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Effect of Natural Ageing on Seed Quality of Fenugreek (Trigonella foenum-graecum L.)

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ABSTRACT

The present research was carried out on four genotypes of fenugreek viz. HM-202, HM-204, HM-205 and HM-214, with four seed lots of each genotype including fresh, one year, two year and three year old seed lot. In this experiment, all the four seed lots of each four genotypes were tested for various physiological and biochemical basis for loss in viability and vigour. It was observed that, test weight (g), seed density (g/cc), standard germination (%), seedling length (cm), dry weight per seedling (mg), vigour index-I & II, viability (%) by tetrazolium test, speed of emergence, seedling establishment (%) decreased whereas, mean emergence time (days) and electrical conductivity (µS/cm/seed**)** of seed leachates increased with ageing period. The seed of each genotype sustain their germination up to two year thereafter, the germination falls below IMSCS (70 %). Maximum germination was retained by genotype HM-202 followed by, HM-205 and maximum loss of germination was observed in genotype HM-214, hence the genotype HM-202 was found superior in respect of viability, vigour and storability whereas genotype HM-214 was found poor under ambient conditions.

Keywords: Natural Ageing, Seed Quality, Fenugreek, Biochemical Tests

I. INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) belongs to the sub family papilionaceae of Leguminosae is an important multiuse seed spice crop cultivated in India. Seed quality plays an important role in the crop establishment and overall performance of the crop. Availability of viable and vigorous seeds at the planting time is important for achieving targets of agricultural production because good quality seed acts as a catalyst for realizing the full potential of other inputs. Since the total cultivable area is decreasing due to over growing population, the increased agricultural productivity is the only option. 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). Plant breeders have developed a number of high yielding varieties and to harvest their potential, quality seed has been recognized as an important and cheapest input. The quality of seed is mainly measured by its genetic purity and capacity to develop into a healthy plant.

The unfavorable environment (especially exposure to rains just for one week) during the post maturation, pre-harvest environment can greatly accelerate the seed ageing phenomenon, resulting in 20 to 30% loss of seed viability. The seed of particular harvest cannot be used immediately for sowing the following crop because of the time required for processing and for seed certification prior to the marketing of seeds. Therefore, the fresh seeds have to be stored for 6-8 months after harvest and under uncontrolled storage conditions.

II. METHODS AND MATERIAL

The present study entitled “Seed quality assessment in naturally aged seed of fenugreek” was carried out during 2011-12 in the laboratories and research farm of Seed Science and Technology Section, Department of

Genetics & Plant Breeding CCS Haryana Agricultural University, Hisar.

Laboratory Parameters

Test weight (g): One thousand seeds replicated thrice in each genotype were counted, weighed and average seed weight of each genotype was calculated.

Seed density (g/cc): One hundred seeds in three replications & of each genotype were taken and weighed on electrical balance. These seeds were dipped in water; density of water is 1.0 at 20°C. Volume of water displaced by the seeds was recorded and seed density was calculated by using the following formula:

$$\text{Seed density} = \frac{\text{Weight of 100 seeds (g)}}{\text{Vol. of water displaced by seeds (cm}^3\text{)}}$$

Standard Germination (%): One hundred seeds of each genotype in three replicates placed in between sufficient moistened rolled towel papers (BP) and kept at 20°C in seed germinator. The first count was taken on 5th day and final count on 14th day and only normal seedlings were considered for percent germination according to the rules of International Seed Testing Association (ISTA, 1999)

Seedling length (cm): Seedling length was measured on 10 randomly selected normal seedlings taken from three replications of standard germination test and average of 10 seedlings was recorded in centimeter for final calculation.

Dry weight per seedling (mg): Seedling dry weight was assessed after the final count in the standard germination test (14 days). The 10 seedlings of each genotype replicated thrice were taken. Seedlings were dried in a hot air oven for 24 hrs at 80±1° C. The dried seedlings of each replication were weighed and average seedling dry weight of each genotype was calculated.

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

I. Vigour index-I: (on seedling length basis):
Vigour index–I = Standard Germination (%) X Average seedling length (cm)

II. Vigour Index–II: (on seedling dry weight basis):
Vigour index–II =Standard Germination (%) x Average seedling dry weight (g)

Tetrazolium test (%): Fifty seeds replicated thrice were soaked in 50 ml water for 16 hrs. at 25°C to activate dehydrogenase enzymes. After removal of seed coat, the seeds were stained in 0.5 percent tetrazolium solution (2, 3, 5-triphenyl tetrazolium chloride) for 4 hrs at 38°C, in petri plates. After that solution was poured off and seeds were rinsed briefly in tap water and examined under magnifications. The number of seeds stained entirely red were considered as normal viable seeds and expressed in percentage according to Moore, 1985.

