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Studies on influence of species, nitrogen and spacing on parameters of plant growth at various stages of basil

Kailash Patel and N.K.Kushwaha*
College of Horticulture (RVSKVV, Gwalior), Mandsour, (MP) - India

Abstract

Humanities rely on a diverse range of cultivated species. It is often stated that only a few staple crops produce the majority of the food supply. Several countries in the world have a rich heritage of herbal drugs, very few can put claim for their procurement only from cultivated species.The present investigation was conducted with two species of *Ocimum (Ocimum basilicum* and *O. canum),* two spacing (45x30 cm and50x30 cm) for different plant population and five levels of nitrogen(0,40,80,120 and 160 kg/ha) in a split plot design with three replications at Research farm, RVSKVV, College of Horticulture, Mandsaur, M.P., India during Kharif season 2011-2012 to determine the influence of various growth parameters.

Key-Words: Basil, Growth parameters, Mandsaur

Introduction

Ocimums are important groups of aromatic and medicinal plants (family : Lamiaceae) which yield many essential oil and aroma chemicals and find diverse uses in perfumery and cosmetic industries as well as in indigenous system of medicine. *Ocimum* species yield essential oil rich in camphor, citral, geraniol, linalool, linalyl acetate, methylchavicol, eugenol and thymol *etc*. and can be harvested for successful utilization by industry. In view of great diversity, various species are classified into two broad groups, of *basilicum* and sanctum groups, based on geographical sources, morphological and cytological features and chemical constituents. Among various cultivated species *Ocimum basilicum* L and *Ocimum canum* are cultivated extensively and commercially for essential oil production through out the world including India. *Ocimum basilicum* L. (Sweet basil or French basil) is an annual herb grown in several regions all over the world and includes at least 60 species and several varieties. The aromatic leaves are used fresh or dried, as a flavouring agent for food, confectioneries, beverages and oral care products. It represents an important source of essential oil (rich in phenolic products including polyphenols such as flavonoids and anthocyanins) used in food, medicines, perfumery and cosmetic industries.

*** Corresponding Author**
E.mail: neeraj_kushwaha07@yahoo.co.in

It contains essential oil from 1% to 1.5% in fresh herbage and from 2.4% to 3.2% in fresh inflorescence. There are many cultivars of sweet basil which vary in their leaf colours (green or purple), flower colour (white, red, purple) and aroma.*Ocimum canum* (Oc-11) is an alternate cheap source of linalool which compares well with that obtained from conventional sources like Lily of the valley and *Mentha citrata.* Linalool finds extensive use in soap, perfumes, cosmetics and technical preprations like *Eau de Cologne*. It is also used for blending floral and artificial perfumes, for flavouring cakes, candies and other confectionaries.[1-2]

Cultivation of medicinal and aromatic plants for profit has attracted the attention of many growers. The production of aromatic plants for profit on commercial basis involves a number of factors. The value of such crops depends on their active principle content which makes it different from the principle of production of agricultural crops. Various species of this crop are commercialy cultivated in U.P., Jammu and Kashmir, Himachal Pradesh, Punjab and in small scale in Madhya Pradesh. In Madhya Pradesh *Ocimum* is cultivated commercially in Malwa region particularly in Neemuch, Mandsaur and Ratlam district which is increasing year after year. The export of this crop has increased in last decade. The seeds of this species of *Ocimum* are exported mainly to Arab countries from India. Cultivation of this crop is also increasing in Madhya Pradesh at a

very steady pace owing its uses and better yield and market potential. There is very little work is done regarding improvement in production technologies of the crop for Madhya Pradesh is general and malwa region in particular. Various researches has been made to study the growth parameters of these species[3-13], but till date no any proper documented work was done, therefore, the present investigation was taken in consideration.

Material and Methods

Experimental area: The experiment was conducted during *Kharif* season of 2011-12 at Research farm College of Horticulture, Mandsaur (MP) under Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, (MP).

Soil analysis: The soils samples were collected from the study sites and their physical and chemical characters were analyzed.[14-16]

Details of experiment: The experiment was conducted in a split plot design with 20 treatments combinations, replicated thrice. The layout plan for experimental field was given below.

