27.0	13.0	13.9	13.5	2.600	3.058	2.829
	T	**S**	**T × S**	**T**	**S**	**T × S**	**T**	**S**	**T × S**	**T**	**S**	**T × S**
SEd	0.725	0.459	1.025	0.073	0.046	0.104	0.090	0.057	0.128	0.020	0.012	0.028
CD (0.05)	1.480	0.936	NS	0.150	0.095	0.212	0.184	0.117	0.261	0.040	0.065	0.057

(Figures in parentheses indicate arcsine values); CG- Commercial grade, NS- Nano size.

Treatment (T): T_1- Control, T_2- Fenugreek seed, T_3- Ashwagandha leaf, T_4- Tea leaf, T_5- Noni leaf.

Table 2: Comparison of seed quality parameters between commercial grade and near nano size botanical seed invigouration (without shaking) of soybean cv. CO 3 seeds germination (%), shoot length (cm), root length (cm) and dry matter production (g 10 $seedling^{-1}$).

T	Germination (%)			Root length (cm)			Shoot length (cm)			Dry matter production (g 10 $seedling^{-1}$)		
	CG	NS	Mean	CG	NS	Mean	CG	NS	Mean	CG	NS	Mean
T_1	78 (62.0)	78 (62.0)	78 (62.0)	9.3	9.3	9.3	22.7	22.7	22.7	1.906	1.906	1.906
T_2	87 (68.8)	92 (73.5)	91 (72.5)	15.3	15.9	15.8	29.3	29.6	28.9	2.512	3.112	2.812
T_3	85 (67.2)	89 (70.8)	89 (70.8)	14.0	14.6	14.6	28.4	28.8	28.3	2.413	2.815	2.614
T_4	85 (67.2)	87 (68.8)	87 (68.8)	12.3	13.3	13.3	27.4	27.2	27.0	2.413	2.734	2.574
T_5	84 (66.4)	85 (67.2)	86 (68.0)	11.3	12.2	12.4	26.3	26.5	26.1	2.221	2.632	2.427
Mean	84 (66.4)	87 (68.8)	86 (68.0)	12.4	13	13	26.8	27.0	26.6	2.293	2.640	2.467
	T	**S**	**T × S**	**T**	**S**	**T × S**	**T**	**S**	**T × S**	**T**	**S**	**T × S**
SEd	0.064	0.387	1.437	0.070	0.068	0.136	0.064	0.054	0.140	0.030	0.024	0.038
CD (0.05)	1.268	1.438	NS	0.148	0.171	0.216	0.147	0.076	0.221	0.060	0.076	0.056

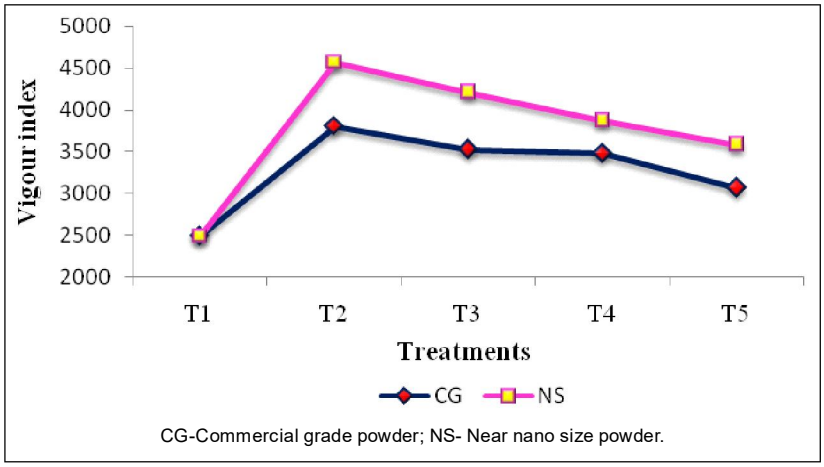
(Figures in parentheses indicate arcsine values); CG- Commercial grade, NS- Nano size.

