



E-ISSN: 2278-4136

P-ISSN: 2349-8234

[www.phytojournal.com](http://www.phytojournal.com)

JPP 2021; 10(4): 399-403

Received: 06-05-2021

Accepted: 10-06-2021

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## Standardization of harvesting time for quality production of fennel genotypes (*Foeniculum vulgare* Mill.)

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**Abstract**

A field experiment was conducted during *Rabi* season of 2018-2019 at Instructional Farm, Department of Vegetable Science, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to study the "Standardization of harvesting time for quality production of fennel genotypes (*Foeniculum vulgare* Mill.)" The experiment was laid out in Factorial Randomized Block Design (RBD) with three replications and two factors *viz.* Factor "A" Genotypes, G<sub>1</sub> (AF-101), G<sub>2</sub> (AF-102), G<sub>3</sub> (IC-598499) and G<sub>4</sub> (IC-398122) and Factor "B" Days of harvesting, D<sub>1</sub> (20DAF), D<sub>2</sub> (30 DAF), D<sub>3</sub> (40 DAF) and D<sub>4</sub> (50 DAF). The various observations in respect of yield parameters, fennel yield per plant, fennel yield per plot and fennel yield per hectare were found to be maximum in genotype G<sub>2</sub> (AF-102) and harvesting time D<sub>3</sub> (40 DAF).

In respect of quality parameters, test weight and length of seed were found to be maximum in D<sub>4</sub> (40 DAF). Whereas, test weight and length of seed were found non significant for different genotypes. However, recovery of fennel was significantly maximum in genotype G<sub>2</sub> (AF-102) and D<sub>4</sub> (50 DAF) and fibre content was significantly minimum in genotype G<sub>2</sub> (AF-102) and D<sub>1</sub> (20 DAF).

Interaction effect between different genotypes and days of harvesting were found to be significant in G<sub>2</sub>D<sub>3</sub> i.e. AF-102 harvested at 40 DAF for fennel yield per plant, fennel yield per plot, fennel yield per hectare. Recovery of fennel was maximum in G<sub>2</sub>D<sub>4</sub> i.e. AF 102 harvested at 50 DAF and fibre content was minimum in G<sub>2</sub>D<sub>1</sub> i.e. AF-102 harvested at 20 DAF. Whereas, test weight and length of seed was found to be non significant.

In respect of organoleptic taste, G<sub>3</sub>D<sub>2</sub> i.e. IC - 598499 harvested at 30 DAF has scored maximum marks in terms of colour (4.87), flavour (4.90), aroma (4.54), texture (4.54) and taste (5.00) of seed.

**Keywords:** fennel, *Foeniculum vulgare* Mill., genotype, harvesting time, yield, quality

**Introduction**

Fennel (*Foeniculum vulgare* Mill.) belongs to the family Apiaceae, locally called *saunf*. It is cross pollinated crop with chromosome number, 2n=22. It is cultivated throughout the temperate and sub-tropical region of the world for its aromatic seeds, which are used as culinary spices. Fennel is an annual, aromatic herb of 100-180 cm height having slender, branched, smooth stem which becomes hollow at maturity. Leaves are alternate, decompounded and have sheathed petiole. Flowers are small, hermaphrodite, complete, regular and pentamerous. The fruit commonly known as seed is a schizocarp of two mericarps attached to a dividing carpophore. A fully grown fruit is 4 to 8 mm long.

A 100 gram portion of fennel seeds provides 345 kilo calories energy and rich source of protein, dietary fibre, vitamins and several dietary minerals like calcium, iron, magnesium, manganese. Fennel seed contain 2- 4 % essential oil. The main constituents of the fennel oil are 60-80 % trans- anethole and 5-10 % fenchone and also limonene, methyl chavicol, anisaldehyde, cis-anethole, anisic acid, anicketon, monoterpenes and alcohols. It is used in pharmaceutical industry as a diuretic, anti-vomiting, antiasthma, analgesic vermicide, antispasmodic and anti- flatulence properties. Fennel oil is a powerful antiseptic and an ingredient in a numbers of skin ointments, powders, soaps, creams, perfumes and liquors, deodorants, mouthwashes, toothpastes and gargles.