Treatment details: Treatments comprised of plant population for different spacing and nitrogen were as follows:

1. $V_1 S_1 N_0$	**6.** $V_1 S_2 N_0$	**11.** $V_2 S_1 N_0$	**16.** $V_2 S_2 N_0$
2. $V_1 S_1 N_1$	**7.** $V_1 S_2$ N1	**12.** $V_2 S_1 N_1$	**17.** $V_2 S_2 N_1$
3. $V_1 S_1 N_2$	**8.** $V_1 S_2 N_2$	**13.** $V_2 S_1 N_2$	**18.** $V_2 S_2 N_2$
4. $V_1 S_1 N_3$	**9.** $V_1 S_2 N_3$	**14.** $V_2 S_1 N_3$	**19.** $V_2 S_2 N_3$
5. $V_1 S_1 N_4$	**10.** $V_1 S_2 N_4$	**15.** $V_2 S_1 N_4$	**20.** $V_2 S_2 N_4$

Treatment combinations : 2x2x5 =20

Pre sowing operation: The field was properly ploughed by disc harrow and then pulverized by disking and harrowing. Thereafter, field was leveled properly with heavy wooden plank and plots were prepared according to layout plan.

Fertilizers doses and applications: FYM was applied @ 15 q/ha uniformly to all treatments at the time of seed sowing. Nitrogen was applied in the form of urea in 3 split doses. The first 1/3 of the pertinent level of nitrogen with requisite quantity of urea were mixed and drilled in the furrows at the time of sowing by hand. Remaining quantity of nitrogen was applied in two splits at first irrigation 30 DAP and at 45 DAP.

Sowing and Nursery management: The pure healthy disease and insect free vigorous and good quality seeds of *Ocimum basilicum* var. glabaratum and *Ocimum canum* var. Oc-11 were used for sowing in nursery. Seeds were treated with thiram 0.3% at the time of sowing. 25 days old seedlings were transplanted in the experimental field at the spacing as per treatments. The sowing of the crop in nursery was done on 22 Jun 2011.

Table 1: Treatment and symbols of experiment

S.N.	Treatment	Symbol
(A)	**Two Species of *Ocimum***	
1.	*Ocimum canum* var. Oc-11	V_1
2.	*Ocimum basilicum* var. *glabaratum* (Ob-15)	V_2
(B)	**Two levels of spacing for different Plant population**	
1.	Plant spacing (74,074plants/ha)(45x30 cm)	S_1
2.	Plant spacing (66,666plants/ha)(50x30 cm)	S_2
(C)	**Five levels of Nitrogen (kg/ha)**	
1.	0	N_0
2.	40	N_1
3.	80	N_2
4.	120	N_3
5.	160	N_4

Intercultural Practices: The insecticide Imidachlorprid @ 3ml/liter of water were done at 40 days after transplanting in main field. Only two weeding was done at 30 and 40 days after transplanting. Only one irrigation was given during the crop growing period, after first cutting of herbage for essential oil distillation at 75% flowering.

Harvesting: Growth were recorded at 30, 60 and 90 days after planting by taking one plants per plot.

Observations to be recorded: Growth attributes recorded at 30, 60 and 90 DAP viz., plant height, root length, no. of primary and secondary branches, leaf area, leaf biomass, stem biomass, root biomass as per standard procedure adopted.[17]

Results and Discussion

Ocimum basilicum L and *Ocimum canum*, belongs to the family Lamiaceae and oil yielding medicinal plant, was selected for present investigation. The scanty availability of information on this plant facilitates to study the growth profile of the plant as influenced by different concentration of nitrogen during pre-sowing seed treatment.

The soil samples were collected randomly through a soil-auger from the different spots of the experimental

field. These soils samples were subjected to determine the physico-chemical properties and it was estimated. All the obtained results were presented in Table. 2