Electrical conductivity (µS/cm/seed): To measure the electrical conductivity, 50 normal and uninjured seeds in three replications were soaked in 75 ml deionized water in 100 ml beakers. Seeds were immersed completely in water and beakers were covered with foil. Thereafter, these 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/seed.

Field Parameters

One hundred seeds in three replications of each four seed lots of each genotype include – fresh, one year old, two year old and three year old seed stored under ambient conditions were sown in a factorial randomized block design.

Speed of emergence index: The number of seedlings emerged were counted on each day from 1st day to 15th day and the Field emergence index (speed of emergence) was calculated as described by Maguire (1962).
Speed of emergence index =

$$\text{Speed of emergence index} = \frac{\text{No. of seedlings emerged}}{\text{First day of sowing}} + \ldots\ldots + \frac{\text{No of seedlings emerged}}{\text{Day of last count (15}^{th}\text{)}}$$

Seedling establishment (SET %): The seedling establishment was determined by counting the total number of seedlings when the emergence was completed or when there was no further addition in the total emergence i.e. on 15th day.

Mean emergence time (days): The mean emergence time was calculated for each treatment combination using the formula cited by Ellis and Robert (1977).
Mean Emergence Time = $\Sigma nt / \Sigma n$
Where,
n = number of seeds newly germinated at time‘t’

t = days from sowing

Σn = final emergence of seedlings

III. RESULT AND DISCUSSION

In present study, results revealed that in all the natural aged seed lots (fresh, one year, two years and three years old) of each genotype, quality decreased with the passage of storage period. The test weight and seed density of each seed lot decreased with ageing (Fig- 1& 2). Similar finding was reported in coriander (*Corandrum sativum* L.) by Kumar, 2007 and in *Salvia* L. by Afshari *et al*., 2011. When seed losses its weight due to natural ageing, seed density will be automatically less.

Standard germination percentage decreases as period of ageing increases in all the four genotypes (Fig-3). Similar results were observed in onion by Kumari, 1994; in Indian mustard seeds by Verma *et al.,* 2003; in onion by Kumar, 2004; in coriander by Desraj (2002), Kumar (2007, 2010); in *Entada pursaetha* by Priya *et al*., 2008; in tomato by Perez-Camacho *et al*., 2008; in wheat by Devender Singh (2009) and in four vegetables seeds (carrot, cucumber, onion and tomato) by Alhamdan *et al.,* 2011. It is concluded that natural ageing has adverse effect on germination.

Seedling length (cm) and Seedling dry weight (mg) in all the four genotypes decreased significantly with the advancement of ageing period (Fig- 4 & 5). Similar finding was reported in urd bean and mung bean by Singh *et al.,* 2003, in Indian mustard seeds by Verma *et al.,* 2003; in onion by Kumar, 2004; in coriander by Desraj, 2002; Kumar, 2007; Kumar, 2010; in turnip by Khan *et al.*, 2005; in wheat by Singh, 2009 and in chickpea by Kapoor *et al.*, 2010.

Vigour index – I and vigour index-II decreased as period of natural ageing increases in all four genotypes (Fig-6 &7). These observations were similar to those already reported by various workers in different crops such as Trawatha *et al*., 1995 in soybean; Agrawal and Sinha, 1980 in okra; Saxena, 1987 in some vegetables seed; Pandita *et al.,* 2002 in garden pea; Gupta and Aneja, 2004 in soybean; Basu *et al.,* 2004 in maize; Rajkumar *et al.* 2004 in pea; Khan *et al.,* 2003 in turnip; Verma *et al.* 2003 in mustard; Gupta *et al.*, 2005 in pearl millet and Kapoor *et al*., 2010 in cowpea.

The results of the present investigation showed that the viability (Tetrazolium test) of the seeds decreased after natural ageing (Fig- 8) confirming the findings in *Brassica juncea* by Verma *et al.* 2003; in onion by Kumar, 2004; in coriander by Desraj, 2002 and Kumar, 2010 and in chickpea by Kapoor *et al.*, (2010).