Treatment (T): T_1- Control, T_2- Fenugreek seed, T_3- Ashwagandha leaf, T_4- Tea leaf, T_5- Noni leaf.

shoot length (31.4 cm), dry matter production (3.639 g 10 seedlings^{-1}) and vigour index (4569) when compared to control (germination (78%), root length (9.3 cm), shoot length (22.7 cm), dry matter production (1.906 g 10 seedlings^{-1}) and vigour index (2496) (Table 1, Table 2, Fig 1 and Fig 2).

Availability of good quality seed is the key for successful agriculture and their use is an important factor for increased productivity. The seeds with good physiological potential act as catalyst for all agricultural inputs (Verghese *et al.,* 2018). All the botanicals, its concentration and shaking duration performed better than control. Plant products are known to contain various antioxidants that would quench free radical attack during seed ageing and a loss in such components would lead to death of seeds. The antioxidants present in the plant products play a major role in improving the performance of the seeds (Ramya *et al.,* 2011). The increase in germination with botanical treatments is in conformity with the findings of Alex Albert (2004) in tomato, Vijayan (2005) in rice, Layek *et al*. (2006) in Bengal gram, Roopa (2006) in muskmelon and Renugadevi *et al*. (2008) in clusterbean. The increase in parameters may be the presence of antioxidants and enhance the synthesis of gibberellin's which is needed for the germination process.

Fenugreek seed powder contain poly phenolics, flavonoids, namely vitexin, tricin, naringenin and quercetin, which act as a hydrogen donor and the OH^- scavenger (Kaviarasan *et al.,* 2007) and also rich in titanium, molybdenum and iron apart from other trace elements (Sathish and Bhaskaran, 2013). Antioxidants are the substances when present in low concentration, effectively protects the cell membrane against the oxidative damage induced by oxidants. Noni leaf contains scopoletin, octoanoic acid, potassium, vitamin C, terpenoids, alkaloids and anthraquinones, which might have enhanced the metabolic activity of the seeds during germination and ultimately the vigour. The physiologically active substances present in the botanical leaves might have activated the embryo and other associated structures which resulted in the absorption of



CG-Commercial grade powder; NS- Near nano size powder.

Fig 1: Comparison of seed quality parameters between commercial grade and near nano size botanical seed invigouration (with shaking) of soybean cv. CO 3 seeds on vigour index.

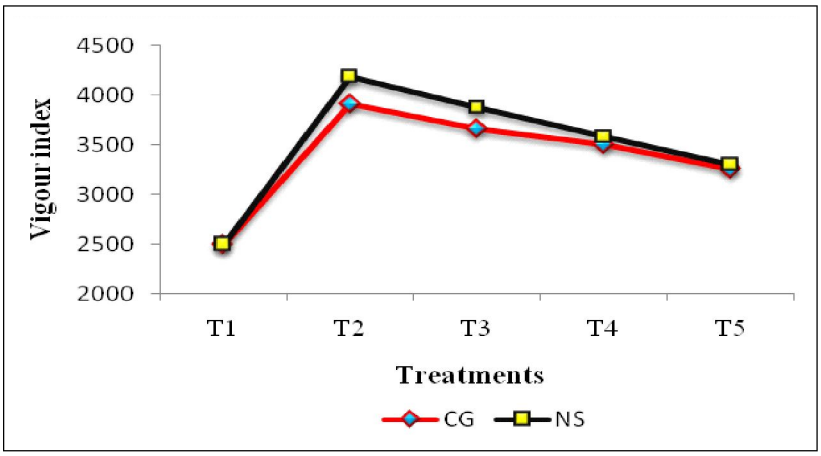


Fig 2: Comparison of seed quality parameters between commercial grade and near nano size botanical seed invigouration (without shaking) of soybean cv. CO 3 seeds on vigour index.