The Growth characters such as plant height, root length, number of primary, secondary and tertiary branches per plant, leaf area, leaf biomass, stem biomass, root biomass per plant, were recorded at 30, 60 and 90 DAP. Species, spacing and nitrogen levels and their interaction significantly affected the plant height in *Ocimum* species. The nitrogen application significantly affected plant height N_4 noted maximum plant height (50.66 cm) significantly followed by N_3 (48.13 cm), N_2 (45.66 cm) and N_1 (43.19 cm). The minimum plant height (40.02 cm) was recorded in N_0. The nitrogen application also affected on plant height N_4 noted maximum plant height (85.66 cm) significantly followed by N_2 (79.94 cm), N_3 (77.94 cm) and N_1 (76.05 cm). The minimum plant height (67.63 cm) was recorded in N_0. Results revealed that the root length at various growth stages were differentially affected by species, spacing, nitrogen and their interactions in *Ocimum* species. The numbers of primary branches were differentially affected by species, spacing, nitrogen application and their interaction in *Ocimum* species. At 30 DAP the species did not influenced number of primary branches significantly while at 30 DAP the species did not influence number of secondary branches/plant and at 30 DAP the species significantly influenced number of tertiary branches/plant. The maximum number of tertiary branches (135.52/plant) was recorded V_1 species as compared to number of tertiary branches (108.2/plant) by V_2 species. The nitrogen application also significantly affected on number of tertiary branches N_4 noted maximum number of tertiary branches (177.41/plant) significantly followed by N_3 (134.41/plant), N_2 (114.46/plant) and N_1 (103.88/plant). The minimum number of tertiary branches (79.00/plant) was recorded in N_0. Leaf area (m^2/ha) varied differentially due to various species, spacing, nitrogen and their interaction during various growth stages. At 30 DAP the plant species had significant effect on leaf area per ha.V_1 species recorded the maximum leaves area (19501m^2/ha) as compared to leaves area (18746 m^2/ha) by V_2 species. At 30 DAP variation in species significantly influenced total leaf biomass. V_1 species recorded the maximum leaf biomass (9.05 q/ha) as compared to leaf biomass (7.52 q/ha) by V_2 species. The nitrogen application affected on leaf biomass. N_4 noted maximum leaf biomass (13.90 q/ha) significantly followed by N_3 (9.13 q/ha), N_1 (6.96 q/ha) and N_2 (6.67 q/ha). The minimum leaf biomass (4.76 q/ha) was recorded in N_0 while at 30 DAP; the species were not found to have significant influence on stem biomass (q/ha) and at 30 DAP, variation in species significantly influenced total root biomass. V_2 species recorded the maximum root biomass (2.709 q/ha) as compared to root biomass (1.628 q/ha) by V_1 species. The nitrogen application affected on root biomass. N_4 noted maximum root biomass (3.087 q/ha) significantly followed by N_3 (2.569 q/ha), N_2 (2.037 q/ha) and N_1 (1.824 q/ha). The minimum root biomass (1.325 q/ha) was recorded in N_0. The detailed results for all the treatments and concentration were presented in table 3 to 6.

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Table 2: Physical and Chemical Composition of the Soil

S.No.	Particulars	Value obtained
	Physical Characters	
(a)	Sand %	35
(b)	Silt%	42
(c)	Clay%	28
	Chemical Characters	
(a)	Soil pH	7.3
(b)	Electric conductivity	0.4000
(c)	Available nitrogen (kg/ha)	192.0 (low)
(d)	Available phosphorus (kg/ha)	9.0 (low)
(e)	Available potash (kg/ha)	470
(f)	Available Sulphur (kg/ha)	14.2
(g)	Soil depth (cm)	150

Table 3: Effect of species, spacing and nitrogen on plant height and root length after planting in Basil

Treatment	Days											
	Plant Height (cm)											
	30				60				90			
	V1		V2		V1		V2		V1		V2	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
N0	36.88	34.77	40.88	47.55	65.22	60.88	70.99	73.44	71.55	67.22	75.66	84.77
N1	40.55	38.33	45.33	48.55	66.22	65.22	88.44	84.33	72.10	70.11	93.55	93.00
N2	41.10	39.22	50.77	51.55	70.88	68.66	91.77	88.44	76.66	75.22	97.22	98.00
N3	43.99	41.55	53.66	53.33	54.33	70.22	92.77	94.44	80.66	77.55	98.21	101.66
N4	45.22	43.33	58.21	55.88	76.10	74.88	95.66	95.99	81.77	82.00	100.66	103.99
	Root Height (cm)											
	30				60				90			
	V1		V2		V1		V2		V1		V2	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
N0	11.20	10.58	12.43	11.35	21.70	20.43	23.81	22.35	22.33	20.98	24.54	23.50