Electrical conductivity (µS/cm/seed) of seed leachates and Mean emergence time (days) increased significantly after ageing in all the four genotypes of fenugreek (Fig- 9). Similar increase in electrical conductivity of seed leachates was observed during natural ageing in turnip by Khan *et al.,* 2005; in onion by Kumar, 2004; in coriander by Desraj, 2002 and Kumar, 2007; in wheat by Singh, 2009; in sweet pepper by Kaewnaree *et al*., 2011 and in soybean by Mohammadi *et al.,* 2011. The good quality seed (fresh seed lot) will release less leachates as compare to old seed lots.

Speed of emergence decreased as period of natural ageing increases in all four genotypes (Fig-10) Confirm the findings in mungbean by Verma *et al.*, 2006; in wheat by Soltani *et al*. (2008, 2009) and in oilseed rape by Khajeh-hosseini, 2010.

Seedling establishment percentage decrease as period of natural ageing increases in all four genotypes (Fig- 11). Similar finding was reported by Verma *et al*., 2003 in *Brassica campestris*; Desraj, 2002 in coriander; Kumar, 2004 in onion; Kumar, 2007 in coriander; Singh, 2009 in wheat and Kumar, 2010 in coriander.

Mean emergence time (days) increased as period of natural ageing increases in all four genotypes of fenugreek (Fig-12). Similar conclusions drawn in turnip by Khan *et al.*, 2005 and in four vegetable crops (carrot, cucumber, onion and tomato) by Alhamdan *et al.*, 2011.

All aged seed lots showed better germination in the laboratory as compared to field observation because; standard germination is conducted in ideal conditions (temperature, moisture and substrates). It was concluded from this investigation that, test weight (g), seed density (g/cc), standard germination (%), seedling length (cm), dry weight per seedling (mg), vigour index-I & II, viability (%) by tetrazolium test, speed of emergence, seedling establishment (%) decreased whereas, mean emergence time (days) and electrical conductivity (µS/cm/seed) of seed leachates increased with ageing period. The seed of each genotype sustain their germination up to two year thereafter, the germination falls below IMSCS (70 %). Maximum germination was retained by genotype HM-202 followed by, HM-205 and maximum loss of germination was observed in genotype HM-214, hence the genotype HM-202 was found superior in respect of viability, vigour and storability whereas genotype HM-214 was found poor under ambient conditions.

