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# Effect of Pelleting on Seed Quality of Fennel (*Foeniculum vulgare*)

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**ABSTRACT**

*The present investigation entitled "Studies on Seed Quality Enhancement and Storability in Fennel (Foeniculum vulgare)" was carried out in the Laboratory of Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar on cultivar Hiasr Swarup (HF 33) of fennel to ascertain the influence of seed pelleting on seed quality during 2017. The present research was laid out in Complete Randomized Design (CRD) and consisting of 7 pelleting treatments with three replications. Fennel seeds responded well to different pelleting treatments. The physiological parameters (standard germination, speed of emergence, seedling length, seedling dry weight and vigour indices) increased on pelleting with Captan (3 g/kg) + Imidacloprid followed by neem leaf powder (100 g/kg seeds), whereas, electrical conductivity was recorded minimum in above pelleting treatments*

***Keywords:*** *Seed pelleting, Fennel, Captan, Imidacloprid, Seed quality*

## INTRODUCTION

Fennel (*Foeniculum vulgare* Mill.), a member of Apiaceae family, also known as *Saunf* or sweet cumin is an aromatic biennial plant with soft, feathery and almost hair-like foliage. It is widely cultivated crop grown extensively for its edible, strongly flavoured leaves and fruits particularly in Northern India as a *rabi* crop and comes up well in fairly mild climate. Indigenous to coastal areas of the Mediterranean region, it has also become widely naturalized in many parts of the world, especially in Europe and North America. Now a day, it is grown worldwide mainly in India, Russia, Mexico, Iran, China, Bulgaria, Turkey, Egypt, Morocco, Afghanistan and Canada. In India, it is cultivated in Gujarat, Rajasthan, West Bengal, Uttar Pradesh, Madhya Pradesh, Karnataka, Telangana, Punjab and Haryana. India is the largest producer and acreage holder of this crop with 53.3% of global production and covering 89.58 thousand hectares area giving production of 148.64 thousand metric tonnes (Anonymous, 2017). In Haryana, it is grown in 0.27 thousand hectares, producing 0.17 thousand metric tonnes (Anonymous, 2015).

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The entire plant of fennel is valuable. The leaves and seeds of fennel are used in many culinary traditions (Ehsanipour et al., 2012), *viz*., leaves for garnishing, leaves and stalks in salad, its enlarged base as a vegetable, its aromatic fruits in various food preparations such as soups, meat dishes, sauces, pastries, confectionaries, pickles, and liquors, *etc*. The fennel seed, which is actually the dried fruit of the fennel plant, is used as a spice, either whole or ground. It is one of the five ingredients in the traditional Chinese five spice blend and is also an essential ingredient in Italian sausages. Dried fruits of fennel have scented odour with pleasant aromatic taste and therefore, used for mastication. Essential oil of fennel fruit has huge significance in food industry (Zoubir et al., 2014). The percentage volatile oil in seed varies from 1.5 to 3.5%. Several components of the essential oil of fennel show important applications, including, limonene as solvent, wetting and dispersing agent; trans-anethole as flavouring agent in perfumery, cosmetics, soap; metyl-chavicol or estragole is used in perfumeries and as flavour in foods and liquors; a-pinene α, used in manufacture of camphor, insecticides, solvents and perfume bases (Marotti et al., 1993 and Cavaleiro et al., 1993). The flowers and leaves of fennel are also used to make yellow and brown dyes (Malhotra, 2012). Being a medicinal plant, it is used as anti-spasmodic, appetite stimulant, stomachic, diuretic, anti-inflammatory, anti-diarrheic, against colic and as a lactation promoter (Marotti et al., 1993 and Cavaleiro et al., 1993).

The good quality seed is pre-requisite to enhance the production and productivity as the good seed in good land yield abundant, Moreover, it plays a crucial role in agricultural production as well as in national economy. Hence, prior assessment of seed quality is important to plant only the quality seed in next season. Now a day, global agriculture is faced with dilemma of meeting the growing demand for seed which is most critical input of agriculture for obtaining higher yields. Quality seed production and maintaining its germination is basic need of seed programme. In this regard, seeds are treated with insecticide, fungicides, botanicals, *etc.* Various seed quality enhancement treatments like seed pelleting, seed priming and seed coating found very much helpful in recuperating seed quality. Seed pelleting comes under pre-sowing management in which seeds are enclosed with a small quantity of inert material using an adhesive just large enough to produce a globular unit of standard size to facilitate precision planting. The inert material creates natural water holding potential and provides nutrients to young seedlings. It is more beneficial in smaller seeds as it helps in reducing the cost and by way of saving seeds.

