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SEED QUALITY ASSESSMENT IN NATURALLY AGED SEED LOTS OF FENNEL

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ABSTRACT
In the present study, fifteen varieties/genotypes of fennel having three seed lots were subjected to study the effect of ambient storage on different seed quality parameters. Results revealed that all the varieties/genotypes showed the germination percentage above the Indian Minimum Seed Certification Standards (65%) in Lot-1 (freshly harvested seed) and Lot-2 (1 year old seed). Results of test weight (g), Standard germination (%), seedling length (cm), seedling dry weight (mg), seedling vigour index-I & II and accelerated ageing test (%) revealed that viability and vigour of seeds declined rapidly in Lot-3 (2 years old seed). Among all the varieties/genotypes, maximum germination was retained by genotype HF 33 (80.25%) followed by HF 102 (78.83%) and maximum loss of germination was observed in genotype HF 115 (67.08%). Hence, the genotypes HF 33 and HF 102 were found superior in terms of viability, vigour and storability whereas genotype HF 115 was found poor under uncontrolled storage conditions.

KEYWORDS: Fennel, Germination (%), Seed lots, Storage, Viability, Vigour.

INTRODUCTION

Fennel (*Foeniculum vulgare* Mill.), belongs to family Apiaceae. It is a diploid species with chromosome number, 2n=22 and native of Europe and Mediterranean region (Agarwal *et al*. 2001). The leaves and seeds of fennel are used in many culinary traditions (Ehsanipour *et al*. 2012). Mature fennel fruits and essential oil are used as flavouring agents in food products such a liqours, bread, pickles, pastries, and cheese (Zoubiri *et al*., 2014). Good seed in good land yield abundant. The good quality seed is pre-requisite to enhance the production and productivity. Seed is an important component and the quality seed plays a crucial role in agricultural production as well as in national economy. Use of quality seeds increased productivity of crop by 15-20% (Sidhawani, 1991).

Seed deterioration is a serious problem especially in tropical countries like India where seed attains higher moisture at higher temperature and respiration becomes also high which leads to seed deterioration and loss of viability. Therefore, prior assessment of seed quality is important to plant only the quality seed in next season. Therefore, the present study was aimed to assess the seed quality parameters of seeds of different varieties of fennel stored under ambient conditions.

MATERIALS & METHODS

The present investigation was carried out on fennel seeds of fifteen genotypes *viz*., HF 33, HF 101, HF 102, HF 103, HF 104, HF 105, HF 106, HF 107, HF 108, HF 109, HF 114, HF 115, HF 118, HF 122 and HF 124 with three lots of seed *viz*., freshly harvested seed (Lot-1), one year old seed (Lot-2) and two year old seed (Lot-3) collected from Department of Vegetable Science, CCS HAU, Hisar during 2014-15. All the 45 seed lots stored under ambient condition were subjected to test weight, standard germination test (%), seedling length (cm), seedling dry weight (mg), seedling vigour index-I, seedling vigour index-II and accelerated ageing test (%) in seed testing laboratory, Department of Seed Science and Technology, CCS Haryana Agricultural University.

Test weight (g)

A random sample of seeds was drawn from each lot of naturally aged seeds of fennel and 1000 seeds were selected without discrimination for their size and appearance and weight of these 1000 seeds denotes the test weight of that seed lot.

Standard germination (%)

Hundred seeds of each genotype in four replicates were placed in between moist rolled towel papers and kept at 25ºC in seed germinator. At the final count seedlings were evaluated and the seedling which possess balanced development of all essential structures such as radical, plumule and cotyledons were considered as normal seedlings.

Seedling length (cm)

Seedling length was measured on ten randomly selected normal seedlings taken from four replications of standard germination test and recorded in centimeter. At last, average of ten seedlings was recorded in centimeters for final calculations.

Seedling dry weight (mg)

Ten normal seedlings selected for measuring seedling length were further kept in hot air oven for taking dry weight. These were dried at 80ºC for 48 hours and the seedling dry weight was recorded in milligram. At last average weight of ten seedlings was taken for further calculation.

