



EFFECT OF SOWING DATE ON YIELD AND QUALITY OF FENUGREEK

**B. Anitha*, M. Lakshmi Narayana Reddy, A. V. D. Dorajee Rao, T. S. K. K. Kiran Patro
and D. R. Salomi Suneetha**

Horticultural College and Research Institute, Dr. Y.S.R. Horticultural University, Venkataramannagudem,
West Godavari District - 534 101 (Andhra Pradesh), India.

Abstract

An experiment was conducted at Horticultural College and Research Institute, Venkataramannagudem, Dr. Y.S.R. Horticultural University with an objective of evaluating the effect of sowing date, variety and their interaction on growth, yield and quality of seed fenugreek in order to assess its fitment into sequence cropping under delayed sowing conditions. A total of five varieties viz., Hissar Sonali, Rmt-1, Co-1, Rajendrakranti and Co-2 were evaluated on five sowing dates at 15-day interval starting from 15th October to 15th December in split plot design with five main plots as sowing dates and five sub-plots as varieties. There were significant differences in the yield and quality of fenugreek. The maximum values in respect of many of these parameters was recorded by Co-1 and Co-2 by sowing on 15th October, it is also observed that Co-1 and Co-2 varieties were at par in some of these characters and on the other hand at lower level Rmt-1 and Rajendrakranti were on par with one another. Regarding the sowing dates 15th October was found to be on par with 1st November and similarly 1st December and 15th December were also on par though recorded minimum values in respect of some of the characters including seed yield per plant and per plot.

Key words : Fenugreek, sowing date, seed yield, diosgenin, protein and chlorophyll.

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is an important seed spice, originated from South-Eastern Europe and belongs to the family Leguminosae. Fenugreek seed is one of the principal odoriferous constituents of curry powder. The dried seeds, leaves and tender shoots are all consumed and are valued as food, flavouring agent and medicine. Aggarwal *et al.* (2005) stated that its leaves are specially used for vegetable purpose. India is the largest producer of fenugreek, where it is the third largest spice after coriander and cumin. It is mainly cultivated in Rajasthan, Gujarat and Madhya Pradesh and to a limited extent in Andhra Pradesh, Tamil Nadu, Haryana, Maharashtra and Punjab (Meena *et al.*, 2014). Rajasthan is considered as “fenugreek bowl” of the country. Fenugreek is mainly grown as leafy vegetable throughout India and there is ample scope for its cultivation as seed spice (Amal *et al.*, 2012). It is a short duration crop fitting well in several cropping systems. Seed crop requires cool dry climate and takes about three months duration thus fitting well as

a *rabi* crop after the harvest of *kharif* main crops like paddy, chillies, cotton and pigeon pea. It is well known that among yield influencing factors date of planting is said to be the major one having direct influence on growth, yield and quality of fenugreek.

Fenugreek seeds contain steroids like, sapogenin and diosgenin (Ahmed *et al.*, 2010). It is of considerable economic importance to the pharmaceutical industry as a starting material for partial synthesis of oral contraceptive drugs and other medicinally used steroids (Purbey and Sen, 2005). At present bulk of the diosgenin is produced from yams (*dioscorea*), which required considerably higher inputs compared to fenugreek.

In general, the crop requires cool climate during vegetative growth and warm dry climate during maturity. During *rabi* season sowing in the month of October is recommended both for seed and leaf crop under coastal A. P. conditions (Anonymous, 2015). However, delay in sowing has become a common feature due to vagaries in monsoon and far approachability to canals in certain localities. Under these circumstances, no systematic work has been carried out so far to find out the best sowing

*Author for correspondence: E-mail: bandianitha786@gmail.com

date of seed fenugreek within *rabi* season satisfying the needs of sequence cropping under late seasonal conditions. An evaluation of different sowing dates is thus planned in order to find out the best one without losing much of grain yield and quality.

Materials and Methods

A field experiment was conducted on growth and yield parameters of fenugreek at Horticultural College and Research Institute, Venkataramannagudem, Dr. Y.S.R. Horticultural University during 2014-15. A total of five varieties *viz.*, Hissar Sonali, Rmt-1, Co-1, Rajendrakranti and Co-2 were evaluated on five sowing dates at 15-day interval starting from 15th October to 15th December in split plot design with five main plots as sowing dates and five sub-plots as varieties. Recommended practices was followed. All the observations on yield and yield components of fenugreek were recorded after harvesting of the crop.