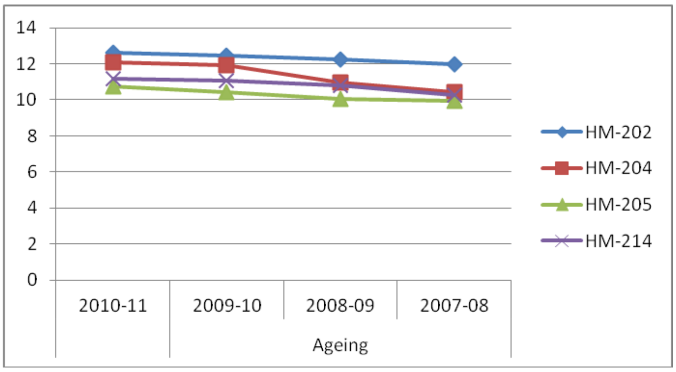

Fig 1: Effect of natural ageing on test weight of fenugreek

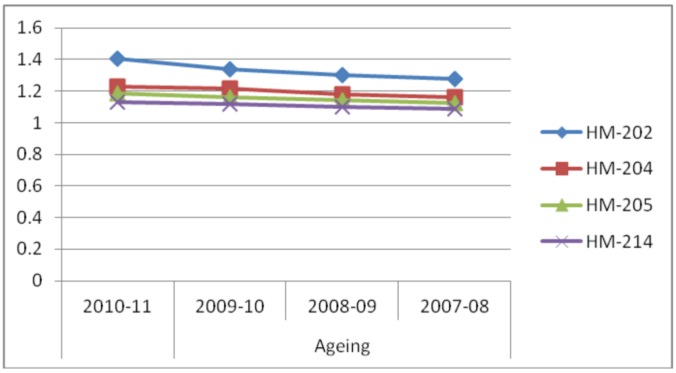

Fig 2: Effect of natural ageing on seed density of fenugreek

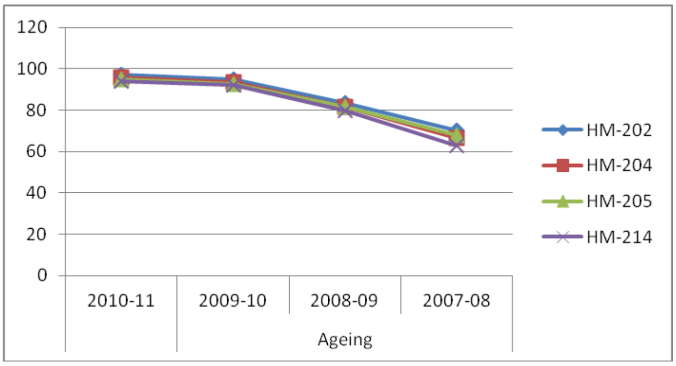

Fig 3: Effect of natural ageing on germination of fenugreek

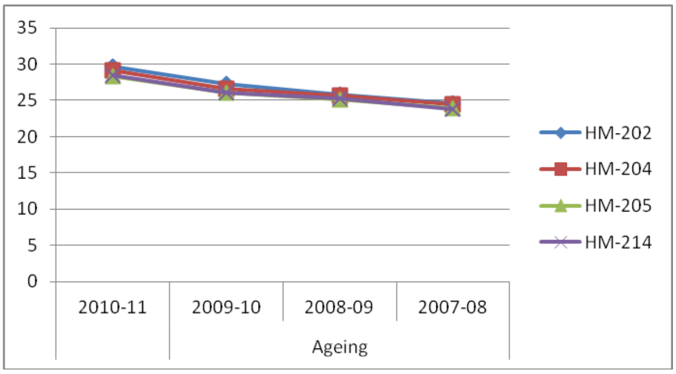

Fig 4: Effect of natural ageing on seedling length of fenugreek

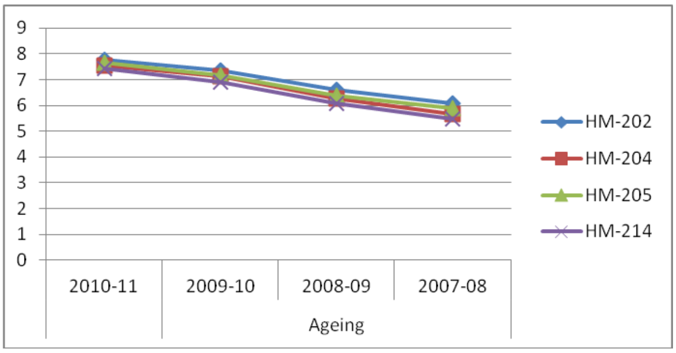

Fig 5: Effect of natural ageing on seedling dry weight of fenugreek

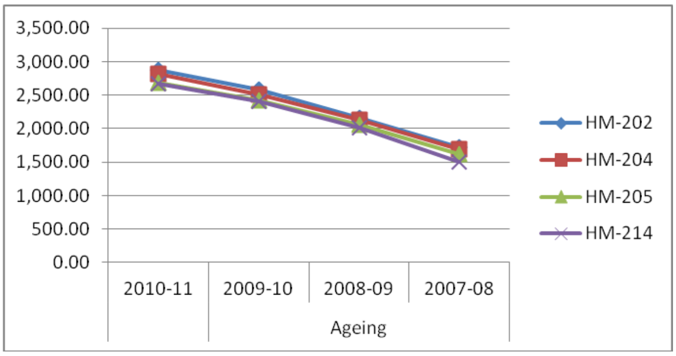

Fig 6: Effect of natural ageing on vigour index-I of fenugreek

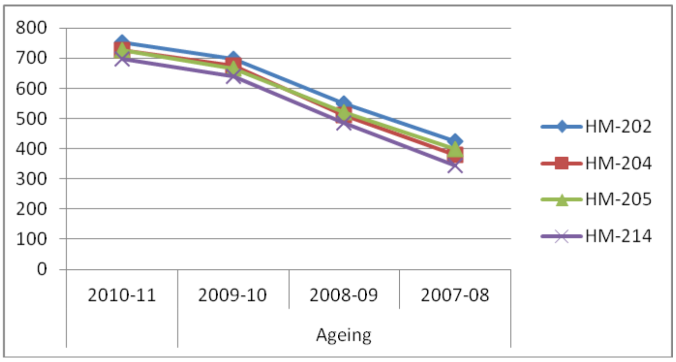

