



Research Article

INFLUENCE OF VARIETIES AND STAGE OF MATURITY ON DRY MATTER ACCUMULATION AND SEED QUALITY IN FENUGREEK

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Abstract: Field and laboratory experiments were performed to study the influence of varieties and stage of maturity on seed quality in fenugreek. The field experiments were conducted at the Agricultural Research Station Balagigapade, Chikkaballapur district, Karnataka. The laboratory studies on seed quality parameters were carried out in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Bengaluru. The experiment consisted of five varieties viz., Bangalore local, Pusa Early Bunching, LS-1, CO-1 and CO-2, harvested at five stages viz., seeds harvested at physiological maturity, 5, 10, 15 and 20 days after physiological maturity. Among the varieties, Bangalore local recorded maximum fresh seed weight (0.755 g and 0.610 g), dry seed weight (0.364 g and 0.327 g) and germination (98.30 % and 95.70 %) while, the electrical conductivity was low (143 dSm⁻¹ and 138 dSm⁻¹) in both rabi, 2005 and summer, 2006, respectively as compared to other varieties. Both fresh weight of seeds and pods drastically decreased with the advance in maturity. The dry weight of pods declined with stages of maturity, while the dry weight of seeds increased up to M3 (0.343 g and 0.342 g) in both rabi, 2005 and summer, 2006, thereafter it started to decline. However, M3 recorded higher germination. Harvesting of fenugreek 10 days after physiological maturity is feasible for nucleus, breeder and foundation seeds whereas, for certified stage seeds, the seed crop can be harvested even 20 days after physiological maturity.

Keywords: Fenugreek, Physiological maturity, Seed Quality

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Introduction

Fenugreek (*Trigonella foenum-graecum* L.), commonly known as methi, is cultivated for leafy vegetable, spice, medicinal and fodder purposes. It is basically grown as a cool season crop. It belongs to the family leguminosae. It is an annual herb, 40-90 cm tall, leaves are light green, pinnately trifoliate. Flowers are hermaphrodite and are self-pollinated. Seeds are small and brownish yellow in colour and they are thick and hard in texture. Fenugreek seeds are endospermic in nature, bitter in taste with a peculiar odour and flavour.

Fenugreek is one of the oldest cultivated plants. The leaves are rich in minerals (1.5 g), vitamin A (6450 I.U), vitamin C (54 mg) and protein (4.4 g) per 100 g of edible portion. Seeds are rich in protein (6.3 %), fat (9.5 %), carbohydrates (42.30 %), Vitamin A (1040 I.U), calories (370/100 g), gums (22.06 %), mucilage (28.00 %), trigonellin (0.13-0.35 %), diosgenin (1 g), gitogenin (0.1 g) and traces of trigonenin per kg of dried seeds [1]. The medicinal value of fenugreek seeds is known to Indians since time immemorial. It is believed that fenugreek stimulates digestive process as well as metabolic process. The seeds are used for curing of many ailments like colic flatulence, dysentery, diarrhea, chronic cough, dropsy enlargement of liver and spleen, rickets and smallpox. The seeds help to control type I and II diabetes. They help in healing mouth ulcers. Seeds are also used by women in India to enhance lactation power during postnatal period. It is very useful to diabetic people for lowering the blood glucose and blood cholesterol levels due to large amount of soluble fibres. A gargle made from fenugreek seeds is best for ordinary sore throat and the fenugreek tea is beneficial in bad breath and body odour. Because of its high economic value, much emphasis is being given for increasing area and production under fenugreek which is possible only through the use of sufficient quantity of high quality seeds.

The seed yield and quality of any crop could be achieved not only by adopting improved cultural practices but also by harvesting the seed crop at right maturity (physiological maturity). At this stage seeds will be well developed, matured and possess maximum vigour and viability and then onwards nutrients are no longer entering seed from the plant, but seed senescence begins [2]. On the contrary, early harvesting prior to physiological maturity lowers drastically seed yield and quality on account of underdeveloped and immature seeds. Further delayed harvesting is encountered with field weathering resulting in decreased viability and vigour and subsequent performance during storage.