N1	12.17	11.63	13.60	12.48	22.14	21.01	24.59	23.39	22.75	21.59	25.44	24.58
N2	13.23	12.37	14.99	13.46	22.92	21.83	25.04	24.23	23.58	23.26	26.85	25.83
N3	14.46	13.54	15.68	14.22	23.88	22.48	26.06	24.62	24.66	22.99	27.22	26.07
N4	15.93	14.77	16.91	15.17	24.55	23.47	27.13	25.12	25.61	24.78	27.86	26.83

Table 4: Effect of species, spacing and nitrogen on branches after planting in Basil

Treatment	Days											
	Primary Branches (No.)											
	30				60				90			
	V1		V2		V1		V2		V1		V2	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
N0	11.55	11.77	11.66	11.88	13.00	13.10	13.22	13.55	13.77	14.77	14.66	14.55
N1	13.22	12.77	12.33	12.88	14.55	14.10	13.99	14.32	14.77	14.99	15.22	15.22
N2	13.44	13.33	13.22	13.77	15.10	14.55	14.77	15.22	15.66	15.44	15.77	15.88
N3	14.10	13.55	14.77	14.55	15.22	15.11	15.77	15.66	16.11	15.88	16.55	16.44
N4	14.99	14.44	15.44	15.66	15.99	15.77	16.44	16.66	16.33	16.21	17.00	16.99
	Secondary Branches (No.)											
	30				60				90			
	V1		V2		V1		V2		V1		V2	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
N0	50.00	52.33	34.66	44.00	57.00	66.00	50.66	55.00	60.33	68.33	56.66	60.66
N1	65.66	74.66	55.00	53.33	71.66	84.66	67.33	66.66	74.66	89.00	71.33	71.66
N2	74.66	78.00	68.66	64.00	87.66	86.66	80.33	78.66	93.00	90.66	84.66	84.00
N3	82.33	82.66	75.66	68.33	94.00	91.66	85.33	84.66	98.33	95.33	90.00	88.66
N4	96.00	91.00	81.66	86.33	104.33	98.00	93.00	101.00	106.33	100.33	96.66	105.66
	Tertiary Branches (No.)											
	30				60				90			
	V1		V2		V1		V2		V1		V2	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
N0	87.33	93.66	63.00	72.00	108.00	122.33	98.33	97.66	118.00	132.33	109.66	108.66
N1	106.20	119.66	96.00	93.66	121.66	136.33	117.33	115.00	132.33	147.00	127.66	131.00
N2	121.33	128.00	102.00	107.33	143.00	148.33	124.33	139.66	153.66	158.66	134.33	150.66
N3	159.33	148.66	107.33	122.33	179.00	167.33	128.33	161.00	187.00	177.66	138.00	171.33
N4	210.00	181.00	119.33	199.33	189.00	197.66	139.00	186.00	219.33	207.00	148.33	196.66

Table 5: Effect of species, spacing and nitrogen on plant height and root length after planting in Basil

Treatment	Days											
	leaf area (m^2/ha)											
	30				60				90			
	V1		V2		V1		V2		V1		V2	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
N0	13470.5	12736.0	16632.6	15525.1	18764.0	17206.3	20652.3	19404.6	9610.66	5218.0	13068.6	11566.0
N1	14979.9	13253.1	18413.6	16695.5	23902.3	20074.0	24465.3	20278.3	14886.0	7348.3	14256.0	13167.6
N2	24052	16145	18497	18945	26719	20402	28698	22070	18129	7910	18443	16615

	.8	.1	.1	.2	.0	.6	.0	.0	.0	.6	.3	.0
N3	27992.4	21687.8	21924.7	20638.5	27368.0	23730.6	31308.0	22263.0	19066.3	8415.6	18662.3	16929.0
N4	29519.9	21175.2	20485.0	19708.4	27225.3	23106.0	27144.6	22639.0	19193.3	7575.0	23660.3	46487.0
	leaf biomass (Q/ha)											
	30				**60**				**90**			
	V1		**V2**		**V1**		**V2**		**V1**		**V2**	
	S1	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**
N0	4.28	2.61	6.32	5.85	8.09	10.42	7.63	13.92	8.15	6.61	8.75	7.23
N1	4.95	10.19	6.81	5.91	9.73	11.07	10.39	13.21	8.56	8.93	15.75	14.36
N2	7.53	5.05	7.10	6.99	16.78	16.83	12.97	15.75	12.57	10.34	19.67	15.53
N3	8.13	9.66	7.72	11.03	18.18	16.31	19.84	23.29	13.36	21.18	22.15	17.08
N4	11.73	26.38	8.72	8.77	36.51	13.31	15.04	28.26	12.11	15.16	20.35	17.10