The quality parameters were measured using standard methods. Chlorophyll content (a, b and total) in leaves (mg g⁻¹) was determined through acetone method. Protein content in seeds (%) was estimated by Lowry method (Lowry *et al.*, 1951). Diosgenin content in seeds (%) was determined as per the methods described by Baccau *et al.* (1977) and Uematsu *et al.* (2000) with some modifications. The diosgenin level was determined by measuring absorbance at 430 nm, based on the color reaction with anisaldehyde, sulfuric acid and ethyl acetate.

Results and Discussion

Fresh weight of the plant (g)

The maximum fresh weight at maturity (21.07 g) was found in the plants sown on 15th October followed by 1st November sown plants (19.46 g). The minimum fresh weight at maturity (15.80 g) was observed in the 15th December sown plots (table 1).

Dry weight of the plant (g)

Significant variations were observed in dry weight of plant at 30, 60 DAS and maturity due to dates of sowings. The maximum dry weight at maturity (15.33 g) was recorded by the plants sown on 15th October followed by 1st November sown plants (13.79 g). The minimum dry weight at maturity (8.73 g) was found in the 15th December sown plots (table 1).

Leaf area (cm²)

The data revealed significant differences among the dates of sowing, varieties and their interaction with respect to leaf area per plant at 30, 60 DAS and at maturity. The highest leaf area at maturity (21.60 cm²) was recorded

Table 1 : Fresh weight, Dry weight and leaf area of the plant (g) as influenced by sowing date and variety in Fenugreek.

Date of sowing/ Variety	Fresh weight at maturity					Dry weight at maturity					Leaf area at maturity							
	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean
Hissar sonali	21.00	19.33	18.33	16.60	15.66	18.18	15.33	13.66	11.66	10.00	9.00	11.93	22.00	19.00	17.00	15.00	14.00	17.40
Rmt-1	19.33	18.00	17.00	16.00	15.00	17.07	13.33	12.33	9.66	8.00	7.00	10.06	20.00	17.00	16.00	14.33	14.00	16.27
Co-1	23.00	21.33	19.66	18.66	17.00	19.93	17.33	15.66	13.00	12.00	10.33	13.66	23.00	19.00	18.00	16.00	17.00	18.60
Rajendrakanthi	20.00	18.33	17.33	16.33	15.33	17.46	14.33	12.66	10.66	9.00	7.33	10.80	21.00	18.00	16.00	15.00	14.00	16.80
Co-2	22.00	20.33	19.33	17.66	16.00	19.06	16.33	14.66	12.00	11.00	10.00	12.80	22.00	20.00	18.00	17.00	13.66	18.13
Mean	21.07	19.46	18.00	17.05	15.80	18.34	15.33	13.79	11.40	10.00	8.73	11.85	21.60	18.60	17.00	15.46	14.53	17.44
Factor	S.Em±					CD at 5% LOS	Factor	S.Em±					CD at 5% LOS	Factor				
Sowing date	0.39					1.11	Sowing date	0.32					0.92	Sowing date				
Variety	0.46					1.30	Variety	0.64					1.82	Variety				
Interaction	0.72					2.07	Interaction	0.94					2.67	Interaction				

Table 2 : Pod yield/plant and seed yield/plant as influenced by date of sowing and variety in fenugreek.

Date of sowing/ Variety	Pod yield per plant (g)						Seed yield per plant (g)					
	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean
Hissar sonali	14.89	12.75	10.16	9.27	8.21	11.06	10.30	8.65	6.63	5.86	5.13	7.31
Rmt-1	12.81	11.22	8.18	7.26	6.68	9.23	8.49	7.24	5.14	4.45	4.02	5.87
Co-1	15.47	14.72	11.96	11.05	10.16	12.67	11.16	10.48	8.28	7.44	6.63	8.80
Rajendranthi	13.73	11.95	9.29	8.23	7.26	10.09	9.37	7.80	5.87	5.13	4.45	6.52
Co-2	14.92	13.77	11.06	10.11	9.27	11.82	10.63	9.55	7.44	6.63	5.86	8.02
Mean	14.36	12.88	10.13	9.18	8.31	10.97	9.99	8.74	6.67	5.90	5.22	7.30
Factor	S.Em±			CD at 5% LOS			Factor	S.Em±			CD at 5% LOS	
Sowing date	0.34			0.97			Sowing date	0.26			0.74	
Variety	0.37			1.04			Variety	0.29			0.82	
Interaction	0.71			2.02			Interaction	0.56			1.61	