Seedling vigour indices

Seedling vigour indices were calculated according to the method suggested by Abdul-Baki and Anderson (1973).

Vigour index-I (on seedling length basis):
Vigour index-I = Standard germination (%) x seedling length (cm)
Vigour index-II (on seedling dry weight basis):
Vigour index-II = Standard germination (%) x seedling dry weight (mg)
Accelerated ageing test (%)
Sufficient number of seeds in a single layer from each lots of genotype were taken on wire mesh tray fitted in plastic boxes having 40 ml of distilled water. The boxes were placed in ageing chamber after closing their lids. The seeds were aged at 40±1° C temperature and about 100 per cent RH for 120 hour and tested for germination in four replications of 100 seeds for each genotype. Then seeds were evaluated in terms of standard germination only. The relation between germination of accelerated aged seeds and standard germination of normal seeds were also worked out.

RESULTS & DISCUSSION

Significant differences were found among all the genotypes and their lots for test weight (Figure 1). Test weight was recorded maximum in HF 102 (9.21g) followed by HF 33 (9.16g) and minimum seed weight was recorded for HF 124 (7.74g) for freshly harvested seed. Maximum test weight was found in freshly harvested seed lots irrespective of the genotypes.

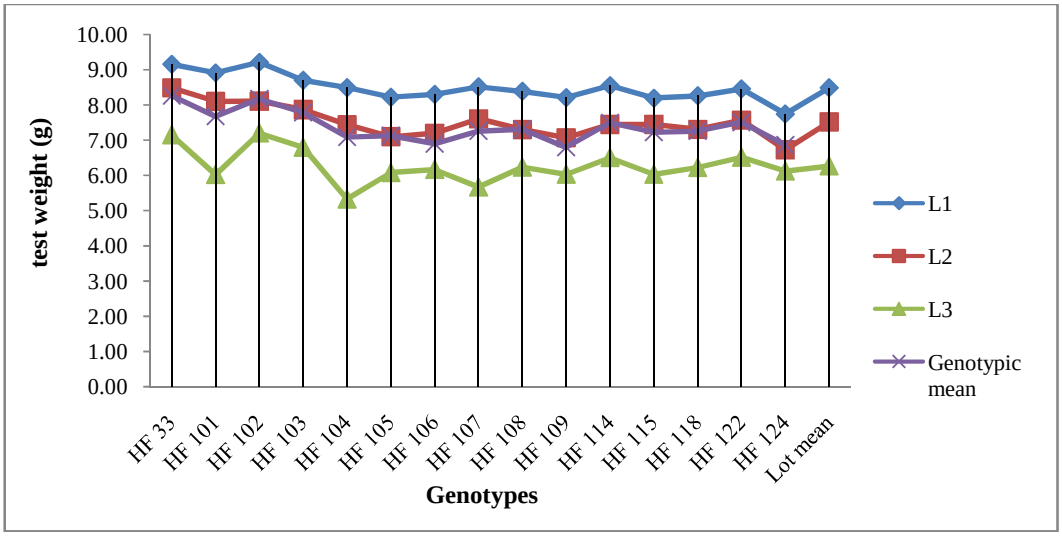

FIGURE 1. Effect of natural ageing on test weight (g) of fennel genotypes

Test weight decreased with advancement of ageing period in all the fifteen genotypes. Significant decrease was observed in one year and two year seed lots as compared to fresh seed lot. The results indicated that the genotype HF 33 (8.27g) recorded highest mean seed weight whereas HF 109 recorded lowest (6.80g). Maximum (3.16g) decrease in test weight was recorded for HF 104 and minimum (1.62g) in HF 124 from fresh seed lot to two year old seed lot. Similar finding was reported in coriander (Kumar, 2007) and in fenugreek (Singh *et al*., 2015)