Fennel seeds are having medicinal importance as carminative, cardi tonic, stimulant, vermicide and lactagogue (Lal, 2014) [10]. The root is regarded as a purgative. Fennel fruits are used in diseases like cholera, bile disturbances, nervous disorders, constipation, dysentery and diarrhea and also used for control of diseases attacking chest, lungs, spleen, and kidney and in colic pain. It has also been used to stimulate lactation in animals. It is a remedy against cough and asthma and safeguard against blindness (Slmon *et al.* 1984) [16]. Fennel seed are used for seasoning of food, flavouring of beverages, perfumery, cosmetics and medicines.

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Mature fennel fruits and essential oil are used as flavouring agents in food products such as liqueurs, breads, pickles, pastries, and cheese, meats, vegetable products, fish sauces soups, salad dressing and alcoholic beverages. It is mostly used as “mouth fresheners”. It is used in a confectionary in sweet industry. In the year 2015, the share of Rajasthan was maximum with 48 % in spice production followed by states Haryana, Madhya Pradesh, Uttar Pradesh with 11 % each and minimum share was of west Bengal and other states. (Anon., 2015) [1]. India accounts about 45 % of the global spice export. Major production centres of fennel in India are Rajasthan, Andhra Pradesh, Telangana, Madhya Pradesh, Uttar Pradesh and Karnataka. In India, fennel is cultivated over an area of 1,00,000 ha with the production of 143000 m ton and productivity of 1430 kg/ha (Sharma *et al.*, 2017) [15]. The time of harvesting depends upon the type of product been marketed. Usually, the crop is harvested before the fruits are fully ripe. For green fennel seed used for chewing purposes, umbels are harvested about 30-40 days after flowering whilst they are still green and have attained just half their final size (If left to grow) since not all plants are matured at the same time, harvesting of umbels has to be done 4-5 times, as an when they become ready. The scientific knowledge and crop management about stage of harvesting of fennel is scanty as well as there is a lack of suitable fennel genotypes for Vidarbha region. Hence there is need to undertake a study. To improve yield and quality characters, information on different genotypes and interrelation among different characteristics is necessary. Use of different genotypes is one of the strategies for checking the production of the crop in Vidarbha region. There are various forms of fennel such as immature tender dark green which is known as *Kashmiri saunf*, mature green *saunf* and mature brown *saunf*. *Kashmiri saunf* has high rate in the market as compare to other. Mature green seeds with uniform size and free from chemical residues, bioagents or physical impurities and optimum fiber content are preferred by customer and have high demand in national as well as International Market with premium price. Brown *saunf* is used for seed purpose.

### Material and Methods

The investigation was carried out at Instructional Farm, Department of Vegetable Science, Faculty of Horticulture, Dr.

Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Rabi* season of 2018-2019. The experiment was laid out in Factorial randomized block design with four replications on medium black *soil* with uniform in texture, colour and having good drainage. The treatments constituted two factors *viz.* Factor “A” Genotypes, G<sub>1</sub> (AF-101), G<sub>2</sub> (AF-102), G<sub>3</sub> (IC-598499) and G<sub>4</sub> (IC-398122) and Factor “B” Days of harvesting, D<sub>1</sub> (20DAF), D<sub>2</sub> (30 DAF), D<sub>3</sub> (40 DAF) and D<sub>4</sub> (50 DAF). Sowing was done on 30 October 2018. Farm yard manure was applied 20 tones per hectare and N:90 kg/ha, P2O5:40 kg/ha during the crop season. Half dose of N and full dose of P and K was mixed in the plots at the time of sowing (basal dose) and remaining half dose was applied one months after sowing. The plants were grown in each replication in a total of 48 plots of 2.4 m × 1.8. The crop was harvested on according to treatment. Each bundle was tied, labeled and dried before threshing. Plot wise threshing, cleaning and weighing operation were done manually.

### Result and Discussion

#### Yield Parameter

#### Fennel yield per plant (g), per plot, per hectare as influenced by different genotypes and days of harvesting

The data regarding fennel yield per plant, per plot and per hectare as influenced by different genotypes and days of harvesting were recorded and presented in table 1.

