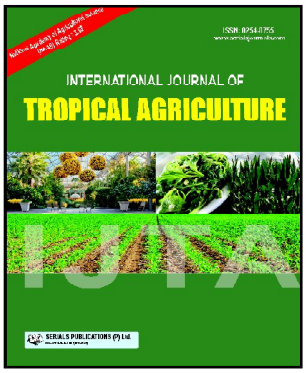

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournal.com

Volume 35 • Number 1 • 2017

Effect of Sowing Dates and Planting Distance on Growth, Oil and Seed Yield of Sweet Basil (*Ocimum basilicum* L.)

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Abstract: Field experiment was conducted at the research farm of CSIR-CIMAP Research Centre Pantnagar during 2016 to evaluate the effect of sowing dates and plant density on growth, oil and seed yield of sweet basil (*Ocimum basilicum* L.) under tarai region of Uttarakhand. The studies involved three sowing dates (23rd and 30th of July and 8th of August) along with three planting distance (50 × 30, 50 × 45 and 50 × 60 cm) were applied. The study revealed that, seed yield was influenced by sowing dates and plant densities interaction. Early sowing date resulted in higher seed yields (210.67 kg/ha) as evident from higher aboveground biomass (205.56 q/ha), the number of inflorescence per plant (107.33), the number of branches/plant (13.11) and plant height (80.67). Among the planting distance, broader spacing showed higher oil content (1.06 %) in sweet basil during experimentation.

Key words: Sowing date, spacing, oil yield, seed yield, basil.

INTRODUCTION

Sweet basil (*Ocimum basilicum* L.) is a popular culinary herb belongs to the Lamiaceae family grown for fresh or dry leaf, essential oil and seed markets. Culinary herbs have been reported to possess antioxidant activities (Yanishlieva *et al.*, 2006) suggesting that they might have potential human health benefits. Basil has shown antioxidant and antimicrobial activities due to its phenolic and aromatic compounds (Gutierrez *et al.*, 2008; Hussain *et al.*, 2008; Javanmardi *et al.*, 2002). The aromatic and curative properties of basil are connected with the presence of essential oil, mainly in the leaves and flowers. Basil essential oil is used to flavor foods, dental and oral products in fragrances and in medicines (Omidbaig, 2002). In aromatic plants, growth and essential oil production

are influenced by various environmental factors (Hasegawa *et al.*, 2000). Maximum yield loss has been reported in many crops due to unfavorable sowing date such as sunflower (Barros *et al.*, 2004) and fennel. The number of plant per unit area is the most important among yield components (Kafi, 2003). The number of inflorescence per plant has the second rank interms of importance in yield components. The number of seed per inflorescence is affected by environmental, field management and its number was reported from 11.3 to 16.8 under varying plant densities (Kafi, 2003). The weight of Basil seed varied in different experiments. Kafi (2003) reported that it was from 2.79 to 2.99 g under varying plant densities. Shortening of the growing cycle decreased the amount of radiation intercepted during the growing season and thus total dry weight of plant (Andrade, 1995). With delayed sowing, development is accelerated because the crops encounter higher temperatures during the vegetative growth (Damato *et al.*, 1994). Delayed sowing date decreases seed weight and the number of inflorescence per plant. This study aimed to determine the optimum sowing date and plant density of Basil for achievement of maximum oil and seed yields under *Tarai* region of Uttarakhand, India.