by the plants sown on 15th October followed by 1st November sown plants (18.60 cm²). The lowest value with respect to leaf area at maturity (14.53 cm²) was observed in the 15th December sown plots (table 1).

Under local conditions of Venkataramannagudem, the fenugreek sown on 15th October was found to produce more plant height, number of leaves per plant, number of branches per plant, plant spread, leaf area and dry weight, as compared to other sowing dates. This might be due to the plants sown on 15th October might had benefited by favourable conditions like temperature and humidity and could achieve better germination, seedling vigour, maximum photosynthetic surface leads to accumulation of maximum fresh weight and dry weight and as compared to those sown on late rabi. Similar results of significant differences in these characters due to date of sowing were also reported by Gill *et al.* (2001) and Singh *et al.* (2005) in fenugreek; Aggarwal *et al.* (2012), Halesh *et al.* (2000), Gowda *et al.* (2006) in fenugreek; Chaudhari *et al.* (1995) in coriander; Susil and Rajkumar (2011) in Ajowan. Baswana *et al.* (1989), Bhati (1991), Pan *et al.* (2003), Bhadkariya *et al.* (2007), Sharangi *et al.* (2014) in coriander; Saddam *et al.* (2012) in fennel.

Weight of pods per plant (g)

Maximum value with respect to weight of the pods per plant (14.36 g) was recorded by the plants sown on 15th October, which was on par with the 1st November sown plants (12.88 g). The lowest weight of the pods per plant (8.31g) was observed in the 15th December sown plots (table 2)..

Seed yield per plant(g)

The highest seed yield per plant (9.99 g) was recorded by the plants sown on 15th October followed by 1st

November sown plants (8.74 g). The lowest seed yield per plant (5.22 g) was noticed by the 15th December sown plots (table 2).

Percentage of grain filling

Significant variations were observed in percentage of grain filling due to dates of sowings. The maximum percentage of grain filling (82.15) was recorded by the plants sown on 15th October, which is on par with the 1st November sown plants (79.90) and the 15th November sown plants. The minimum percentage of grain filling (65.80) was observed in the 15th December sown plots (table 3).

Shelling percentage

The highest shelling percentage (69.40) was recorded by the plants sown on 15th October, which is on par with the 1st November sown plants (67.63). The lowest shelling percentage (62.51) was noticed by the 15th December sown plots (table 3).

1000-seed weight (g)

Maximum weight of 1000 seed (15.60 g) was recorded by the plants sown on 15th October, which was on par with the 1st November sown plants (14.86 g). The lowest weight 1000 seed (13.43 g) was observed in the 15th December sown plots (table 3).

The plants sown on 15th October and those belong to Co-1 variety were found to produce more number pods per plant, maximum weight of the pods per plant, seed per pod as well as test weight. Thus, the cumulative effect of the merit exhibited by these combinations could have ultimately led to increased seed yield per ha. This might be due to favourable environmental conditions available to the crop that was sown on 15th October as compared

Table 3 : Percentage of grain filling, shelling percentage and 1000 seed weight (g) as influenced by sowing date and variety in fenugreek.