Material and methods

Field experiment was conducted to know the influence of varieties and stage of maturity on seed quality in fenugreek during rabi, 2005 (sown on 3rd November 2005 and harvested on 18th February 2006) and summer, 2006 (sown on 16th January 2006 and harvested on 15th April 2006) at Agricultural Research Station, Balagigapade, Chikkaballapura district, Karnataka. Five varieties viz., V1: Bangalore local; V2: Pusa Early Bunching (PEB); V3: LS -1; V4: CO-1 and V5: CO-2 were used harvested at five different stages M1- Harvesting at PM (when 80% of the pods turned yellow), M2- Harvesting 5 days after PM, M3- Harvesting 10 days after PM, M4- Harvesting 15 days after PM and M5- Harvesting 20 days after PM. Fresh seeds of varieties Pusa Early Bunching (PEB) and LS-1 were purchased from National Seed Corporation, Hebbal, Bengaluru and Bangalore local, a local variety from Hebbal. The varieties CO-1 and CO-2 were procured from TNAU, Coimbatore and used for the study. Around 300-350 pods that have turned 80 percent yellow were tagged under each replication in all the five varieties.

Influence of Varieties and Stage of Maturity on Dry Matter Accumulation and Seed Quality in Fenugreek

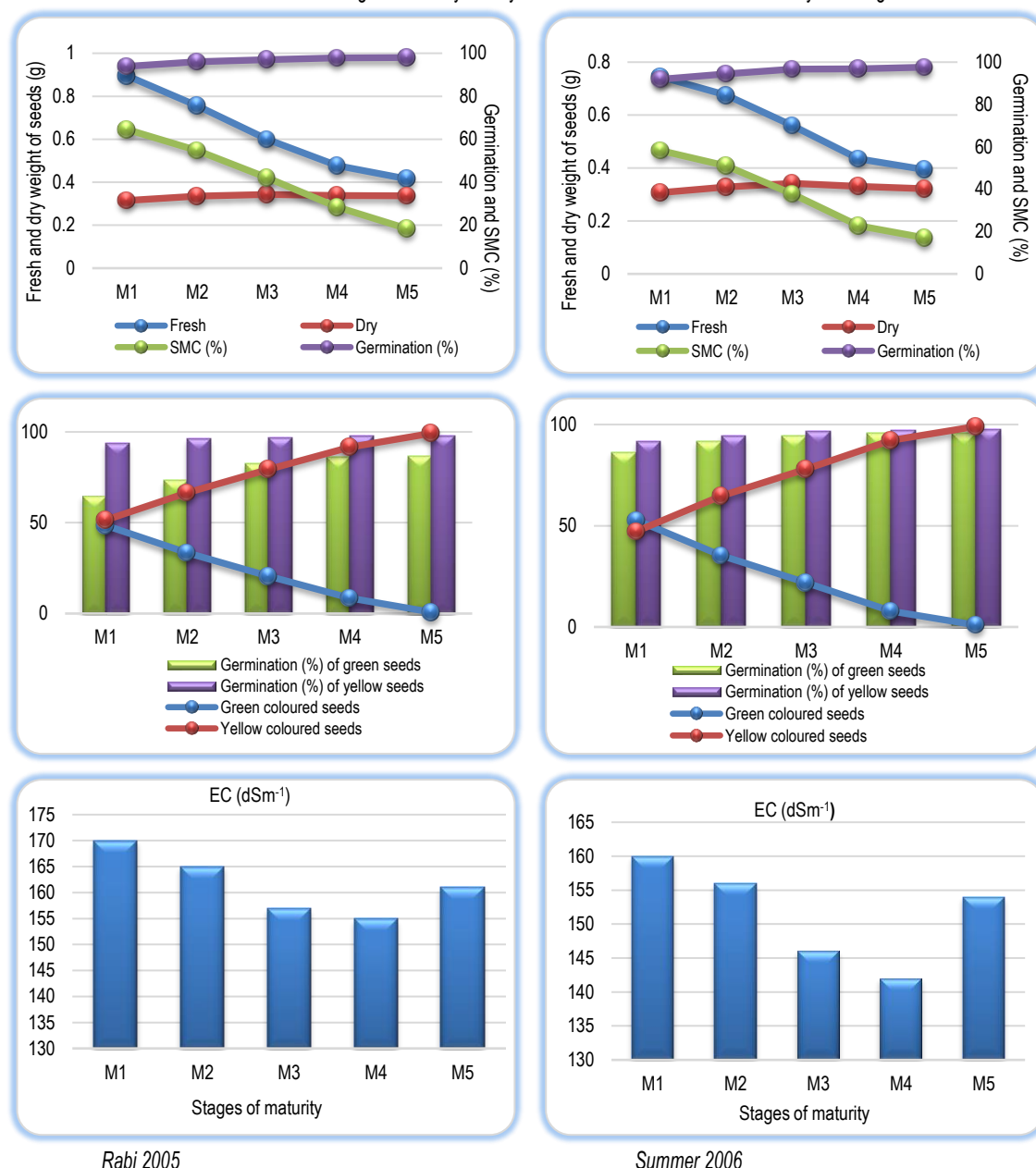


Fig-1 Influence of stages of maturity on fresh weight of seed (g), dry weight of seed (g), moisture content of seed (%), germination (%), percent green and yellow seeds, germination of green and yellow coloured seeds and electrical conductivity of seed leachate during rabi 2005 and summer 2006 in fenugreek
M1-harvesting at physiological maturity (PM), M2-harvesting 5 days after PM, M3-harvesting 10 days after PM, M4-harvesting 15 days after PM, M5-harvesting 20 days after PM

The pods were harvested at an interval of five days from M1, up to a period of 20 days (*i.e.*, M2, M3, M4 and M5). At each sampling, around 50-60 pods in each plot were harvested and used for further observations.

Fresh pod weight (g): At each stage of maturity, 10 pods were harvested in four replications and the fresh weight of the pods was recorded and expressed in grams.

Dry pod weight (g): The pods harvested to record the fresh weight were dried in hot air oven at $85\pm 2^{\circ}\text{C}$ for 17h and then samples were cooled to room temperature and their dry weight was recorded in grams.

Fresh seed weight (g): The pods harvested to record fresh weight of pods were hand shelled and used to record the fresh weight of seeds and expressed in grams up to two decimal places.

Dry seed weight (g): Seeds used to record fresh weight of seeds were dried at $85\pm 2^{\circ}\text{C}$ for 17h and then samples were cooled to room temperature and their dry weight was recorded and expressed in grams.

Seed moisture (%): The moisture content of seeds was determined by the oven dry method as per ISTA rules (2).

Percentage of yellow and green seeds: Ten pods from each stage of maturity were hand shelled and the number of yellow and green seeds was counted, and