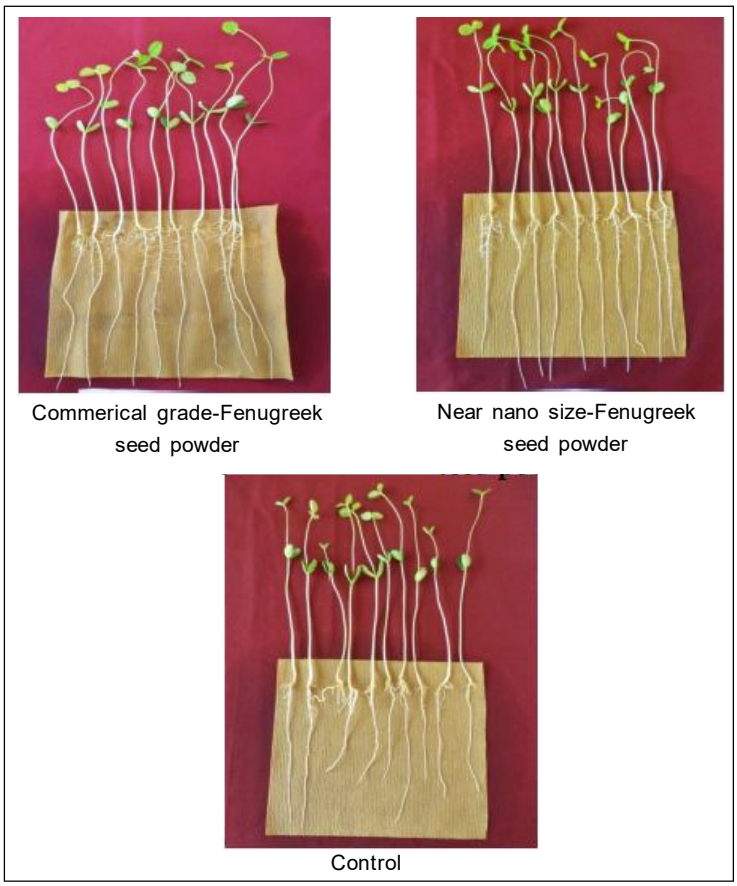


Fig 3: Comparison of seed quality parameters between commercial grade and near nano size fenugreek seed powder (with shaking) of soybean cv. CO 3 on germination (%), seedling length (cm).

more water due to elasticity of cell wall and development and increased vigour index (Devarani and Rangaswamy, 1998). Sathish and Bhaskaran (2013) reported that blackgram seeds treated with 3 g/kg of fenugreek seed powder with 1 h shaking registered an increased physiological performance in terms of germination percentage, dry matter production and vigour index. Among the several botanicals available, presence of antioxidant property along with high nutrient content was pharmacologically proved in fenugreek seed powder (Bukhari *et al.,* 2008 and Toppo *et al.,* 2009), ashwagandha, tea and noni leaf. Therefore, these botanicals could serve as a potential source of natural antioxidants which can be used for seed treatments to improve vigour and viability. However, dry dressing of seeds will be more effective rather than wet treatment; since wet treatment leads to soaking injury due to the hygroscopic nature of pulse seeds (Kalavathi, 1985). Ti plays a major role in biomass production and participates in cell metabolism as redox catalyst (Tlustos *et al.,* 2005). Molybdenum is utilized by selected enzymes to carry out redox reactions and helps in vigorous seedling growth (Kaiser *et al.,* 2005). Iron is also utilized by several enzymes and participates in the energy-yielding electron transfer reactions of respiration during germination (Guerinot and Yi, 1994). The pronounced effect of FSP could be attributed to excellent proton radical scavenging property as described earlier and subsequent alleviation of deteriorative effect (Bhatia *et al.,* 2002; Chandrashekar and Kulkarani, 2011). The results are in conformity with findings of Mythili (2012) in onion.

CONCLUSION

Soybeans seeds treated near nano size fenugreek seed powder @ 2 g kg^{-1} with 60 min recorded highest seed quality attributes compared to other treatments and control.

Conflict of interest

The authors declare that they don't have conflict of interest.

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