Fennel yield per plant, per plot, per hectare were found to be significant. Fennel yield per plot and fennel yield per hectare were found to be maximum in genotype G<sub>2</sub> (AF-102) and harvesting time D<sub>3</sub> (40 DAF). The data indicated that, the difference in seed yield per might be due to the genotypic difference and ecological variation. Similar results are also reported by Bhandari and Gupta (1993) [3], Rajagopalan *et al.* (1996) [13], Carubba *et al.* (2002) [7], Datta and Choudhuri (2006) [8] in coriander. Moniruzzaman *et al.* (2013) [11] in coriander crop. Variation in seed yield this may be because of, in early harvesting a large amount of the fruits was immature and in late harvesting fruit yield declining mainly due to fruit shattering. This results are in agreement with the findings of Seham *et al.* (2017) [14] in fennel crop.

**Table 1:** Fennel yield per plant (g), per plot, per hectare as influenced by different genotypes and days of harvesting

Treatments	Fennel yield per plant	Fennel yield per plot	Fennel yield per hectare
G <sub>1</sub> (AF-101)	28.68	856.73	20.75
G <sub>2</sub> (AF-102)	30.71	893.00	20.89
G <sub>3</sub> (IC- 598499)	26.86	775.42	18.53
G <sub>4</sub> (IC – 398122)	29.37	840.67	20.14
SE (m)±	0.66	1.63	0.26
CD at 5 %	1.92	4.72	0.75
D <sub>1</sub> (20 DAF)	19.04	489.57	12.53
D <sub>2</sub> (30 DAF)	32.47	984.33	22.87
D <sub>3</sub> (40 DAF)	35.43	1053.75	24.53
D <sub>4</sub> (50 DAF)	28.69	838.17	19.70
SE (m)±	0.66	1.63	0.26
CD at 5 %	1.92	4.72	0.75

### Quality parameters

#### Test weight, Length of seed, Recovery (%), Fibre (%) as influenced by different genotypes and days of harvesting

The data regarding the, Test weight, Length of seed, Recovery (%), Fibre (%) as influenced by different genotypes and days of harvesting were recorded and presented in table 2.

With respect to the quality parameters, test weight and length of seed was found to be maximum in D<sub>4</sub> (40 DAF). Whereas,

test weight and length of seed was found non significant for different genotypes. However, recovery of fennel was significantly maximum in genotype G<sub>2</sub> (AF-102) and D<sub>4</sub> (50 DAF) and fibre content was significantly minimum in genotype G<sub>2</sub> (AF-102) and D<sub>1</sub> (30 DAF).

The data revealed that, Test weight of seed was significantly influenced by stage of picking of umbel because seeds which were harvested early after anthesis was immature, under

developed and under sized. They might have less stored food material, resulted in minimum test weight. As in case of late harvesting test weight was maximum. Similar results also reported by Bhati *et al.* (1990) [6], and Raj *et al.* (2017) [12] in fennel crop. Length of seed as influenced by different days of harvesting were statistically found significant. Significantly maximum length of seed (8.13 mm) were recorded in D<sub>4</sub>(50 DAF) which was followed by (6.62 mm) D<sub>3</sub> (40 DAF). Whereas, minimum test weight (5.16 mm) was recorded in D<sub>1</sub> (20 DAF). Similar results are in line with Bhardwaj *et al.* (2010) [4] and Bhardwaj *et al.* (2013) [5] in fennel.

The data indicated that, the difference in recovery of fennel might be due to the genotypic difference and ecological variation. The data from table revealed that recovery of fennel

maximum in delay of harvesting due to there is less loss of moisture. Whereas, in early stage there is more loss of moisture. Therefore, recovery is minimum in early harvesting. The data, indicated that, the difference in fibre content might be due to the genotypic difference and ecological variation. These results are also supported by Ehsanipour *et al.* (2012) [9] in fennel crop. The data revealed that, Fibre content increases with delay in harvesting. Fiber content in early stages of harvesting is very less (i.e. Smooth texture) as compared to last harvesting stage. Therefore, fennel seeds harvested at 20 and 30 DAF are more preferable for chewing purpose than late harvested seed. This are in conformity with the results of Tiwari and Agarwal, (2004) [19] and Raj *et al.* (2017) [12] in fennel crop.

