Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 495-499
Received: 06-01-2019
Accepted: 10-02-2019

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Influence of sowing date and variety on Harvest index of fenugreek

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Abstract
An investigation was conducted at Horticultural College and Research Institute, Venkataramannagudem, Dr. YSR 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, Rajendra kranti 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 vegetative and yield parameters. The maximum values in respect of Harvest index and its related parameters 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 Rajendra kanthi 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 Harvest index including seed yield.

Keywords: fenugreek, harvest index, sowing date, variety

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.

Fenugreek is mainly grown as leafy vegetable throughout India and there is ample scope for its cultivation as seed spice. 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.

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. 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. 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.

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. 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, seed fenugreek is one among such choices for *rabi* sequence crop. However, time of sowing varies according to the cultivar selected for cultivation and agro climatic conditions and also there are several modern cultivars developed by different research institutes. But their performance with respect to Harvest index and other related yield parameters under different agro-climatic conditions was not uniform. The useful interactions between sowing time and cultivar offer us a scope to select the best sowing time for a particular seed fenugreek variety and *vice versa.*

Materials and Methods

A field experiment was conducted on growth and yield parameters of fenugreek at Horticultural College and Research Institute, Venkataramannagudem, Dr. YSR 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 growth parameters were recorded at different growth stages of plant and observations on yield and yield components of fenugreek were recorded after harvesting of the crop.

Harvest index (%)

The harvest index was calculated by the ratio of economic yield and biological yield and expressed in percentage by using the following formula.

Results and Discussion

1. Leaf area (cm^2)

The highest leaf area at maturity (21.60 cm^2) was recorded by the plants sown on 15th October followed by 1st November sown plants (18.60 cm^2). The lowest value with respect to leaf area at maturity (14.53 cm^2) was observed in the 15th December sown plots. Among the varieties, the maximum leaf area at maturity (18.60 cm^2) was observed in Co-1 which was on par with Co-2 (18.13 cm^2) and the lowest value with respect to leaf area was recorded by the variety Rmt – 1 (16.27 cm^2).

The highest leaf area was recorded by the 15th October sown crop as compared to those sown on 1st November and later dates at various growth stages This might be due to the better vigour of the crop sown on 15th October due to favourable climatic parameters. The early sown plants could have benefited by the advantage of better vigour leading to maximum photosynthetic surface as there was more number of leaves and all of them reached maximum size thus resulting in a higher leaf area as compared to late sown fenugreek crop. *et al.* (2012), Halesh *et al*. (2000), Gowda *et al.* (2006) [6] in fenugreek; Chaudhari *et al.* (1995) [4] in coriander; Susil and Rajkumar (2011) [11] in Ajowan.

2. Number of days taken for appearance of first flower

Maximum number of days taken for appearance of first flower (39.00) was recorded by the plants sown on 15th October followed by 1st November sown plants (38.00). Minimum number of days taken for appearance of first flower (35.67) was observed in the 15th December sown plots which was on par with 1st December sown plants (36.20). Among the varieties, the highest number of days taken for appearance of first flower (39.00) was observed in Co-1. And the lowest number of days taken for appearance of first flower (35.60) was recorded by the variety Rmt – 1 (47.35 cm) which was on par with Rajendra kanthi (36.27).

3. Days taken to 50% flowering

Maximum number of days taken to 50% flowering (42.66) was noticed by the plants sown on 15th October followed by 1st November sown plants (41.13). Minimum number of days taken to 50% flowering (38.20) followed by 1st December sown plants. Among the varieties, highest number of days taken to 50% flowering (41.93) was found in Co-1 and the lowest number of days taken to 50% flowering was found in the variety Rmt – 1 (38.93) which was on par with the variety Rajendra kanthi (39.60).

4. Days taken to first pod formation

Highest number of days taken to pod formation (47.66) was recorded by the plants sown on 15th October followed by 1st November sown plants (45.26). Minimum number of days taken to first pod formation (41.60) which was on par with 1st December sown plants (42.60). Among the varieties, highest number of days taken to first pod formation (45.80) was observed in Co-1which was on par with the Co-2 (44.93) and the lowest number of days taken to first pod formation was observed by the variety Rmt – 1 (42.53) which was on par with the variety Rajendra kanthi (43.26).