MATERIALS AND METHODS

A field experiment was conducted at the research farm of CSIR-Central Institute of Medicinal and Aromatic Plant, Research Centre, Pantnagar (Udham Singh Nagar) Uttarakhand, India during 2016. The experimental site is located between 29° N latitude and 79.38° E longitude and at an altitude of 243 m above mean sea level. The maximum temperature ranges between 35 to 45°C, and minimum between 2 to 5°C. The experimental soil was sandy-loam in texture, neutral in reaction (7.2 pH), medium in organic carbon (0.52%), low in available nitrogen (135 kg ha^{-1}), and medium in available phosphorus (13 kg ha^{-1}) as well as in potassium (140 kg ha^{-1}). The experimental design was split plot design with thrice replications. Main plot treatments were three sowing dates (23rd and 30th of July and 8th of August) along with three planting distance (50 × 30, 50 × 45 and 50 × 60 cm) were applied. Each experimental plot was 5 × 5 m^2. The raised nursery plant of basil cv. CIM-Saumya transplanted to the respected field at 3-4 leaf stage. Recommended dose of fertilizer @ 100:40:40 kg/ha N: P: K was applied. The crop was kept free from weeds by hand weeding. Sampling was performed from 4 middle rows in appropriate times. Plants were harvested at physiological maturity stage when plants turn into yellowed. Five plants was randomly were selected in each plot to measure the plant height number of branches/plant, number of inflorescence/plant and seed yield and oil content (%). The data relating to each character were analyzed statistically by applying the technique of analysis of variance and the significance was tested by "F" test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth Attributes

Crop growth attributes data (Table 1) revealed that taller plants (80.67 cm) with maximum number of branches/plant (13.11) and days to maturity (118.67 days) in first planting dates (3rd week of July) which was significantly higher to second planting date (4th week of July) and third planting dates (1st week of August), however, second planting date (4th week of July) was also received higher crop growth attributes as compared to third planting dates (1st week of August) treatment during experimentation (Table 1). It was might be due to better moisture, light and environmental condition conducive for brought good crop establishment and supported growth parameters in planting dates treatment. Among the plant spacing treatments, wider space (50 × 60 cm) recorded the highest plant height (83.67 cm), number of branches/plant (13.33) and days to maturity (115.33 days), respectively, in comparison to closer spacing (50 × 45) and

Table 1
Effect of sowing dates and different spacing on growth, oil and seed yield of sweet basil.

Treatment	*Plant height (cm) plant*	*No. Branches/ Plant*	*No. of inflorescence/*	*Days to Maturity*	*Herbage yield (q/ha)*	*Oil (%) (kg/ha)*	*Oil yield (kg/ ha)*	*Seed yield*
Sowing Dates								
D_1 (3rd Week of July)	80.67	13.11	107.33	118.67	205.56	1.04	213.46	210.67
D_2 (4th Week of July)	77.33	12.00	95.00	115.67	191.89	0.98	187.46	184.00
D_3 (1st Week of Augast)	73.00	9.33	91.00	110.67	180.56	0.96	172.47	173.33
Sem±	0.72	0.29	0.27	0.31	1.10	0.02	3.37	1.09
LSD (p = 0.05)	2.00	0.80	0.76	0.87	3.05	0.04	9.36	3.02
Planting Distance								
S_1 (50 × 30 cm)	71.00	9.67	85.00	114.33	218.89	0.94	206.82	176.67
S_2 (50 × 45 cm)	76.33	11.44	94.67	115.33	185.22	0.98	181.45	186.67
S_3 (50 × 60 cm)	83.67	13.33	113.67	115.33	173.89	1.06	185.12	204.67
Sem±	0.70	0.51	1.05	0.75	0.74	0.02	3.78	1.09
LSD (p = 0.05)	1.53	1.10	2.30	NS	1.61	0.04	8.23	2.38
Interaction (S × D)	NS	NS	*	NS	*	NS	*	*

(50 × 30) treatment. Pant spacing (50 × 45) also showed that significantly higher plant height (76.33) and number of branches/plant (11.33) as compared to spacing (50 × 30) except days to maturity which was non-significant during experimentation. Similar findings were also reported by Yanishlieva *et al.*, 2006; Gutierrez *et al.*, 2008; Hussain *et al.*, 2008 and Javanmardi *et al.*, 2002.

