Seed invigouration with botanicals to improve physiological performance of soybean (Glycine max (L.) merrill) seeds

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ABSTRACT

A laboratory experiment was carried out in the Department of Seed Science and Technology Laboratory, Tamil Nadu Agricultural University, Coimbatore, from 2012-2013 to study the seed invigouration with different botanicals on the seed quality of soybean seeds. 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 and 2 h and treated to seeds @ 2, 3 and 4g kg\(^{-1}\) with 30, 60 and 90 min. shaking. The treatments were subjected for seedling evaluation test. The results indicated that, among all the dry treatments, treatment with 1h ball milled fenugreek seed powder @ 2 g kg\(^{-1}\) with 60 min. shaking showed higher seed quality parameters viz., germination % (95 %), dry matter production (3.639 g) and vigour index (4569) than other treatments and control.

Key words: Ball milling, Botanicals, Fenugreek seed powder, Seed quality, Soybean.

INTRODUCTION

Availability of good quality seed is the key for successful agriculture and their use is an important factor in the production of higher yield. Unfortunately seeds used in Indian agriculture are not upto the mark in respect of physiological stand point. Seed quality is the pre-requisite condition that affects the germination and yield of any crop plant.

India is the fifth-largest producer of soybean in the world. In 2012-2013, the area under soybean was 10.7 million hectares with a production of 12.6 million metric tonnes (www.bloomberg.com). India had witnessed a bumper soybean output of 1325 kg\(^{-1}\) ha with an area of 9.55 million hectares and productivity of 12.66 million tonnes in the year 2010-2011 (www.eandsdacnetnicin). During 2011-2012, the area, production and productivity of soybean were 9.95 million hectares, 12.57 million tonnes and 1264 kg\(^{-1}\) ha, respectively. Minimum support price of soybean had been enhanced from Rs. 1,650 to Rs. 2,200 per quintal in 2012 (www.indexmundi.com).

Seed is a living entity. When subjected to various environmental stresses, the quality will be very much affected. To improve the productivity and to prevent the quantitative and qualitative losses due to biotic and abiotic factors, different chemical seed management practices are followed which may cause harmful effect in agricultural seed production and also to human beings. Hence, a safe and feasible seed treatment is to use suitable botanicals for maintaining vigour and viability during storage. Development of eco-friendly, simple technique of dry treatment with some botanicals would be of great advantage to reduce the problem in maintenance of seed quality.

Layek et al. (2006) found that dry treatment with red chilli powder along with bleaching powder and aspirin, improved storability and field performance of high vigour seeds of bengal gram. However, at times, some problems may be faced when surplus edible seeds were unknowingly consumed, if these were treated with toxic chemicals particularly in oil seeds. To overcome such eventualities and to improve the performance of seed, dry treatment purely with crude plant materials and pharmaceutical formulation in powder forms were followed which had significantly slowed down the deterioration of seeds under various ageing conditions as reported by many researchers De et al., (2004) in wheat; Rudrapal and Basu (2004) in French bean; Sengupta et al., (2005) in onion; Kundagrami et al., (2008) in rice. These powdered plant materials are generally considered as commercial grade materials.

In order to overcome the same, dry dressing treatment of high vigour or high medium vigour seeds of
leguminous and nonleguminous crops with halogenated compounds like bleaching powder, iodinated calcium carbonate have been attempted by earlier researchers (Mandal et al., 2000). Besides, a 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). The present study was taken with a view to assess the seed quality of soybean by using different botanicals treatments.

MATERIALS AND METHODS
Seed source: Seeds of soybean cv. CO 3 obtained from Department of Pulses, Tamil Nadu Agricultural University, Coimbatore formed the base material.

Collection and preparation of botanical powders: The fresh leaf samples of noni (Morinda citrifolia) , tea (Camellia sinensis) and ashwagandha (Withania somnifera) and seed sample of fenugreek (Trigonella foenum-graceum) were collected from the Department of Medicinal Plants, Tamil Nadu Agriculture University, Coimbatore during 2012-13. The ground leaf samples of tea, ashwagandha, noni and seed sample of fenugreek were ball milled for 1 and 2 h.

Seed treatment: For seed treatment ball milled botanical powders viz., seed powder of fenugreek leaf powders of ashwagandha, tea and noni were treated @ 2, 3 and 4 g kg⁻¹ of seeds and were subjected to different durations of shaking viz., 30, 60 and 90 min. with seed materials. The germination of seeds was observed at 8th day and percent germination of seed was calculated.