## MATERIALS AND METHODS

The present experiment was carried to ascertain the influence of seed pelleting on seed quality during 2017. The experiments were carried out in the Laboratory of Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar on cultivar Hisar Swarup (HF 33) of fennel. The details of the materials used and techniques followed to conduct experiments are described as under: The experiment was laid in Completely Randomized Block Design with three replications with 8 treatments replicated thrice. Pelleting of seed was done with three botanicals and four chemicals. Gum arabica was used as binder/adhesive. Wood ash was used as filler material for pelleting of treatments $P_5$ to $P_8$. The enzyme activity was recorded for fresh seeds. The details of the experiment are provided below:

**$P_1$**- Control
**$P_2$** - *Pongamia* leaf powder (100 g/kg seed)
**$P_3$** - Turmeric leaf powder (100 g/kg seed)
**$P_4$** - Neem leaf powder (100 g/kg seeds)
**$P_5$** - $KH_2PO_4$ (2.0%)
**$P_6$** - $KNO_3$ (1.0%)
**$P_7$** - $K_2SO_4$ (1.0%)
**$P_8$** - Captan (3 g/kg) + Imidacloprid (2 g/kg)

Before seed treatment, the seeds were manually cleaned and graded. As seed of fennel is schizocarpic so, before seed treatment each seed was divided into two equal halves. Fresh *Pongamia*, neem and turmeric leaves were obtained from the particular plants and were completely dried

under the sun. Dried leaves were powdered finely with a grinder. The ground material was sieved using muslin cloth. The wood ash was obtained locally and was also sieved through the muslin cloth before applying to the seed. The required quantity of neem leaf powder, *Pongamia* leaf powder and turmeric leaf powder (*i.e.*, 100 g/kg of seed) were treated with seed using gum arabica as binder. The required quantity of $KH_2PO_4$ (1%), $KNO_3$ (1%), $K_2SO_4$ (1%) and Captan (3 g/kg) + Imidachloprid (2g/kg) were treated with seed and pelleting was carried out by using gum arabica as binder and wood ash as filler material. Before pelleting, moisture content of seeds was brought to about 8.0 per cent. Afterwards the treated seeds were dried for three days under shade.

Five grams of seeds was taken for determining the moisture content using low constant temperature method. The powdered seed material was placed in a weighed moisture aluminium cup and placed in hot air oven maintained at 105 ± 2°C for 24 hr (Selvi et al., 2006) after removing the lid. After that the content were dried and weighed in an electronic balance along with bottle and lid. The moisture content was worked out using the following formula and expressed as percentage.

$$\text{Moisture content (\%)} = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Where, $M_1$ = weight of the aluminium cup alone

$M_2$ = weight of the aluminium cup + sample before drying

$M_3$ = weight of the aluminium cup + sample after drying

Germination percentage was worked out according to standard germination procedure of ISTA, (2011). This was carried out by using between paper methods in the seed germinator at 25°C. The germination was counted on 14th day. Germination percentage was calculated by using the formula given below:

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds used}} \times 100$$

Speed of emergence was calculated as per formula of Maguire (1962).Twenty five seeds were selected at random from all the treatments and were used for the radical emergence studies. This was carried out by using top paper methods in the seed germinator at 25°C. The radicle emergence was recorded up to 14th day. Germination counts were taken every day till last count. An index of the speed of emergence was then calculated by adding the quotients of the daily counts divided by the number of days of germination.

Speed of emergence = $\sum$ [n1/d1 + n2-n1/d2 +……nn- nn- 1/dn]

Where, n= number of seeds germinated on day (d)

d= serial number of days

The length of seedlings was measured on 14th day of germination test. Ten normal seedlings selected at random from between paper method were used to work out the seedling length. Total seedling length was worked out by taking the total length of seedlings from the tip of the primary leaf to the tip of primary root with the help of scale and expressing the mean value in centimetre (cm).

