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Response of spacing and nitrogen levels on growth and flowering of salvia (*salvia splendens* L.)

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Abstract

A field experiment was conducted to ascertain the response of spacing and nitrogen levels on growth and flowering of *Salvia* (*Salvia splendens* L.) during the winter season in the year of 2016. It was observed that among the three different spacings viz; 30× 20 cm, 30 × 30 cm and 40 × 30 cm, tried, wider spacing (30 × 30 cm) its growing higher plant height, plant spread, number branches and number of leaves and also maximum number of florets per spike, number of spike, spike length and rachis length. Plant was also recorded wider spacing i.e. 30 × 30cm. Among various nitrogen levels viz. 0, 60, 100 and 140 kg N/ha, maximum improvement in various growth and flower character were observed under 100 kg N/ha. Among interactions, the spacing of 30 × 30 cm and application of 100 kg N/ha recorded maximum value of growth characters viz. plant height, plant spread, number of branches per plant and flower characters viz. Days required for spike initiation, number of spikes, number of florets per spikes, spike length and rachis length and the treatment was considered as superior treatment.

Keywords: Nitrogen, spacing, *Salvia*

Introduction

Floriculture is a first emerging, rapidly expanding in the present scenario, thus as become of great antiquity. The importance of flower has been realized throughout the world and today, flower cultivation has developed into an intensive than any other branch of agriculture.

Floriculture industry in india during the last decade has expanded and deepened its root on account of strong research and development base, focused attention of the government coupled with innovative entrepreneurships, progressive flower grower and increased awareness among the masses for use of flowers in homes, offices, social function etc. presently about 1.16 lakh ha. area is under floriculture with the production of loose flower about 654837 metric tonnes and 19515 lakh number of cut flowers (Singh and Upadhaya, 2007).

The flower is god gift to mankind. In India it is rightly said that the man has borne with flowers and died with flowers. Flowers symbolize the purity, beauty, peace, love and passion. To an Indian, especially to Hindus, flowers have a much greater significance. A devoted Hindu needs flowers every morning for the religious offering to the family deity. The aesthetic value of flowers in our daily life cannot be over emphasized. In our country no special function is complete without the use of Flowers. Floral glands of, gajras and veins are needed for marriage ceremonies. The gajras and veins are also used as hair adornments by women. Floral bouquets or flower arrangements also find a pride of place in social Gatherings, birthday parties, welcoming a home coming friend. Also the various valuable by products are manufactured from various flower likes the attar, gulkand and rose water from rose, perfume from the jasmine etc. The flowers are also used as for landscaping purpose hence have great aesthetic value.

The *salvia* belongs to the phylum angiospermae sub - phylum dicotyledonae, family labiate, genus *salvia* and species *splendens*. The world *salvia* is derived from the Latin word 'salvo' which means 'to save'. In reference to the plants used in ancient medicine; the name sage from its supposed power to make people wise by strengthening the memory.

Brazil is one of the main centre of the origin of the garden *salvia*, which comprises a number of species like *salvia coccinea*, *salvia horminum* and *salvia splendens*, in these the most common and popular type is *salvia splendens* with a bright scarlet flowers. This is one of the most brilliant red flowered bedding plants in cultivation, it is generally grown in masses, It does best full sunshine but may be used in shady place to light up the dark woody recesses. It should have a dark background of contrast. It is propagated either by cuttings or srezs, but the propagation through seed is best.

It possess a good raceme which has a spike of 6 inch or more in length with 30 or more flower in a raceme and 2-6 flowers in a whorl, each flower being 2 or more inch long.

Some varieties have erect raceme other pendulous and there are some white varieties together with some intermediate colours. The salvia abounds in volatile aromatic oil which is used in perfumery and also has stimulants, many of them possess a bitter astringent property.

The yield of any crop is influenced by a number of factors namely cultural, environmental, soil fertility, variety, time of sowing and irrigation. Apart from the varietal character the chief consideration for increasing the yield are soil fertility and number of plants accommodated per unit area which can be changed according to need. Salvia can be grown in well drained rich soil and in sunny situation. Soil fertility in modern age is considered to be soil having additional fertility than in native fertility, nitrogen has the quickest most pronounced effect on the plant growth that ultimately leads to good yield. Nitrogen is the constituent of different amino acids, proteins and chlorophyll which is essential for good growth of plant. Nitrogen deficiency can be characterised by stunted growth; flowering and fruiting are also reduced. Nitrogen tends to produce succulence, a quality of great importance in flower crops like chrysanthemum etc. Recovery from the deficiency is usually rapid if the application of nitrogen fertilizers are made in some quick available form.