**Table 2:** Test weight, Length of seed, Recovery (%), Fibre (%) as influenced by different genotypes and days of harvesting

Treatments	Test weight (1000 seed wt in g)	Length of seed (mm)	Recovery (%)	Fibre (%)
G <sub>1</sub> (AF-101)	6.40	6.56	52.40	21.76
G <sub>2</sub> (AF-102)	6.60	6.48	58.44	19.85
G <sub>3</sub> (IC-598499)	6.49	6.08	51.06	22.29
G <sub>4</sub> (IC-398122)	6.55	6.53	55.08	20.67
SE (m)±	0.34	0.21	0.73	0.06
CD at 5 %	-	-	2.11	0.18
D <sub>1</sub> (20 DAF)	4.83	5.16	39.42	12.70
D <sub>2</sub> (30 DAF)	6.17	5.73	42.60	19.4
D <sub>3</sub> (40 DAF)	6.85	6.62	46.78	21.57
D <sub>4</sub> (50 DAF)	8.18	8.13	88.17	31.36
SE (m)±	0.34	0.21	0.73	0.06
CD at 5 %	0.99	0.61	2.11	0.18

#### Colour of seed as influenced by of different interactions

Table indicated that, seed colour of the treatment combinations was observed visually and they were categorized into dark green, green, light green and light brown. Combinations (G<sub>1</sub>D<sub>1</sub>, G<sub>2</sub>D<sub>1</sub>, G<sub>3</sub>d<sub>1</sub> and G<sub>4</sub>D<sub>1</sub>) were

observed as dark green, (G<sub>2</sub>D<sub>1</sub>, G<sub>2</sub>D<sub>2</sub>, G<sub>2</sub>D<sub>3</sub> and G<sub>2</sub>D<sub>4</sub>) were observed as green, (G<sub>3</sub>D<sub>1</sub>, G<sub>3</sub>D<sub>2</sub>, G<sub>3</sub>D<sub>3</sub> and G<sub>3</sub>D<sub>4</sub>) were observed as a light green and (G<sub>4</sub>D<sub>1</sub>, G<sub>4</sub>D<sub>2</sub>, G<sub>4</sub>D<sub>3</sub> and G<sub>4</sub>D<sub>4</sub>) were observed as light brown.

**Table 3:** Colour of seed as influenced by different genotypes and days of harvesting

Treatment combinations	Colour of seed
G <sub>1</sub> D <sub>1</sub>	Dark green
G <sub>1</sub> D <sub>2</sub>	Green
G <sub>1</sub> D <sub>3</sub>	Light green
G <sub>1</sub> D <sub>4</sub>	Light brown
G <sub>2</sub> D <sub>1</sub>	Dark green
G <sub>2</sub> D <sub>2</sub>	Green
G <sub>2</sub> D <sub>3</sub>	Light green
G <sub>2</sub> D <sub>4</sub>	Light brown
G <sub>3</sub> D <sub>1</sub>	Dark green
G <sub>3</sub> D <sub>2</sub>	Green
G <sub>3</sub> D <sub>3</sub>	Light green
G <sub>3</sub> D <sub>4</sub>	Light brown
G <sub>4</sub> D <sub>1</sub>	Dark green
G <sub>4</sub> D <sub>2</sub>	Green
G <sub>4</sub> D <sub>3</sub>	Light green
G <sub>4</sub> D <sub>4</sub>	Light brown

**Table 4:** Organoleptic taste as influenced by different genotypes and days of harvesting

Treatment combinations	Organoleptic taste (Out of 5 marks)				
	Colour	Flavour	Aroma	Texture	Taste of seed
G <sub>1</sub> D <sub>1</sub>	3.17	4.09	4.22	4.28	4.50
G <sub>1</sub> D <sub>2</sub>	4.54	4.79	4.29	4.89	4.95
G <sub>1</sub> D <sub>3</sub>	3.09	3.19	3.09	3.81	3.78
G <sub>1</sub> D <sub>4</sub>	2.80	2.51	2.78	3.08	3.11
G <sub>2</sub> D <sub>1</sub>	3.4	4.34	4.47	4.53	4.75
G <sub>2</sub> D <sub>2</sub>	4.82	4.89	4.35	4.94	4.98
G <sub>2</sub> D <sub>3</sub>	3.34	3.44	3.38	4.06	4.03
G <sub>2</sub> D <sub>4</sub>	3.05	2.76	3.03	3.33	3.36