Ten seedlings selected for measuring seedling length were used to work out seedling dry weight. Seedlings were kept in oven at 80°C for 48 hours and weights were measured then mean value was expressed in milligrams (mg).

Seedling length was multiplied with the standard germination of the same treatment and the seedling vigour index-I was calculated as per the formula given by Abdul-Baki and Anderson (1973).

Seedling dry weight was multiplied with the standard germination of the same treatment and the seedling vigour index-II was calculated as per the formula given by Abdul-Baki and Anderson (1973).

The electrical conductivity of seeds was measured using 50 normal and undamaged seeds of each treatment. Seeds were imbibed in 75 ml deionized water in 100 ml beakers and beakers were covered with aluminum foil. Thereafter, the samples were kept at 25°C for 24 hrs. The electrical conductivity of the seed leachates was measured using a direct reading conductivity meter. The conductivity was expressed in µS $cm^{-1}seed^{-1}$.

The statistical analysis of the data generated was done as per design of the experiment as suggested by Panse and Sukhatme (1961)

## RESULTS AND DISCUSSION

Pelleting has caused a significant effect on standard germination and speed of emergence of fennel seeds (Fig. 1). Higher germination (87.67%) and maximum value of speed of emergence (25.08) was observed in the seeds pelleted with Captan (3g/kg) + Imidacloprid (2g/kg) which was at par with neem leaf powder (100g/kg seeds), *i.e.*, 87.33% and 24.35, respectively. The minimum germination (79.67%) and speed of emergence (21.51) was recorded in unpelleted seeds. The pronounced effect of seed pelleting on standard germination might be attributed to their efficient role in sink-source relationship. Seeds with higher initial capital food reserves always showed higher and rapid germination. Also, Captan and Imidacloprid might have provided protection against seed and soil borne pathogens and insects leading to early vigorous growth of plants. The improvement in speed of emergence could also be attributed to activation of cells, resulting in the enhancement of mitochondrial activity leading to the formation of more high energy compounds and vital biomolecules, which are made available during the early phase of germination (Ananthi et al., 2015). These findings are in agreement with the results of Manjunath et al. (2009) who obtained superiority of seed pelleting with $ZnSO_4$ (300 mg/kg) + Captan (2.5 g/kg) + Imidacloprid (2.5 g/kg) and recorded the highest standard germination (94.00%) and speed of germination (17.63) on pelleting in paprika chilli cv. Kt-PI-19. Similarly, Prakash et al., (2018) obtained maximum speed of germination and germination percentage by pelleting with *Pongamia pinnata* leaf powder @ 200g per kg in clusterbean.