Fig 7: Effect of natural ageing on vigour index-II of fenugreek

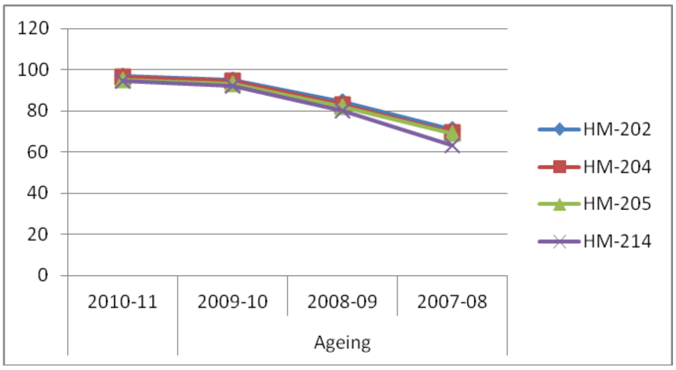

Fig 8: Effect of natural ageing on viability (Tetrazolium) of fenugreek

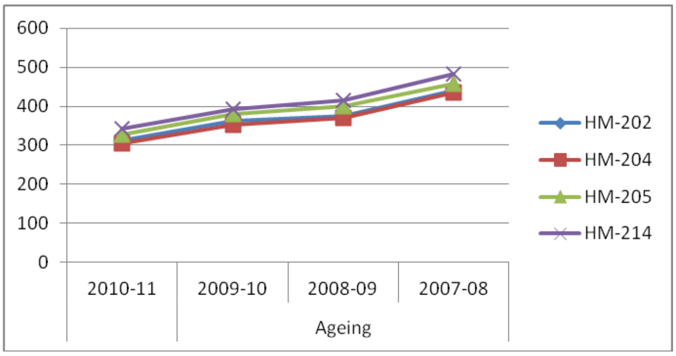

Fig 9: Effect of natural ageing on electrical conductivity of fenugreek

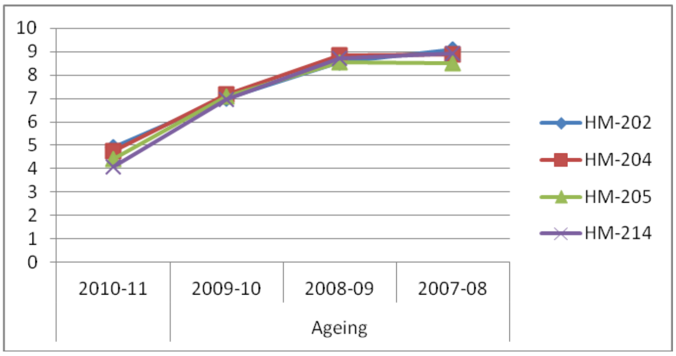

Fig 10: Effect of natural ageing on speed of emergence of fenugreek

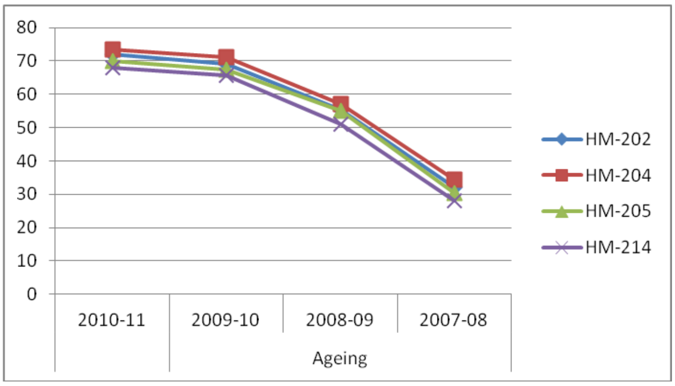

Fig 11: Effect of natural ageing on seedling establishment fenugreek

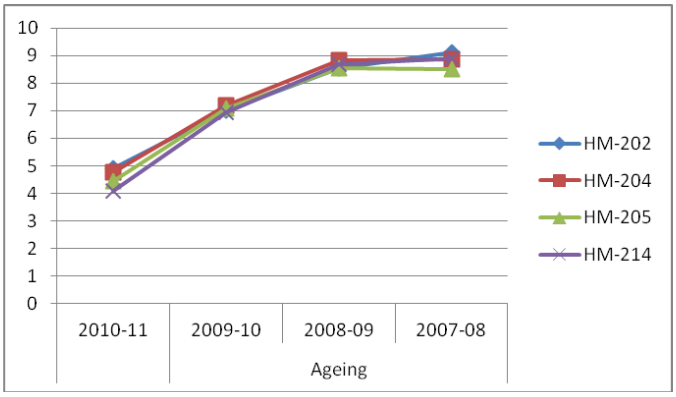

Fig 12: Effect of ageing on mean emergence time of percentage of fenugreek

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