the percent yellow and green seeds were calculated on number basis.

100 seed weight (g): From each treatment combination, sample of 100 seeds were randomly taken and the average weight of eight replicates was recorded and expressed in grams.

Germination (%) of both green and yellow seeds: The germination test was carried out in four replicates of hundred seeds in each treatments in seed germinator maintained at $25\pm 1^{\circ}\text{C}$ and 90 ± 2 percent RH using the 'Between Paper' method as per ISTA rules [3]. The number of normal seedlings was counted on fourth and tenth day of germination test as first and final count, respectively and the average of four replications was worked out and expressed as percentage based on normal seedlings.

Electrical conductivity (dSm^{-1}): Twenty-five seeds of four replicates were washed with acetone for few minutes and soaked in 25 ml of double distilled water and kept in an incubator maintained at $25\pm 1^{\circ}\text{C}$ for 18h. Then, the steeped water (seed leachate) from the soaked seeds was collected and electrical conductivity (EC) of the leachate was measured in the Digital Conductivity meter. The EC values due to electrolytes were expressed in dSm^{-1} [4].

Table-1 100 seed weight, seed colour and germination as influenced by the stage of maturity of fenugreek

Rabi, 2005						
Stage of maturity	100 seed weight (g)	Seed colour		Germination (%)		Electrical Conductivity (dSm ⁻¹)
		Green	Yellow	Green	Yellow	
M ₁	1.230	48.50	51.50	65.00	93.90	170
M ₂	1.263	33.45	66.55	73.40	96.10	165
M ₃	1.285	20.59	79.41	82.50	97.00	157
M ₄	1.289	8.43	91.57	86.15	97.90	155
M ₅	1.296	0.75	99.25	86.60	98.00	161
Summer, 2006						
M ₁	1.189	52.77	47.23	86.30	91.90	160
M ₂	1.220	35.26	64.74	91.80	94.50	156
M ₃	1.287	21.92	78.08	94.50	96.70	146
M ₄	1.335	7.78	92.22	95.60	96.90	142
M ₅	1.330	0.93	99.07	95.70	97.60	154

M1-harvesting at physiological maturity (PM), M2-harvesting 5 days after PM, M3-harvesting 10 days after PM, M4-harvesting 15 days after PM, M5-harvesting 20 days after PM

Results and discussion

Beneficial influence of harvesting of seed crop at physiological maturity for obtaining higher seed yield and quality in terms of viability and vigour have been revealed by several seed technologists. Harvesting at early stage may result in a greater number of under developed and immature seeds with high seed moisture content and delayed harvesting results in lower seed yield and poor quality due to field weathering. Hence, harvesting at appropriate stage of physiological maturity is very important for getting better seed yield and quality. Certain physiological maturity indices such as visual symptoms (yellowing and drying of plant and pods, pod and seed coat colour), physical and physiological indices (dry matter production, dry weight of seed, germination percentage, electrical conductivity of seed leachates etc.) have been adopted for determining the physiological maturity in several crops.