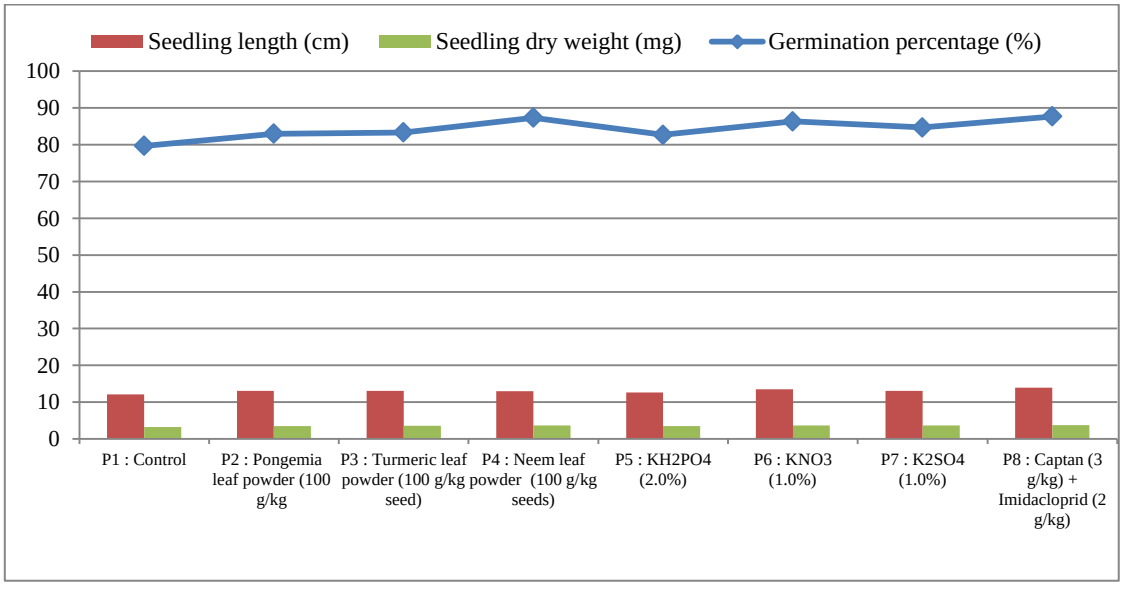


**Fig. 1: Effect of seed pelleting on standard germination, seedling length and seedling dry weight in fennel cv. HF 33**

Seed pelleting significantly affected the seedling length along with seedling dry weight, which increased significantly with pelleting treatments (Fig. 1). Maximum seedling length (13.89 cm) was obtained in the seeds pelleted with Captan (3 g/kg) + Imidacloprid (2 g/kg) followed by treatment $KNO_3$ (1.0%), *i.e.*, 13.49 cm and the minimum

(12.12 cm) was observed in case of unpelleted seeds. On the other hand, the maximum value of seedling dry weight was recorded on pelleting with Captan (3 g/kg) + Imidacloprid (2 g/kg), *i.e.*, 3.72 mg followed by pelleting with neem leaf powder (100 g/kg seeds), *i.e.*, 3.68 mg, $KNO_3$ (1.0%), *i.e.*, 3.67 mg and $K_2SO_4$ (1.0%), *i.e.*, 3.61 mg. The minimum seedling dry weight (3.26 mg) was recorded in unpelleted seeds. These findings are in line with the results of Chaya Devi et al. (2017) who obtained maximum seedling length (35.20 cm) and seedling dry weight (248.83 mg) in seeds pelleted with $ZnSO_4$ @ 3g/kg + borax @ 3g/kg + Capton (2.5g/kg) + Imidacloprid (2.5g/kg) as compared to control in French bean and Zala et al. (2016) who reported a significant increase in seedling length as well as seedling dry weight at the end of eight month of storage period in chilli with Thiram (3 g/kg) + Imidacloprid (600 g/lit). The increase in seedling length may be due to the cell wall extension and increased metabolic activities as reported by Afzal et al. (2002) in maize seeds and the increase in dry weight might be due to enhanced lipid utilization and enzyme activity owing to the bioactive substances like auxin.

Seedling vigour index-I and seedling vigour index-II were significantly increased with seed pelleting treatments (Fig. 2). Maximum seedling vigour index-I (1224) was obtained with Captan (3 g/kg) + Imidacloprid (2 g/kg) treatment, which was at par with $KNO_3$ (1.0%), *i.e.*, 1169. Whereas, seedling vigour index-II was found maximum (327) with the application of Captan (3 g/kg) + Imidacloprid (2 g/kg) followed by neem leaf powder (100 g/kg seeds), *i.e.*, 320, $KNO_3$ (1.0%), *i.e.*, 317 and $K_2SO_4$ (1.0%), *i.e.*, 307. The obtained results were in good accordance with the results of Chaya Devi et al. (2017) who obtained maximum seedling vigour index-I (3484) and seedling vigour index-II (2463) in seeds pelleted with $ZnSO_4$ @ 3g/kg + borax @ 3g/kg + Captan (2.5g/kg) + Imidacloprid (2.5g/kg) as compared to control in french bean and Manjunath et al. (2009) who obtained maximum vigour index (17.37) by pelleting the seeds with $ZnSO_4$ (300 mg/kg) + Captan (2.5 g/kg) + Imidacloprid (2.5 g/kg) in paprika chilli cv. Kt-PI-19. The higher seedling vigour parameters might be due to the fact that well developed quality seeds shall have higher germination potential and seedling growth along with higher root and shoot length. Hence, the vigour index being the product of germination and seedling length, germination and seedling dry weight, therefore, it is also higher with these pelleted seed treatments. Moreover, Prasad (1994) opined that the leaf powder in botanical pelleting act as wick by absorbing/regulating the soil moisture availability, thereby enhancing better seed-soil relationships, as indicated through higher seed and seedling quality characters of the pelleted seeds.