In freshly harvested seed lots (L_1) and one year aged seed lots (L_2), all the varieties/genotypes showed germination percentage above Indian Minimum Seed Certification Standards (65.00 %). Among varieties/genotypes, HF 33 (93.75%) recorded highest germination followed by HF 102 (92.50%) whereas the genotype HF 115 recorded lowest germination (79.25%) for freshly harvested seed. Thereafter standard germination decreased gradually with the advancement of storage period among all the genotypes (Table 1). Standard germination declined with a faster rate in two year aged seed lot as compared to one year aged seed lot. The maximum standard germination was recorded in HF 33 (64.50%) followed by HF 102 (63.75%) and lowest in HF 115 (49.25 %) in two year aged seed lot (L_3). Maximum mean standard germination (80.25%) was observed for HF 33 while minimum (67.08%) for HF 115. Above results are in agreement with various workers in different crops such as okra (Narwal, 1995), Indian mustard (Verma *et al.*, 2003), carrot (Maskri *et al*., 2003), turnip (Khan *et al*., 2005) and in four vegetables seed (carrot, cucumber, onion and tomato) by Alhamdan *et al.* (2011).

TABLE 1: Effect of natural ageing on standard germination (%) of fennel

Genotypes	Seed lots			Mean
	L_1	L_2	L_3	
HF 33	93.75(75.70)	82.50(65.37)	64.50(53.42)	80.25(64.83)
HF 101	90.25(71.86)	80.75(64.01)	56.50(48.72)	75.83(61.53)
HF 102	92.50(74.33)	80.25(63.61)	63.75(52.98)	78.83(63.64)
HF 103	89.50(71.23)	78.00(62.03)	60.25(50.91)	75.92(61.39)
HF 104	85.50(67.70)	74.75(59.83)	53.00(46.70)	71.08(58.08)
HF 105	84.25(66.62)	73.25(58.86)	61.25(51.49)	72.92(58.99)
HF 106	84.75(67.05)	77.50(61.75)	57.50(49.30)	73.25(59.37)
HF 107	87.25(69.10)	79.50(63.08)	61.25(51.49)	76.00(61.22)
HF 108	85.75(67.90)	77.00(61.35)	61.50(51.64)	74.75(60.29)
HF 109	87.50(69.36)	77.75(61.86)	58.50(49.88)	74.58(60.37)
HF 114	83.25(65.83)	74.75(59.83)	60.00(50.75)	72.66(58.80)
HF 115	79.25(63.25)	72.25(58.20)	49.25(44.55)	67.08(55.33)
HF 118	85.25(67.46)	77.25(61.53)	58.50(49.88)	73.66(59.62)
HF 122	87.00(68.94)	78.25(62.27)	59.25(50.32)	74.83(60.51)
HF 124	82.50(65.26)	74.50(59.67)	52.50(46.41)	69.83(57.12)
Mean	86.58(68.77)	77.22(61.55)	58.50(49.89)	

C.D. (p = 0.05) for genotypes =1.85, lots =0.83, Genotypes x lots = 3.20

Figures in parenthesis are arcsine transformed values

All the genotypes recorded maximum seedling length (Figure 2) at the commencement of storage and thereafter, it declined as the period of ambient storage advanced. Seedling length in all the fifteen genotypes decreased significantly with the advancement of ageing period. Seedling length showed a variation in freshly harvested seed of different genotypes from 11.42 to 14.73cm with a general mean of 13.23cm.