Yield Attributes and Seed Yield

Seed yield is considered to be a function of various yield attributing characters *viz.,* number of inflorescence/plant and biomass yield. Number of inflorescence/plant and biomass yield was significantly influenced by planting dates (Table 1). The highest number of inflorescence/plant (107.33) and herbage yield (205.56 q/ha) recorded by first planting dates (3rd week of July) which was significantly higher to second planting date (4th week of July) and third planting dates (1st week of August), however, second planting date (4th week of July) was also received higher number of inflorescence/plant (95.00) and herbage yield (191.89 q/ha) as compared to third planting dates (1st week of August) treatment during experimentation (Table 1). Among the plant spacing treatments, wider space (50 × 60 cm) recorded the highest number of inflorescence/plant (113.67) as compared to other spacing (50 × 45) and (50 × 30) treatment. Plant spacing (50 × 45) also showed that significantly higher plant number of inflorescence/plant (94.67) as compared to spacing (50 × 30).

However, closer spacing (50 × 30) treatment was received higher herbage yield (218.89 q/ha) as compared to both wider spacing (50 × 60 and 50 × 45) treatment during experimentation (Table 1). Its might be due to influenced by planting dates and closer and wider spacing on number of inflorescence/plant and herbage yield either decreased or increased. Similar results were supported by Ball *et al.* (2000), Behera *et al.* (2004) and Kafi (2003).

The first planting date (3rd week of July) registered significantly higher seed yield (210.67 kg/ha) as compared to second planting date (4th week of July) and third planting dates (1st week of August), however, second planting date (4th week of July) was also received higher seed yield (184.00 kg/ha) as compared to third planting dates (1st week of August) treatment which was produced lowest (173.33 kg/ha) during experimentation (Table 1). Among the plant spacing treatments, wider space (50 × 60 cm) recorded the highest seed yield (204.67 kg/ha) as compared to other spacing (50 × 45) and (50 × 30) treatment. Plant spacing (50 × 45) also showed that significantly higher seed yield (186.67 kg/ha) as compared to spacing (50 × 30). However, closer spacing (50 × 30) treatment was received lowest seed yield (176.67 kg/ha) as compared to both wider spacing (50 × 60 and 50 × 45) treatment during experimentation (Table 1). Its might be due to early planting dates and and wider spacing contributed maximum yield contributing characters which ultimately increased the yield. Similar results were supported by Sadeghi *et al.*, (2009) and Arslan and Bayrak (1987).

Oil Content and Oil Yield

Oil yield is considered to be a function of various yield attributing characters *viz.,* oil content/kg biomass and biomass yield. Oil content and oil yield was significantly influenced by planting dates (Table 1). The highest Oil content (1.04 %) and oil yield (213.46 kg/ha) recorded by first planting dates (3rd week of July) which was significantly higher to second planting date (4th week of July) and third planting dates (1st week of August), however, second planting date (4th week of July) was also received higher oil yield (187.46 kg/ha) as compared to third planting dates (1st week of August) treatment during experimentation (Table 1). Among the plant spacing treatments, wider space (50 × 60 cm) recorded the highest oil content (1.06 %) as compared to other spacing (50 × 45) and (50 × 30) treatment. However, closer spacing (50 × 30) treatment was received highest oil yield (206.82 kg/ha) as compared to both wider spacing (50 × 60 and 50 × 45) treatment during experimentation (Table 1). Its might be due to influenced by planting dates and closer and wider spacing on oil content and oil yield either decreased or increased. Similar results were supported by Sadeghi *et al.*, (2009) and Arslan and Bayrak (1987) and Yassen *et al.* (2003).

CONCLUSIONS

Basil is sensitive to plant density and sowing date. Early sowing in dry land Basil was results in critical to increase in seed yield, possibly due to higher aboveground biomass, the number of inflorescence per plant and plant height. Lower densities do not produce sufficient seed per unit area. However, the relatively small absolute differences in seed yield between some plant densities demonstrated the remarkable compensation capacity of Basil between the different yield components.