Date of sowing/ Variety	Percentage of grain filling					Shelling percentage					1000 seed weight(g)									
	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean		
Hissar sonali	82.25	82.25	76.38	70.50	64.63	75.20	69.15	67.85	65.25	63.24	62.54	65.61	15.71	14.86	14.29	14.00	13.43	14.46		
Rmt-1	70.50	64.63	64.63	58.75	58.75	63.45	66.25	64.51	62.85	61.25	60.25	63.02	14.57	13.71	13.14	12.86	12.29	13.31		
Co-1	93.50	94.00	94.50	82.25	76.38	88.13	72.15	71.23	69.25	67.35	65.25	69.05	16.57	16.00	15.43	15.14	14.57	15.54		
Rajendrakanthi	76.38	70.50	70.50	64.63	58.75	68.15	68.23	65.25	63.14	62.35	61.28	64.05	15.14	14.29	13.71	13.43	12.86	13.89		
Co-2	88.13	88.13	82.25	76.38	70.50	81.08	71.24	69.32	67.25	65.58	63.25	67.33	16.00	15.43	14.86	14.57	14.00	14.97		
Mean	82.15	79.90	77.65	70.50	65.80	75.20	69.40	67.63	65.55	63.95	62.51	65.81	15.60	14.86	14.29	14.00	13.43	14.43		
Factor	CD at 5% LOS					S.Em \pm					Factor					S.Em \pm				
Sowing date	11.26					0.88					Sowing date					0.29				
Variety	13.00					0.92					Variety					0.33				
Interaction	21.16					1.88					Interaction					0.74				
	CD at 5% LOS					CD at 5% LOS					CD at 5% LOS					CD at 5% LOS				
	0.83					2.53					Sowing date					0.83				
	0.95					2.63					Variety					0.95				
	2.10					5.37					Interaction					2.10				

to late sown crops in case of both Co-1 and Co-2 varieties. These results are in conformity with the findings of Halesh (2000), Sheoran *et al.* (2000a) and Gowda *et al.* (2006) in fenugreek; Batra *et al.* (2002), Saddam *et al.* (2012) in fennel, Chaudhari *et al.* (2009) in amaranthus, Seyyed *et al.* (2012), Bhadkariya *et al.* (2007).

Chlorophyll content

Chlorophyll a (mg/g)

The maximum chl. a content (3.43 mg) was recorded by the plants sown on 15th October followed by 1st November sown plants (3.19 mg). The minimum chl. a content (2.69 mg) was found in the 15th December sown plots (table 4).

Chlorophyll b (mg/g)

The chlorophyll b content was found to vary significantly among the sowing dates. The maximum chl. b content (1.18 mg) was recorded by the plants sown on 15th October followed by 1st November sown plants (1.94 mg). The minimum chl. b content (1.14 mg) was found in the 15th December sown plots (table 4).

Total chlorophyll (mg/g)

The highest total chlorophyll content (4.61 mg) was recorded by the plants sown on 15th October followed by 1st November sown plants (4.36 mg). The lowest total chlorophyll content (3.83 mg) was found in the 15th December sown plots (table 5).

Ratio of chlorophyll a and chlorophyll b

The differences observed among the dates of sowing were found to be significant with respect to ratio of chl. a and chl. b. The highest ratio with respect to chl. a and chl. b (2.91 mg) was recorded by the plants sown on 15th October followed by 1st November sown plants (2.74 mg). The minimum chl. a and chl. b ratio (2.35 mg) was found in the 15th December sown plots (table 5).

Diosgenin content (%)

The highest diosgenin content in seeds (0.54%) was recorded by the plants sown on 15th October followed by 1st November sown plants (0.49%). The minimum diosgenin content (0.40%) was observed in the 15th December sown plots (table 6).

Protein content (%)

The highest protein content in seeds (12.90%) was recorded by the plants sown on 15th October followed by 1st November sown plants (10.44%). The lowest value with respect to protein content in seeds (9.55%) was observed in the 15th December sown plots (table 6).

A perusal of data on the contents of chlorophyll a, chlorophyll b and total chlorophyll revealed that the

Table 4 : Chlorophyll content (mg/g) as influenced by date of sowing and variety in fenugreek.

Date of sowing/ Variety	Chlorophyll (a)						Chlorophyll (b)					
	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean
Hissar sonali	3.36	3.20	2.72	2.80	2.65	2.95	1.18	1.17	1.16	1.15	1.14	1.16
Rmt-1	3.15	2.95	2.65	2.56	2.45	2.75	1.17	1.15	1.14	1.13	1.12	1.14
Co-1	3.70	3.45	3.25	3.10	3.00	3.30	1.18	1.19	1.18	1.17	1.16	1.18
Rajendrakanthi	3.25	3.02	2.69	2.65	2.56	2.83	1.17	1.16	1.15	1.14	1.13	1.15
Co-2	3.69	3.35	3.10	3.00	2.80	3.19	1.18	1.18	1.17	1.16	1.15	1.17
Mean	3.43	3.19	2.88	2.82	2.69	3.00	1.18	1.19	1.16	1.15	1.14	1.16
Factor	S.Em±			CD at 5% LOS			Factor	S.Em±			CD at 5% LOS	
Sowing date	0.05			0.16			Sowing date	0.03			0.09	
Variety	0.07			0.20			Variety	0.02			0.04	
Interaction	0.12			0.33			Interaction	0.07			0.13	

Table 5 : Ratio of chlorophyll and total chlorophyll content in leaves as influenced by date of sowing and variety in fenugreek.