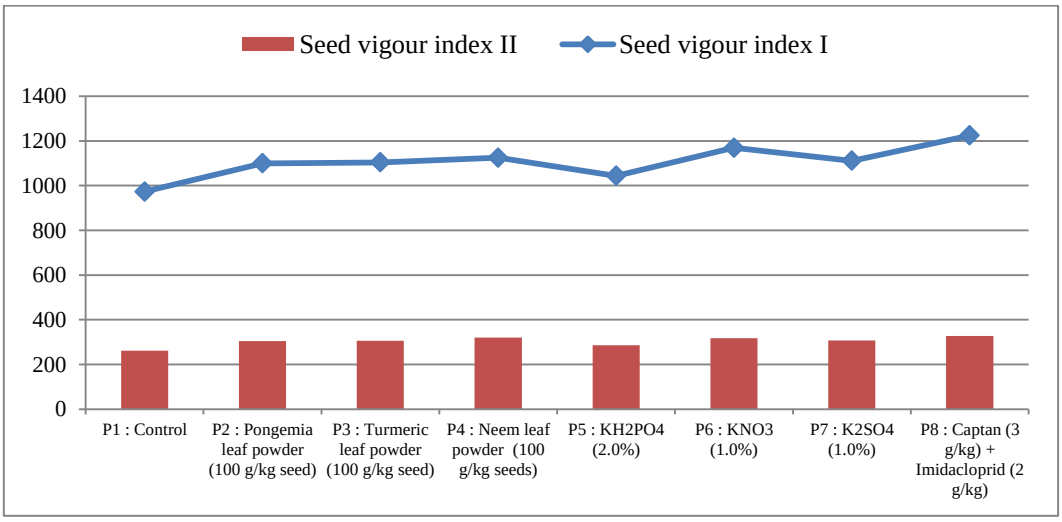


**Fig. 2: Effect of seed pelleting on seedling vigour index-I and seedling vigour index-II in fennel cv. HF 33**

In case of moisture content, statistically all the treatments were same in terms of moisture content in the seeds, either with or without pelleting treatments irrespective of the pelleting material *viz*., botanicals (*Pongamia* leaf powder, turmeric powder and neem leaf powder) and chemicals ($KH_2PO_4$, $KNO_3$ , $K_2SO_4$, Captan+ Imidacloprid). The results of present study confirms the results of Khatun et al. (2010) who stated that no significant effect on moisture percentage among the different botanicals was observed in lentil including the control which indicated that botanicals had no effect on seed moisture percentage, but contradicts with Manjunatha, (2007) who obtained lower moisture content (7.89%) in the seeds treated with polymer @ 7 g/kg of seed and thiram @ 2 g/kg of seed when compared to control in chilli cv. Byadagi Kaddi. However, seed pelleting significantly affected the electrical conductivity, which decreased significantly over the control. The minimum electrical conductivity (3.52 µS $cm^{-1}seed^{-1}$) was obtained with Captan (3 g/kg) + Imidacloprid (2 g/kg) followed by pelleting with $KNO_3$ (1.0%), *i.e.*, 3.85 µS $cm^{-1}seed^{-1}$, against the maximum (4.92 µS $cm^{-1}seed^{-1}$) in case of control. The results obtained are in line with Manjunath et al. (2009) who reported the superiority of seed pelleting with $ZnSO_4$ (300 mg/kg) + Captan (2.5 g/kg) + Imidacloprid (2.5 g/kg) and noted lower electrical conductivity (0.365 dS/m) than the other treatments in paprika chilli cv. Kt-PI-19. Electrical conductivity (EC) of seed leachates is inversely proportional to seed quality. Higher the electrical conductivity lower is the seed quality and vice versa. In general, well developed high quality seeds will leak less leachates when compared to poorly developed low quality seeds (Simon, 1974). In the present study, the same phenomenon has been observed with seed pelleting treatments.

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