Among the varieties studied, Bangalore local recorded better seed quality parameters in terms of dry matter accumulation, seed viability as well as vigour at all the stages of maturity over other varieties. Bangalore local recorded maximum fresh pod weight (1.754 g and 1.456 g), dry pod weight (0.622 g and 0.513 g), fresh seed weight (0.755 g and 0.610 g), dry seed weight (0.364 g and 0.327 g), seed moisture content (46.29 % and 40.64 %), 100 seed weight (1.537 g and 1.465 g), green coloured seeds (31.78 % and 29.32 %), germination of green coloured seeds (83.10 % and 92.20 %), germination of yellow coloured seeds (98.30 % and 95.70 %) while, electrical conductivity of seed leachates was lower (143 dSm⁻¹ and 138 dSm⁻¹) in both rabi, 2005 and summer, 2006, respectively [Table-1]. The differences in seed quality attributes observed among varieties may be attributed to genetic potential of the varieties, differences in seed development and accumulation of food reserves. Better performance of Bangalore local over the other varieties may be due to its bolder seeds and better filling of individual seeds probably due to better translocation of photosynthates. Varietal differences in different genotypes have also been reported by Lal *et al.* (2003) [5] and Korla and Saini (2003) in fenugreek [6].

Seed quality parameters were greatly influenced by different stages of maturity. In the present study, fresh and dry weight of pods and seeds, and seed moisture content were significantly influenced by the stages of maturity. Both fresh weight of seeds and pods decreased with the advance in maturity. The decrease in fresh weight of seed was concomitant with decrease in moisture content of seed owing to prevailing higher temperature and lower relative humidity at harvesting time. Besides, the dry weight of pods declined with stages of maturity, while the dry weight of seeds increased upto M₃ (0.343 g and 0.342 g) and thereafter, it started to decline. Although decline in dry weight was not significant, but it was on par with M₃ [Fig-1]. The loss in fresh weight was mainly due to the loss in moisture content of pod as it is related to prevailing temperature and relative humidity. These findings agree with the results reported by Anita (1987) [7] in urd bean, Indira and Dharmalingam (1996) [8] in fenugreek and Seth *et al.* (1999) in fodder cowpea [9]. Similarly, fresh weight of seed also gradually decreased over maturity period. The decline in fresh weight of seed was concomitant with decrease in moisture content of seed owing to prevailing higher temperature and lower relative humidity at harvesting time. Moisture content of seed gradually decreased as maturity period advanced. Maximum moisture content (64.51 % and 58.27 %) of seed was

recorded at M₁ and minimum (18.34 % and 17.05 %) at M₅ [Fig-1]. This decrease in moisture content of seed at maturity was due to more accumulation of dry matter in seeds and higher desiccation towards maturity. The results are in conformity with the reports of Demir *et al.* (1994) [10] in snap bean, Ramaiah *et al.* (1994) [11], Venture *et al.* (1996) [12] in Phaseolus vulgaris, Suryavamsi and Patil (1996) [13] in mungbean, Indira and Dharmalingam (1996), Vasudevan *et al.* (2008) [14] in fenugreek and Seth *et al.* (1999) in fodder cowpea.

Seed quality is sum of physical, physiological and bio-chemical attributes which determine crop performance in the field. Generally, seeds harvested earlier will be immature, under developed and not equipped with full germination potential and as such perform poorly compared to seeds harvested at physiological maturity. Further, the seeds harvested later than physiological maturity will also be poor in quality owing to field weathering. Thus, the seed quality largely depends on the stage at which it is harvested.

Maximum percentage of green coloured seeds (48.50 % and 52.77 %) were recorded when seeds were harvested at 80 percent of the pods turned yellow (M₁) followed by five and ten days after 80 percent of the pods turned yellow (33.45 % and 35.26 %; 20.59 % and 21.92 %) in both rabi, 2005 and summer, 2006, respectively [Table-1]. However, the percent green coloured seeds were lower (0.75 % and 0.93 %) and percent yellow coloured seeds were higher (99.25 % and 99.07 %) when pods were harvested 20 days after 80 percent of the pods turned yellow in both rabi, 2005 and summer, 2006, respectively [Fig-1].