G <sub>3</sub> D <sub>1</sub>	3.20	4.18	4.35	4.34	4.76
G <sub>3</sub> D <sub>2</sub>	4.87	4.90	4.54	4.95	5.00
G <sub>3</sub> D <sub>3</sub>	3.22	3.29	3.35	3.90	3.85
G <sub>3</sub> D <sub>4</sub>	2.87	2.64	2.87	3.18	3.22
G <sub>4</sub> D <sub>1</sub>	2.92	3.84	3.97	4.03	4.25
G <sub>4</sub> D <sub>2</sub>	4.39	4.24	4.04	4.64	4.70
G <sub>4</sub> D <sub>3</sub>	2.84	2.94	2.84	3.56	3.53
G <sub>4</sub> D <sub>4</sub>	2.55	2.26	2.53	2.83	2.86

From table it was observed that, G<sub>3</sub>D<sub>2</sub> i.e. IC - 598499 harvested at 30 DAF has scored maximum marks in terms of colour (4.87), flavour (4.90), aroma (4.54), texture (4.54) and taste (5.00) of seed.

This can be attributed to the fact that the seeds had maximum bright green colour, good flavour, aroma, highest dry matter with minimum fibre content at the 30 DAF. At the time of 50 DAF the seeds shrunk, deteriorating the sensory quality of the seed.

This was at 20 DAF, dry matter content remained lower with the high moisture content. Seed harvested at low initial moisture content had better storability and maintained good quality. At 50 DAF, the seeds dry matter gets converted to crude fibre which deteriorates flavour, green colour, texture. Similar results are in line with Bhardwaj *et al.* (2010)<sup>[4]</sup> and Bhardwaj *et al.* (2013)<sup>[5]</sup> in fennel.

### Conclusion

On the basis of present findings, it can be concluded that, the yield and quality parameters of fennel has significantly influenced by different genotype and harvesting time.

For yield parameters, fennel yield per plant, fennel yield per plot and fennel yield per hectare were found to be maximum in genotype G<sub>2</sub> (AF-102) and harvesting time D<sub>3</sub> (40 DAF).

With respect to the quality parameters, test weight and length of seed was found to be maximum in D<sub>4</sub> (40 DAF). Whereas, test weight and length of seed was found non significant for different genotypes. However, recovery of fennel was significantly maximum in genotype G<sub>2</sub> (AF-102) and D<sub>4</sub> (50 DAF) and fibre content was significantly minimum in genotype G<sub>2</sub> (AF-102) and D<sub>1</sub> (30 DAF).

Interaction effect between different genotypes and days of harvesting were found to be significant in G<sub>2</sub>D<sub>3</sub> i.e. AF-102 harvested at 40 DAF for fennel yield per plant, fennel yield per plot, fennel yield per hectare. Recovery of fennel was maximum in G<sub>2</sub>D<sub>4</sub> i.e. AF 102 harvested at 50 DAF and fibre content was minimum in G<sub>2</sub>D<sub>1</sub> i.e. AF-102 harvested at 20 DAF. Whereas, test weight and length of seed was found to be non significant.

In respect of organoleptic taste, G<sub>3</sub>D<sub>2</sub> i.e. IC - 598499 harvested at 30 DAF has scored maximum marks in terms of colour (4.87), flavour (4.90), aroma (4.54), texture (4.54) and taste (5.00) of seed.

The present observations are based on the results of experiment conducted for only one season in black cotton soil under conditions of Akola, Maharashtra. Therefore, these results are suggestive and not conclusive.

### Acknowledgements

The authors are thankful to Dr. P. K. Nagre Dean, Faculty of Horticulture, Dr PDKV, Akola and Dr. A. M. Sonkamble, Head, Department of Vegetable Science, Faculty of Horticulture Dr. PDKV, Akola for their encouragement, guidance, suggestions and facilities provided for undertaking this programme.

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