Date of sowing/ Variety	Ratio of Chlorophyll a and Chlorophyll b						Total Chlorophyll					
	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean
Hissar sonali	2.84	2.75	2.36	2.43	2.32	2.47	4.54	4.37	3.88	3.95	3.79	4.11
Rmt-1	2.68	2.58	2.32	2.26	2.18	2.34	4.32	4.10	3.79	3.69	3.57	3.89
Co-1	3.15	2.91	2.75	2.64	2.58	2.72	4.88	4.64	4.43	4.27	4.16	4.48
Rajendrakanthi	2.76	2.60	2.34	2.32	2.26	2.38	4.42	4.18	3.84	3.79	3.69	3.98
Co-2	3.12	2.85	2.64	2.58	2.43	2.63	4.87	4.53	4.27	4.16	3.95	4.36
Mean	2.91	2.74	2.48	2.45	2.35	2.51	4.61	4.36	4.04	3.97	3.83	4.16
Factor	S.Em±			CD at 5% LOS			Factor	S.Em±			CD at 5% LOS	
Sowing date	0.05			0.16			Sowing date	0.06			0.19	
Variety	0.05			0.15			Variety	0.03			0.09	
Interaction	0.07			0.20			Interaction	0.08			0.25	

Table 6 : Diosgenin content and protein content in seeds (%) as influenced by date of sowing and variety in fenugreek.

Date of sowing/ Variety	Diosgenin content in seeds (%)						Protein content in seeds(%)					
	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean	15-Oct	1-Nov	15-Nov	1-Dec	15-Dec	Mean
Hissar sonali	0.55	0.49	0.46	0.44	0.40	0.47	10.96	9.89	9.74	9.68	9.56	9.97
Rmt-1	0.45	0.40	0.36	0.35	0.30	0.37	8.95	9.65	9.54	9.48	9.35	9.39
Co-1	0.62	0.59	0.56	0.53	0.50	0.56	12.90	11.91	10.98	9.89	9.75	11.09
Rajendrakanthi	0.50	0.45	0.41	0.39	0.35	0.42	9.86	9.76	9.65	9.56	9.48	9.66
Co-2	0.57	0.54	0.51	0.48	0.45	0.51	11.89	10.98	9.89	9.78	9.63	10.43
Mean	0.54	0.49	0.46	0.44	0.40	0.47	10.91	10.44	9.96	9.68	9.55	10.11
Factor	S.Em±			CD at 5% LOS			Factor	S.Em±			CD at 5% LOS	
Sowing date	0.02			0.05			Sowing date	1.31			3.74	
Variety	0.01			0.04			Variety	0.86			2.46	
Interaction	0.03			0.08			Interaction	2.10			NS	

optimum season of sowing *i.e.* 15th October to 1st November as evident through the results on yield parameters, also had positive influence on chlorophyll contents. As the time of sowing went late, the reductions observed in the contents of chlorophyll a, b and total chlorophyll are mainly due to reduction in transpirational pull in late cooler months as compared to October.

The results on protein content as well as diosgenin content in the seed revealed that maximum values in respect of both of them were exhibited by early sown crop is due the maximum physiological activity that could have led to make maximum quantum of photosynthates available for various metabolic (anabolic) pathways. These facts are in conformity with the findings of Taylor *et al.* (1997) and Rathore *et al.* (2008) also reported that either diosgenin or protein content of the crop was significantly influenced by the time of sowing.

Conclusion

Thus, it can be conclusively stated that the date of sowing as 15th October was found to be on par with 1st November in respect of some of the characters including seed yield per plant and quality. Under the local conditions of coastal Andhra Pradesh the fenugreek sow as sequence crop in *rabi* season. In case the season is delayed the negative effect on yield has also been quantified in respect of different parameters.