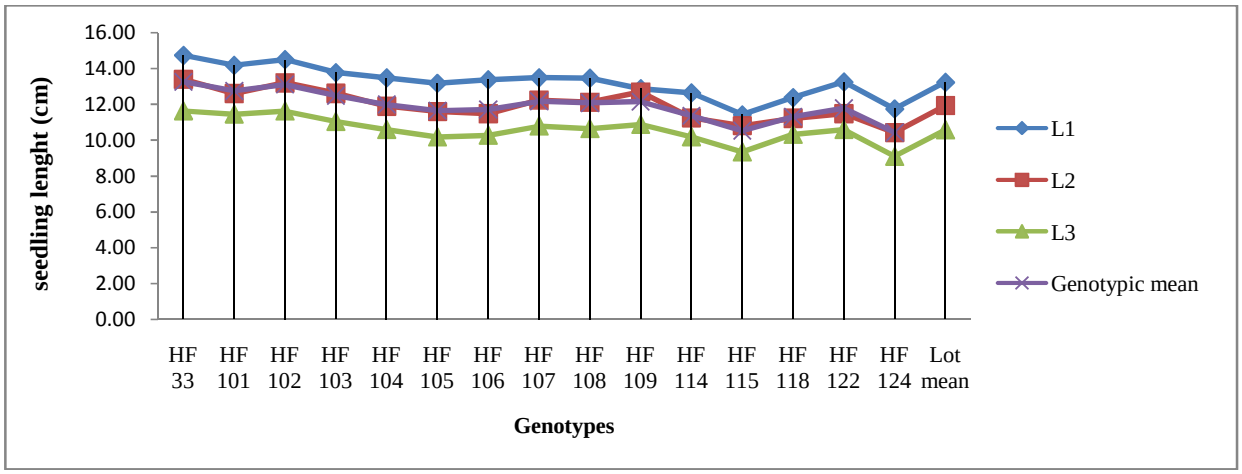

FIGURE 2: Effect of natural ageing on seedling length (cm) of fennel

The maximum average value for seedling length was recorded for genotype HF 33 (13.26cm) followed by HF 102 (13.11cm) and minimum (10.43cm) for HF 124. The maximum decrease (3.09cm) in seedling length was recorded for both HF 33 and HF 106 and minimum (2.05cm) for HF 118 from fresh seed lot to two year old seed lot. The genotypes and seed lots interaction were also found significant, as this decreasing response of genotypes was not similar for all the aged seed lots. Similar findings were also reported in fenugreek by Kumari *et al.* (2014), Singh *et al.* (2015), in coriander by Deshraj (2002), Kumar (2007) and in turnip by Khan *et al.* (2005).

Seedling dry weight of different genotypes is presented in Figure 3 revealed that all the fifteen genotypes differed significantly with respect to their seedling dry weight irrespective of the genotypes and seed lots. Among all the fifteen genotypes, HF 33 recorded highest value of seedling dry weight (10.95mg) followed by HF 118 (10.90mg) whereas genotype HF 115 recorded lowest (8.13mg) seedling dry weight value in freshly harvested seed lot. Thereafter seedling dry weight decreased gradually with the advancement of storage period among all the genotypes. Highest mean seedling dry weight was observed in HF 33 (9.48mg) followed by HF 102 (9.41mg) and lowest in HF 115 (6.55mg). These observations were similar to those already reported by various workers in different crops such as Singh *et al.* (2003) in urd bean and mung bean and Singh *et al.* (2015) in fenugreek

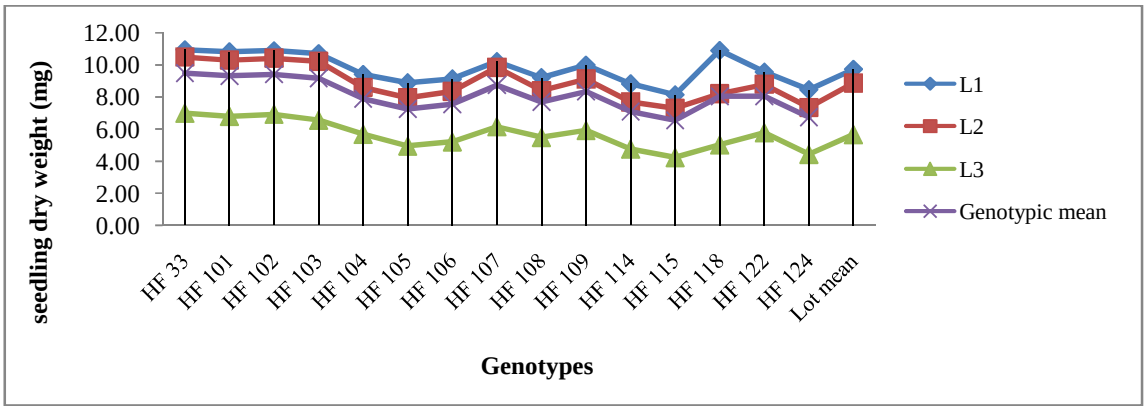

FIGURE 3. Effect of natural ageing on seedling dry weight (mg) of fennel genotypes