Physiological characters of seed: The seeds subjected to different treatments were put for germination in between paper medium (roll towel method) and kept in germination room maintained at 25 ± 2°C and 95 ± 2 % RH using 100 seeds in four replicates (ISTA, 2010). After the germination period of 8 days, the test was terminated and evaluated for the occurrence of normal seedlings (seedling which show the capacity for continued development into normal plant). Based on the number of normal seedlings, the germination percentage of each treatment were recorded as per the standards of ISTA (2010). Ten normal seedlings were selected at random and measured for dry matter production in each of the replications. Using the data, the vigour index values were adopting the formula germination (%) x total seedling length (cm) (Abdul-Baki and Anderson, 1973).

The statistical analysis design adopted for laboratory experiments were factorial completely randomized block design with four replications. The data gathered for each of the above parameters were subjected to analysis of variance and tested for significance as per Panse and Sukhatme (1995). The percentage values were arcsine transformed prior to statistical analysis.

RESULTS AND DISCUSSION
In this study, the effect of botanical powders of fenugreek seed, leaves of ashwagandha, tea and noni for their effect on seed germination of soybean were tested. The results of the investigation expressed that among the botanical powder treatments, fenugreek seed powder ball milled for 1 h treated @ 2 g kg⁻¹ and shaken for 60 min. expressed higher germination percentage, dry matter production and vigour index than other treatments and control.

Germination is the most important indicator of seed quality parameter and changes in seed germination may occur due to different treatments. In the present study, seed invigouration with 1h ball milling, dosage of 2 g kg⁻¹ with 60 min. shaking duration of fenugreek seed powder recorded 17 per cent higher germination, followed by ashwagandha leaf powder, which was 16 per cent higher, tea leaf powder of 12 per cent higher and noni leaf powder of 9 per cent higher than control (Table 1). 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.

In the present investigation, germination percentage was higher in seeds treated with botanicals when compared to 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 mode of action of crude plant materials and pharmaceutical formulations is still not clear and there is a need to elucidate the beneficial effects on the viability maintenance. Fenugreek seed contains phenols and flavonoids (Annegowda et al., 2010), polyphenolic content, antioxidant and antibacterial activity (Ramya et al., 2011). Fenugreek seed extract exhibit antioxidant activity that could act as potent source of antioxidants (Sauvaire et al., 1991). The constituents of ashwagandha are alkaloids and steroidal lactones, among that withanine is the main constituent. Tea leaves contains phenolic acids, mainly caffeic, quinic and
TABLE 1: Effect of ball milling, shaking duration and dosage of botanical powders for germination (%) of soybean cv. CO 3 seeds

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Effect of ball milling, shaking duration and dosage of botanical powders for germination (%) of soybean cv. CO 3 seeds

In the present study, fenugreek seed powder treated seeds recorded higher vigour index value (4569) followed by ashwagandha leaf powder treated seeds (4215) compared to control (2496) (Table 3). The results are in conformity with Jegathambal (1996) in sorghum and Kavitha (2002) in blackgram. 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. Fenugreek seed powder contains phenols and flavonoids (Annegowda et al., 2010) and ashwagandha leaf powder contain alkaloids and steroidal lactones. Among the various alkaloids, withanine is the main constituent. In the present study, noni leaf powder also recorded the enhanced performance. Since, noni leaf powder contains scopoletin, octanoic 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 gallic. Theanine is an amino acid found only in tea leaves. One third of the dry weight of tea leaves comprises catechins and other polyphenols such as quercitin, myricitin and kaempferol. Antioxidants are the substances when present in low concentration, effectively protects the cell membrane against the oxidative damage induced by oxidants.

Dry matter production of the seedlings are the manifestations of the physiological efficiency of seeds, which depend upon the seed vigour (Heydecker, 1973). In the present study, seed invigourated with ball milled fenugreek seed powder recorded higher dry matter production (3.639) followed by the seeds invigourated with ashwagandha leaf powder (3.412 g) compared to control (1.906 g) (Table 2). Increase in above physiological parameters over control was also recorded by seeds invigourated with commercial grade. The secondary metabolites of plants are the potential source of natural antioxidants (Walton and Brown, 1999) which slowed down the deterioration of seeds and resulted in increased seedling growth.
activated the embryo and other associated structures which resulted in the absorption of more water due to elasticity of cell wall and development and increased vigour index (Devarani and Rangaswamy, 1998).
parameters. The present study of improving seed performance by botanicals revealed that seed invigouration with 1h ball milled seed powder of fenugreek @ 2 g kg$^{-1}$ of seed and shaken for 60 min. recorded higher germination and vigour index.

REFERENCES