References

- Aggarwal, K. B., J. K. Ranjan, S. S. Rathore, S. N. Saxena and B. K. Mishra (2013). Changes in physical and biochemical properties of fenugreek (*Trigonella* sp. L.) leaf during different growth stages. *International Journal of Seed Spices*, **3(1)** : 31-35.
- Batra, V. K., V. P. Mohan, K. K. Thakral and A. K. Bhatia (2002). Seed yield and quality of fennel as influenced by date of sowing and seed rate. *Haryana Journal of Horticultural Sciences*, **31(1/2)** : 111-13.
- Chaudhari, S. M., S. M. Kharche and U. T. Desai (1995). Effects of sowing dates on seed production in coriander. *Journal of Maharashtra Agricultural Universities*, **20(1)** : 139.
- Gowda, M. C., D. P. Halesh and A. A. Farooqi (2006). Effect of dates of sowing and spacing on growth of fenugreek (*Trigonella foenum-graecum* L.). *Biomed.*, **1(2)** : 141-46.
- Halesh, D. P., M. C. Gowda, A. A. Farooqi, M. Vasundhara and K. N. Srinivasappa (2000). Effects of dates of sowing and spacing on growth and yield in fenugreek (*Trigonella foenum - graecum* L.). *Spices and aromatic plants : challenges and opportunities in the new century*. Contributory papers. Centennial conference on spices and aromatic plants, Calicut, Kerala, India; **20-23** : 129-32.
- Rathore, H. S. and M. K. Porwal (2008). Nutrient uptake, protein content and relative economics of fenugreek (*Trigonella foenum graecum*) as influenced by sowing dates, microbial inoculation and weed management. *Indian Journal of Agricultural Sciences*, **78(6)** : 560-62.
- Taylor, W. G., M. S. Zaman, Z. Mir, P. S. Mir, S. N. Acharya, G. J. Mears and J. L. Elder (1997). Analysis of steroidal sapogenins from amber fenugreek (*Trigonella foenum-graecum*) by capillary gas chromatography and combined gas chromatography/mass spectrometry. *Journal of Agricultural and Food Chemistry*, **45(3)** : 753-59.
- Saddam, A. D., H. Adel, G. Abdel, A. Jawad, Al-Daiaeen, A. Haditha and Thalaen (2012). Effect of planting date and spacing on growth and yield of fennel (*Foeniculum vulgare* Mill.) under irrigated conditions. *Pakistan Journal of Biological Sciences*, **15(23)** : 1126-132.
- Saini, R. S., K. D. Sharma, O. P. Dhankar and R. A. Koushik (2006). Analytical Techniques for physiological parameters. *Laboratory Manual of Analytical Techniques in Horticulture*. Agrobios(India), Jodhpur; 37-50.
- Seyyed, G. (2012). Effects of sowing date and plant density on some traits of (*Coriandrum sativum* L.). *Technical Journal of Engineering and Applied Sciences*, **2(1)** : 11-16.
- Sedigheh, S., R. Aptin, Y. Zoheir and Ashrafi (2009). Study Importance of Sowing Date and Plant Density affect on Black Cumin (*Cuminum carvi*) Yield. *Botany Research International*, **2(2)** : 94-98.
- Sheoran, R. S., H. C. Sharma, P. K. Panuu and R. Niwas (2000). Influence of sowing time and phosphorus on phenology, thermal requirement and yield of fenugreek (*Trigonella foenum-graecum* L.) genotypes. *Journal of Spices and Aromatic Crops*, **9(1)** : 43-46.
- Sudeep, S. G. S., S. P. Singh and D. S. Brar (2005). Effect of different dates of sowing and row spacings on yield of fenugreek (*Trigonella foenum-graecum*). *Journal of Medicinal and Aromatic Plant Sciences*, **27(4)** : 629-30.
- Susil, T. and M. Rajkumar (2011). Effect of Date of Sowing of Ajowan (*Trachyspermum ammi* L.) Sprague on Seed Yield in Southern Telangana, Andhra Pradesh. *Madras Agricultural Journal*, **98(1-3)** : 39-40.