Results indicated that seedling vigour indices declined significantly in all the varieties/genotypes with the passage of seed storage time. Genotype HF 33 showed maximum value (1381.35) of vigour index- I followed by HF 102 (1339.89) and minimum in HF 115 (910.99) in freshly harvested seed lot (Fig. 4). In two year stored seed lot maximum value of vigour index-I was recorded for HF 33 (749.90) followed by HF 102 (741.32) and minimum for genotype HF 115 (460.20). Maximum mean vigour index-I was observed in HF 33 (1078.78) followed by HF 102 (1047.10) and lowest in HF 115 (717.57).

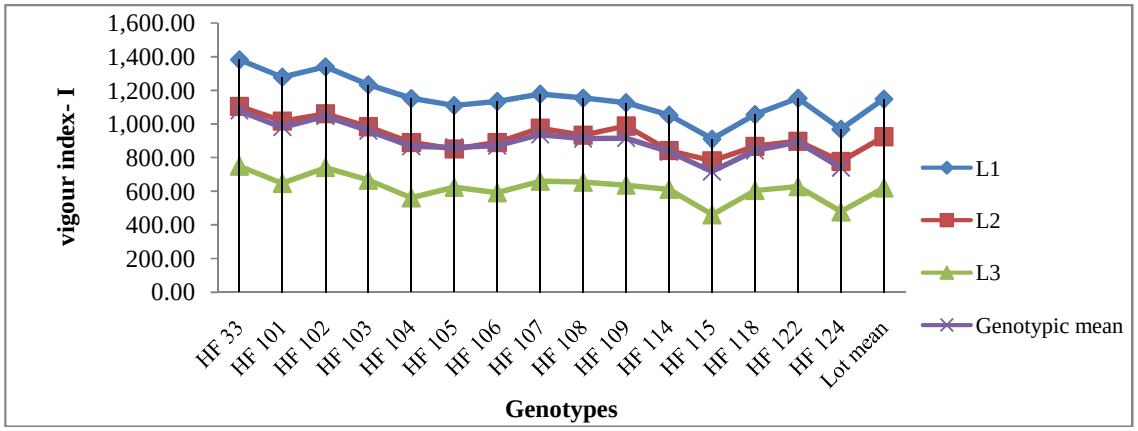

FIGURE 4. Effect of natural ageing on vigour index-I of fennel

Vigour index –II ranged from 1026.64 (HF 33) to 648.26 (HF 115) among genotypes for fresh seed lot (Fig. 5). In freshly harvested seed lot, the maximum value of seed vigour index-II was recorded in HF 33 (1026.54) followed by HF 102 (1006.79), which were statistically at par and lowest in HF 124 (696.59). However in two year old seed lot, the maximum value of seed vigour index-II was recorded in HF 33 (451.09) and minimum was recorded in HF 115 (207.80). The present results are also in corroborate with the findings of Kumar *et al.* (2015) in coriander and Rajkumar *et al.* (2004) in pea where loss of vigour increased with increase in period of storage.