5. Days taken to 50% pod formation

Maximum number of days taken to 50% pod formation (50.93) was recorded by the plants sown on 15th October which was on par with the 1st November sown plants (50.00). Minimum number of days taken to 50% pod formation (47.60) which was on par with 1st December sown plants (48.20). Among the varieties, highest number of days taken to 50% pod formation (51.00) was observed in Co-1 followed by the Co-2 (49.93) and the lowest number of days taken to 50% pod formation was observed by the Rmt – 1(47.20) which was on par with the Rajendra kanthi (43.26).

Sowing on different sowing dates resulted in different times for flowering and fruiting. This might be due to the differences environmental conditions at vegetative and reproductive stages of the crop. The possible reason for recording minimum number of days for flowering to pod maturity in delayed sowing might be insufficient time for vegetative growth as the plant entered in the reproductive phase at a faster rate. Among the varieties Co-1 was showing superior performance as compared to other cultivars. Co-1 variety sown on 15th October exhibited superior values in respect of most of the parameters among the interactions. These results are found to be in consonance with the findings of Gowda *et al.* (2006) [6] and Sharangi, *et al.* (2014) [9].

6. 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. Among the varieties, highest weight of the pod (12.67 g) was recorded by Co-1 which is on par with Co-2 (11.82 g) and lowest value with respect to weight of pods per plant was observed in the Rmt – 1 (9.23 g).

7. Weight of pods per plot (kg)

The Maximum weight of the pods per plot (0.66 kg) was found in the plants sown on 15th October followed by 1st November sown plants (0.59 kg). The minimum weight of the pods per plot (0.38 kg) was recorded by the 15th December sown plots. Among the varieties, the highest value with respect to weight of the pods per plot (0.58 kg) was recorded by Co-1 which was on par with Co-2 (0.54 kg), Hissar sonali (0.51kg) and Rajendra kanti (0.47 kg). The lowest weight of the pods per plot was recorded by the Rmt – 1 (0.43kg).

8. 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. Among the varieties, the maximum seed yield per plant (8.80 g) was observed in Co-1 which was on par with Co-2 (8.02 g) and the lowest seed yield per plant was recorded by the Rmt – 1 (5.87 g).

9. Seed yield per plot (g)

The maximum seed yield per plot (460.25 g) was recorded by the plants sown on 15th October followed by 1st November sown plants (312.84 g). The minimum seed yield per plot (240.48 g) was recorded by the 15th December sown plots. Among the varieties, Highest seed yield per plot (405.48 g) was recorded by Co-1 and the lowest seed yield was recorded by the Rmt – 1 (270.38 g).

10. Straw + shell yield (kg/ha)

The highest value with respect to (straw + shell) yield (3194.36 kg) was recorded by the plants sown on 15th October which was on par with the 1st November sown plants (3190.60 kg), 15th November sown plants (3173.63 kg) and 1st December sown plants(3159.20 kg).The lowest (straw + shell) yield (3089.88kg) was recorded by the 15th December sown plots. Among the varieties, maximum yield of (straw+ shell) (3219.82 kg) was noticed by Co-1on par with Co-2 (3190.43 kg) and the lowest yield of (straw + shell) was recorded by the Rmt – 1 (3107.48 kg).

11. Biological yield (kg/ha)

The highest biological yield (5325.17kg) was recorded by the plants sown on 15th October which is on par with the 1st November sown plants (5056.05kg). The minimum biological yield (4203.21kg) was observed in the 15th December sown plots. Among the varieties, maximum biological yield (5097.04 kg) was found in Co-1 which is on par with Co-2 (4901.47 kg) and the lowest biological yield was observed in the Rmt – 1 (4359.25 kg).

12. Harvest index (%)

The highest value with respect to harvest index (39.92) was noticed by the plants sown on 15th October followed by the 1st November sown plants (36.74). Minimum harvest index (26.29) was recorded by the 15th December sown plots. Among the varieties, maximum harvest index (36.48) was observed in Co-1 which is on par with the Co-2 (34.50) and lowest harvest index was recorded by the Rmt – 1 (28.21).