ACKNOWLEDGMENT

Authors are thankful to the Council of Scientific and Industrial Research for financial support under AGTECH project (BSC-0110). Authors are also thankful to the Director, CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP) Lucknow, U.P. (India) for providing necessary facilities and encouragement.

REFERENCES

Andrade, F. H., (1995), Analasis of growth and yield of maize, soybean grown at Balcare, Argentina, Field Crop Res. **41**, 1-12.

Arslan, N., and Bayrak, A., (1987), Effects on yield and some yield components of Basil (*Ocimum basilicum*L.) of different sowing times, Doga Tu Agr. and for. Jour. 11, 2, Ankara, Turkey.

Ball, R.A., Purcell, L.C., and Vories, E.D., (2000), Short-season soybean production and yield compensation

in response to plant population and water regime, Crop Science, **40**, 1070-1078.

Barros, J.F.C., Carvalho, M.D. and Basch, G., (2004), Response of sunflower (*Helianthus annus* L.) to sowing date and plant density under Mediterranean conditions, Europ. J.Agronomy. **21**, 347-356.

Behera, S., Nagarajan, S. and Rao, L.J.M., (2004), Microwave heating and conventional roasting of Basil Seeds (*Ocimum basilicum*L.) and effect on chemical composition of volatiles, Food Chemistry. **87**(1), 25-29.

Damato, G., Biaco, V.A., and Laterza, M., (1994), First result of plant density and nitrogen rate on yield and quality of Florence fennel (*Foeniculum vulgar Mill.* Var. Azotericum Thell.) seeds. International Symposium on Agrotechnics and Storage of Vegetative and Ornamental Seeds. Bari, Italy. July.

Gomez, K.A., and Gomez, A.A., (1984), Statistical procedures for agricultural research (Second Eds.). An International Rice Research Institute Book. John Wiley and Sons.

Gutierrez, J.C., Barry Ryan, P. Bourke., (2008), The antimicrobial efficacy of plant essential oil combinations and interactions with food ingredients, International Journal of Food Microbiology. **124**, 91-97.

Hasegawa, P. M., R. A., Bressan, J. K., Zhu, H. J., Bohnert., (2000), Plant cellular and molecular responses to high salinity, Annu. Rev. Plant Physiol. Plant Mol. Biol. **51**, 463-499.

Hussain, A. I., F., Anwar, S. T. H., Sherazi, R., Przybylski., (2008), Chemical composition, antioxidant and antimicrobial activities of basil (*Ocimum basilicum*) essential oils depends on seasonal variations, Food Chemistry. **108**, 986–995.

Javanmardi, J., A., Khalighi, A., Kashi, H. P., Bais, J. M., Vivanco., (2002), Chemical characterization of basil (*Ocimum basilicum* L.) found in local accessions and used in traditional medicines in Iran, Journal of Agricultural and Food Chemistry. **50**, 5878–5883.

Kafi, M., (2003), Basil-Production and Processing. Ferdowsi Univ. Mashhad Publication. Mashhad, Iran. **195**.

Omidbaig, R., (2005), Production and Processing of Medicinal Plants, Astane Quds Pub. Tehran, Vol. 2, 438.

Sadeghi, S., A., Rahnavard, Z. Y., Ashrafi., (2009), The effect of plant density and sowing date on yield of Basil (*Ocimum basilicum* L.) In Iran, Journal of Agricultural Technology. **5**(2), 413-422.

Yanishlieva, N. V., E. Marinova, J. Pokorny., (2006), Natural antioxidants from herbs and spices, European Journal of Lipid Science and Technology. **108**, 776-793.

Yassen, M., P. Ram, A. Yadav, K. Singh., (2003), Response of Indian basil (*Ocimum basilicum*) to irrigation and nitrogen schedule in Central Uttar Pradesh, Annals Plant Phys. **17**, 177–181.