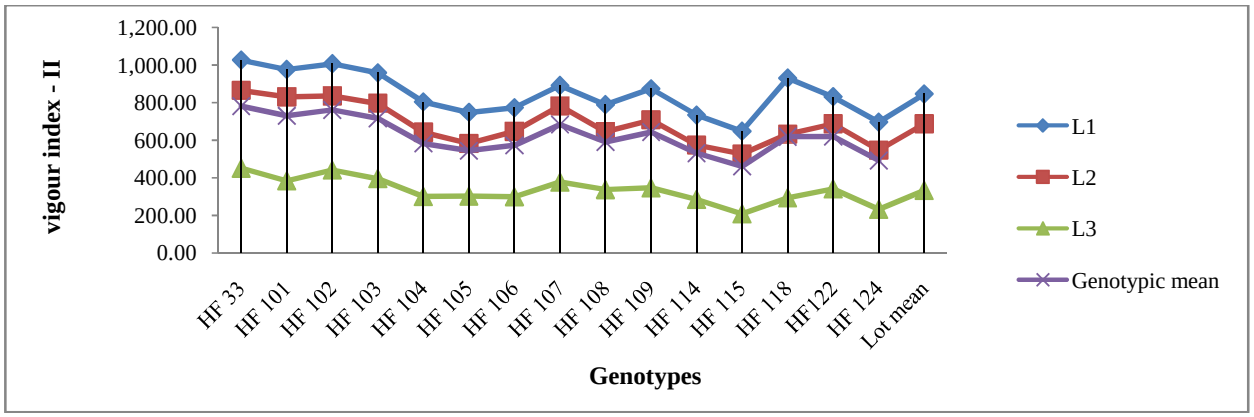

FIGURE 5. Effect of natural ageing on vigour index-I of fennel

Different seed lots of different genotypes of fennel were subjected to accelerated ageing treatment and the percentage germination of normal seedlings are presented in Table 2. The range of percentage germination for different genotypes varied from 67.50 (HF 33) to 51.25 (HF 115) in freshly harvested seed, 58.00 (HF 33) to 31.75 (HF 115) in one year old seed lot, 22.25 (HF 33) to 11.75 (HF 115) in two year old seed lot. The mean value ranged from 49.25 (HF 33) to 31.58 (HF 115). The genotype HF 33 (49.25) and HF 102 (46.33) recorded significantly high percentage of normal seedlings because these genotypes strongly resisted the accelerated ageing up to certain period, hence could be classified as a good storer. The decline in seed germination and vigour during accelerated ageing as well as storage treatments were influenced by chronological age of seed rather than initial germination percentage (Agarwal *et al*., 1980). The similar results were reported by Kumar *et al.* (2015) in coriander, Kumar and Verma (2008) in fenugreek.

TABLE 9: Effect of accelerated ageing of fennel genotypes and seed lots

Genotypes	Seed lots			Mean
	L_1	L_2	L_3	
HF 33	67.50(55.23)	58.00(49.60)	22.25(28.12)	49.25(44.32)
HF 101	52.75(46.56)	34.50(35.93)	15.50(23.06)	34.25(35.19)
HF 102	66.25(54.48)	51.25(45.70)	21.50(27.57)	46.33(42.58)
HF 103	63.50(52.82)	41.50(40.08)	19.25(25.99)	41.42(39.63)
HF 104	53.25(46.85)	36.25(37.00)	16.25(23.73)	35.25(35.86)
HF 105	57.25(49.15)	39.75(39.06)	18.50(25.40)	38.50(37.87)
HF 106	62.00(51.93)	40.50(39.50)	19.25(25.99)	40.58(39.14)
HF 107	55.75(48.29)	39.25(38.76)	18.50(25.42)	37.83(37.49)
HF 108	58.50(49.88)	38.75(38.48)	18.25(25.27)	38.50(37.88)
HF 109	52.25(46.27)	33.75(35.48)	15.00(22.69)	33.66(34.82)
HF 114	64.50(53.43)	42.75(40.81)	20.25(26.71)	42.50(40.32)
HF 115	51.25(45.70)	31.75(34.28)	11.75(19.98)	31.58(33.32)
HF 118	54.75(47.71)	37.75(37.89)	16.50(23.92)	36.33(36.51)
HF122	58.75(50.02)	40.50(39.50)	18.50(25.42)	39.25(38.32)
HF 124	52.25(46.27)	33.50(35.32)	14.25(22.13)	33.33(34.57)
Mean	58.03(49.64)	39.98(39.16)	17.70(24.76)	

C.D. ($p = 0.05$) for genotypes =1.52, lots =0.68, Genotypes x lots = 2.6

Figures in parenthesis are arcsine transformed values

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