The data obtained on yield parameters revealed the better performance of 15th October sown crop compared to late sown crop. Among the varieties Co-1 recorded higher values in respect of many of the yield attributing parameters. The combination of both of them showed the highest value among the interactions. 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. And also increment in Biological yield is due to higher values for growth parameters *viz.* plant height, branches per plant and dry matter accumulation which improved the yield attributing characters and hence improvement in seed and straw yield. 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 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*. (2000) [10] and Gowda *et al.* (2006) [6] in fenugreek; Batra *et al.* (2002) [2], Saddam *et al.* (2012) [7] in fennel, Seyyed *et al*. (2012) [8], Bhadkariya *et al.* (2007) and Baswana *et al.* (1989) [1] in coriander. Korla and Amit (2003) in fenugreek; Seyyed *et al.* (2012) [8] in coriander; Saddam *et al.* (2012) [7] in fennel and Ahmad *et al.* (2011) in cumin.

Table 1: leaf area of the plant (g), Days taken for first flosswer and Days taken for 50% flowering as influenced by sowing date and variety in Fenugreek

Date of sowing/ Variety	Leaf area at maturity						Days taken for first flower						Days taken for 50% flowering					
	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	22.00	19.00	17.00	15.00	14.00	17.40	39.00	38.00	37.00	36.00	35.00	37.00	42.66	41.00	40.33	39.66	38.33	40.40
Rmt-1	20.00	17.00	16.00	14.33	14.00	16.27	37.00	36.00	35.00	35.00	35.00	35.60	40.66	39.66	39.00	38.00	37.33	38.93
Co-1	23.00	19.00	18.00	16.00	17.00	18.60	41.00	40.00	39.00	38.00	37.00	39.00	44.66	43.00	41.66	41.00	39.33	41.93
Rajendrakanthi	21.00	18.00	16.00	15.00	14.00	16.80	38.00	37.00	36.00	35.00	35.33	36.27	41.66	40.00	39.33	39.33	37.66	39.60
Co-2	22.00	20.00	18.00	17.00	13.66	18.13	40.00	39.00	38.00	37.00	36.00	38.00	43.66	42.00	41.33	40.00	38.33	41.06
Mean	21.60	18.60	17.00	15.46	14.53	17.44	39.00	38.00	37.00	36.20	35.67	37.17	42.66	41.13	40.33	39.60	38.20	40.38
Factor		S.Em ±		CD at 5% LOS			Factor	S.Em ±		CD at 5% LOS			Factor	S.Em ±		CD at 5% LOS		
Sowing date		0.32		0.90			Sowing date	0.32		0.91			Sowing date	0.30		0.84		
Variety		0.41		1.18			Variety	0.33		0.94			Variety	0.35		1.00		
Interaction		0.92		2.62			Interaction	0.64		1.81			Interaction	0.68		1.93		

Table 2: Days taken to 50% pod formation as influenced by date of sowing and variety in fenugreek

Date of sowing/ Variety	Days taken to 50% pod formation					
	15- Oct	1 -Nov	15- Nov	1 -Dec	15- Dec	Mean
Hissar sonali	51.00	52.00	49.00	48.00	47.00	49.40
Rmt-1	49.00	46.00	47.00	47.00	47.00	47.20
Co-1	53.00	52.00	51.00	50.00	49.00	51.00
Rajendrakanthi	50.00	49.00	47.00	47.00	47.00	48.00
Co-2	51.66	51.00	50.00	49.00	48.00	49.93
Mean	50.93	50.00	48.80	48.20	47.60	49.11
Factor		S.Em ±		CD at 5% LOS		

Sowing date	0.33	0.95
Variety	0.34	0.96
Interaction	0.66	1.89

Table 3: Weight of pods/plant, and Weight of pods/plot as influenced by date of sowing and variety in fenugreek

Date of sowing/ Variety	Weight of pods per plant (g)						Weight of pods per plot (kg)					
	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	0.69	0.59	0.47	0.43	0.38	0.51
Rmt-1	12.81	11.22	8.18	7.26	6.68	9.23	0.59	0.52	0.38	0.33	0.31	0.43
Co-1	15.47	14.72	11.96	11.05	10.16	12.67	0.71	0.68	0.55	0.51	0.47	0.58
Rajendrakanthi	13.73	11.95	9.29	8.23	7.26	10.09	0.63	0.55	0.43	0.38	0.33	0.47
Co-2	14.92	13.77	11.06	10.11	9.27	11.82	0.69	0.63	0.51	0.47	0.43	0.54
Mean	14.36	12.88	10.13	9.18	8.31	10.97	0.66	0.59	0.47	0.42	0.38	0.51
Factor		S.Em ±		CD at 5% LOS			Factor		S.Em ±		CD at 5% LOS	
Sowing date		0.34		0.97			Sowing date		0.03		0.07	
Variety		0.37		1.04			Variety		0.06		0.17	
Interaction		0.71		2.02			Interaction		0.09		0.25	