Table 6: Effect of species, spacing and nitrogen on plant height and root length after planting in Basil

Treatment	**Days**											
	stem biomass (Q/ha)											
	30				**60**				**90**			
	V1		**V2**		**V1**		**V2**		**V1**		**V2**	
	S1	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**
N0	4.563	3.217	6.267	4.437	32.07	39.98	38.37	24.66	16.50	26.03	37.20	35.92
N1	5.920	3.547	6.783	4.883	32.15	48.51	49.05	68.52	29.08	26.51	47.68	40.40
N2	7.157	5.327	7.893	8.660	35.54	61.14	57.80	72.05	34.38	27.83	58.05	45.10
N3	8.390	5.880	8.390	9.883	62.42	64.18	82.69	71.98	52.03	33.40	71.08	57.77
N4	10.61	8.660	10.73	11.327	79.99	90.62	101.96	120.25	55.84	35.36	76.50	62.52
	root biomass (Q/ha)											
	30				**60**				**90**			
	V1		**V2**		**V1**		**V2**		**V1**		**V2**	
	S1	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**	**S1**	**S2**
N0	0.987	0.770	2.220	1.327	2.87	2.57	3.76	2.47	2.80	4.10	7.98	7.66
N1	1.603	0.990	2.713	1.990	2.93	3.46	4.47	6.43	4.59	4.43	8.70	9.20
N2	1.973	0.990	3.083	2.103	2.97	4.87	5.32	8.47	5.23	4.70	9.86	9.81
N3	2.590	1.550	3.700	2.437	4.50	5.36	6.45	9.33	6.44	5.11	10.03	10.25
N4	2.837	1.993	4.193	3.327	6.48	5.99	7.56	12.38	6.84	6.21	12.07	10.80

$V_1S_1N_0$	$V_1S_2N_4$	$V_2S_2N_4$	$V_1S_2N_4$	$V_2S_1N_0$	$V_1S_1N_0$
$V_1S_1N_1$	$V_1S_2N_3$	$V_2S_2N_3$	$V_1S_2N_3$	$V_2S_1N_1$	$V_1S_1N_1$
$V_1S_1N_2$	$V_1S_2N_2$	$V_2S_2N_2$	$V_1S_2N_2$	$V_2S_1N_2$	$V_1S_1N_2$
$V_1S_1N_3$	$V_1S_2N_1$	$V_2S_2N_1$	$V_1S_2N_1$	$V_2S_1N_3$	$V_1S_1N_3$
$V_1S_1N_4$	$V_1S_2N_0$	$V_2S_2N_0$	$V_1S_2N_0$	$V_2S_1N_4$	$V_1S_1N_4$
$V_2S_1N_4$	$V_2S_2N_4$	$V_2S_1N_4$	$V_1S_1N_4$	$V_2S_2N_0$	$V_1S_2N_0$
$V_2S_1N_3$	$V_2S_2N_3$	$V_2S_1N_3$	$V_1S_1N_3$	$V_2S_2N_1$	$V_1S_2N_1$
$V_2S_1N_2$	$V_2S_2N_2$	$V_2S_1N_2$	$V_1S_1N_2$	$V_2S_2N_2$	$V_1S_2N_2$
$V_2S_1N_1$	$V_2S_2N_1$	$V_2S_1N_1$	$V_1S_1N_1$	$V_2S_2N_3$	$V_1S_2N_3$
$V_2S_1N_0$	$V_2S_2N_0$	$V_2S_1N_0$	$V_1S_1N_0$	$V_2S_2N_4$	$V_1S_2N_4$
R-III		**R-II**		**R-I**	

Fig. 1: Experiment design and layout