Germination of green coloured seeds were lower when harvested at all the stages over yellow coloured seeds indicating immature and under developed seeds and not equipped with germination potential [Fig-1], whereas, the electrical conductivity of seed leachates was recorded higher in all the stages of maturity.

Although, the pods harvested at 10 days after physiological maturity (M₃) recorded higher dry matter, the later stages (M₄ and M₅) were on par with each other. M₁ recorded higher moisture content and immature seeds but germination percentage was significantly superior at M₃ (harvesting 10 days after physiological maturity). For any crop, the ideal harvest time would be immediately after physiological maturity but before the loss of mature seeds [15,16]. In the present investigation, fenugreek attained physiological maturity at M₃ possessing high seed quality with lower moisture content (42.05% and 37.71%) in both rabi, 2005 and summer, 2006, respectively. Thereafter, the seeds must be properly dried immediately after harvesting to arrest the development of field weathering and microbial activity. If sunny days are not available at this stage, the seeds must be dried in artificial dryers. This method may not be economical when the seeds are in large quantity.

Conclusion

Harvesting of fenugreek at physiological maturity (M₃) is feasible for nucleus, breeder and foundation seeds whereas, for certified stage seeds can be harvested even at M₅, since germination percentage was on par with less moisture content (18.34 % and 17.05 %) in both rabi, 2005 and summer, 2006, respectively. Similar results were reported by Indira and Dharmalingam (1996), Sudarshan (2004) [17] and Vasudevan *et al.* (2008) in fenugreek and Seth *et al.* (1999) in fodder cowpea.

Application of research: Harvesting of fenugreek 10 days after physiological maturity is feasible for nucleus, breeder and foundation seeds whereas, for certified seeds, the seed crop can be harvested even 20 days after physiological maturity.

Research Category: Seed Science and Technology

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University: University of Agricultural Sciences, Bengaluru, 560065, India

Research project name or number: PhD Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Agricultural Research Station, Balajigapade, Chikkaballapura district, Karnataka

Cultivar / Variety / Breed name: Fenugreek (*Trigonella foenum-graecum* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

- [1] Aykroyd U.R. (1963) *Indian Council of Medical Research, Special Report, Series, No. 42, Choudary, B. 1976, Vegetables, National Book Trust India (4th Edn.), New Delhi, 188-191.*
- [2] Harrington J.F. (1972) *Seed storage and longevity. In; Seed Biology, (Ed.) T.T. Kozlowski, Academic Press Ltd., London, 145-245.*
- [3] Anonymous (2007) *Seed Sci& Technol., (Supplement), 35, 25-30.*
- [4] Presley H.T. (1958) *Pl. Dis. Rep., 42, 52.*
- [5] Lal S., Rana M.K. and Partap P.S. (2003) *Haryana J. Hort. Sci., 32(3&4), 262-265.*
- [6] Korla B.N. and Saini A. (2003) *Haryana J. Hort. Sci., 32(1&2), 120-122.*
- [7] Anita.S. (1987) *Indian J. Pl. Physiol., 20, 199-201.*
- [8] Indira K. and Dharmalingam C. (1996) *Madras Agric. J., 83 (4), 239-240.*
- [9] Seth R.C.H., Padmavathi and Mesra L.P. (1999) *Seed Res., 27 (1), 66-70.*
- [10] Demir J., Vannaz R. and Gunay A. (1994) *Bohsce, 28, 59-64.*
- [11] Ramaiah H., Prakash K.S., Bomme Gowda A. and Jagadish G.V. (1994) *Mysore J. Agric. Sci., 28, 303-306.*
- [12] Venture A.A., Vande, Demir Mellon S.D.E. and Loubes W.A. (1996) *South African J. Pl. & Soil, 13, 47-50.*
- [13] Suryavamshi Y.B. and Patil R.B. (1996) *Seed Res., 23 (1), 25-27.*
- [14] Vasudevan S.N., Sudarshan J.S., Kurdikeri M.B. and Dharmatti P.R. (2008) *Karnataka J. Agric. Sci., 21 (1), 122-124.*
- [15] Gray D. and Joyce R.A. Steckel (1983) *Annal. Appl. Biol., 107(3), 559-570.*
- [16] Gray D. and Joyce R.A. Steckel (1986) *J. Hort. Sci., 61(3), 315-323.*
- [17] Sudarshan J.S. (2004) *M.Sc. (Agri.) Thesis, submitted to University Agricultural Sciences, Dharwad.*