Table 4: Seed yield/plant and Seed yield/plot as influenced by date of sowing and variety in fenugreek

Date of sowing/ Variety	Seed yield/plant(g)						Seed yield/plot (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	10.30	8.65	6.63	5.86	5.13	7.31	474.44	398.72	305.51	270.05	236.50	337.04
Rmt-1	8.49	7.24	5.14	4.45	4.02	5.87	391.05	333.55	236.98	204.87	185.46	270.38
Co-1	11.16	10.48	8.28	7.44	6.63	8.80	514.22	483.07	381.71	342.89	305.51	405.48
Rajendrakanthi	9.37	7.80	5.87	5.13	4.45	6.52	431.79	359.42	270.29	236.50	204.87	300.57
Co-2	10.63	9.55	7.44	6.63	5.86	8.02	489.78	439.93	342.65	305.51	270.05	369.58
Mean	9.99	8.74	6.67	5.90	5.22	7.30	460.25	312.84	307.43	271.96	240.48	336.61
Factor		S.Em ±		CD at 5% LOS			Factor		S.Em ±		CD at 5% LOS	
Sowing date		0.26		0.74			Sowing date		11.18		31.90	
Variety		0.29		0.82			Variety		11.25		32.12	
Interaction		0.56		1.61			Interaction		19.51		55.68	

Table 5: Straw yield, Biological yield and Harvest index as influenced by date of sowing and variety in fenugreek

Date of sowing/ Variety	Straw+ shell yield(kgha^{-1})						Biological yield(kgha^{-1})						Harvest index (%)					
	15th Oct	1st Nov	15th Nov	1st Dec	15th 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	3170.24	3186.25	3174.65	3158.35	3125.68	3163.03	5366.72	5032.18	4589.05	4408.57	4220.59	4723.42	40.93	36.68	30.82	28.36	25.94	32.55
Rmt-1	3100.64	3150.64	3150.32	3135.80	3000.00	3107.48	4911.07	4694.83	4247.45	4084.28	3858.62	4359.25	36.86	32.89	25.83	23.22	22.25	28.21
Co-1	3300.45	3250.20	3200.54	3189.29	3158.64	3219.82	5681.08	5486.62	4967.71	4776.75	4573.04	5097.04	41.90	40.76	35.57	33.23	30.93	36.48
Rajendrakanthi	3150.28	3165.75	3158.00	3145.00	3015.45	3126.90	5149.30	4829.75	4409.33	4239.91	3963.93	4518.44	38.82	34.45	28.38	25.82	23.93	30.28
Co-2	3250.18	3200.15	3184.63	3167.56	3149.65	3190.43	5517.66	5236.89	4770.98	4581.96	4399.87	4901.47	41.09	38.89	33.25	30.87	28.41	34.50
Mean	3194.36	3190.60	3173.63	3159.20	3089.88	3161.53	5325.17	5056.05	4596.90	4418.29	4203.21	4719.93	39.92	36.74	30.77	28.30	26.29	32.40
Factor		S.Em ±		CD at 5% LOS			Factor		S.Em ±		CD at 5% LOS		Factor		S.Em ±		CD at 5% LOS	
Sowing date		15.24		43.48			Sowing date		87.78		250.51		Sowing date		0.85		2.43	
Variety		16.98		48.46			Variety		88.77		253.36		Variety		0.88		2.52	
Interaction		41.76		119.17			Interaction		153.92		439.29		Interaction		1.74		4.96	

Conclusion

Thus it can be conclusively stated that the date of sowing as 15th October was found to be recorded maximum values in respect of some of the characters including seed yield per plant and per plot. Under the local conditions of coastal Andhra Pradesh the fenugreek cultivars *viz.,* Co-1 and Co-2 are found to be better as compared to other varieties like Hissar Sonali, Rajendrakranthi and Rmt-1 in the order. Hence these varieties can be preferred to sow fenugreek 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.

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