Spacing costs a dominant influence on growth and yield of most of the flowering crops, to maintain the plant population,

spacing either in row or between the plants is very important, in closer spacing more number of plants per unit area can be accommodated which result in more production per unit area, wide spacing facilitates better growth for each plant, the plant density significantly influences the period for emergence of flower buds.

Materials and methods

The present investigation entitled "Response of spacing and nitrogen levels on growth and flowering of *Salvia splendens*" was carried out at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad (U.P) in the month of November to March during the winter season of the year 2016-2017.

The different treatment manipulated as follows T₁- S1N0- 30 × 20 cm + 0 kg, T₂- S1N1- 30 × 20 cm + 60 kg, T₃- S1N2- 30 × 20 cm + 100 kg, T₄- S1N3- 30 × 20 cm + 140 kg, T₅- S2N0- 30 × 30 cm + 0 kg, T₆- S2N1- 30 × 30 cm + 60 kg, T₇- S2N2- 30 × 30 cm + 100 kg, T₈- S2N3- 30 × 30 cm + 140 kg, T₉- S3N0- 40 × 30 cm + 0 kg, T₁₀- S3N1- 40 × 30 cm + 60 kg, T₁₁- S3N2- 40 × 30 cm + 100 kg, T₁₂- 40 × 30 cm + 140 kg. The treatments were arranged in a randomized block design with 12 treatments in 3 replications.

Table 1

Treatment notation with treatment symbol	Treatments combination	Plant height (cm)	Plant Spread (cm) N-S to E-W	Number of branches per plant	Number of leaves per plant	Days required for spike initiation	Number of spike per plant
S1N0-T ₁	30×20 cm + 0 kg	21.07	21.33	8.44	70.78	91.33	7.90
S1N1-T ₂	30×20 cm + 60 kg	22.44	22.39	9.22	78.33	90.44	9.86
S1N2-T ₃	30×20 cm + 100 kg	24.47	25.67	10.00	88.11	88.00	12.79
S1N3-T ₄	30×20 cm + 140 kg	23.01	24.39	9.56	81.78	88.56	10.84
S2N0-T ₅	30×30 cm + 0 kg	22.12	22.34	9.11	76.67	91.22	8.64
S2N1-T ₆	30×30 cm + 60 kg	22.69	24.22	9.56	79.78	90.00	10.41
S2N2-T ₇	30×30 cm + 100 kg	25.49	26.69	11.00	103.44	86.22	13.16
S2N3-T ₈	30×30 cm + 140 kg	24.29	24.89	9.89	86.22	88.22	12.67
S3N0-T ₉	40×30 cm + 0 kg	21.20	21.83	9.00	71.62	91.33	8.46
S3N1-T ₁₀	40×30 cm + 60 kg	22.59	22.89	9.44	79.22	90.11	9.92
S3N2-T ₁₁	40×30 cm + 100 kg	25.14	26.06	10.09	90.33	87.78	13.10
S3N3-T ₁₂	40×30 cm + 140 kg	23.19	24.72	9.67	83.33	88.44	11.39
S. Em. (±)		0.384	1.020	0.148	0.891	0.913	0.804
C. D. at 5 %		0.796	2.115	0.306	1.849	1.893	1.667

Treatment notation with treatment symbol	Treatments combination	Number of florets per spike	Spike length (cm)	Rachis length (cm)
S1N0-T ₁	30×20 cm + 0 kg	76.33	22.00	18.08
S1N1-T ₂	30×20 cm + 60 kg	84.67	25.26	19.04
S1N2-T ₃	30×20 cm + 100 kg	88.33	26.92	23.16
S1N3-T ₄	30×20 cm + 140 kg	85.67	27.19	22.40
S2N0-T ₅	30×30 cm + 0 kg	80.00	24.13	18.95
S2N1-T ₆	30×30 cm + 60 kg	85.33	26.52	21.21
S2N2-T ₇	30×30 cm + 100 kg	105.00	28.39	25.48
S2N3-T ₈	30×30 cm + 140 kg	87.33	26.59	22.87
S3N0-T ₉	40×30 cm + 0 kg	79.00	22.57	18.39
S3N1-T ₁₀	40×30 cm + 60 kg	84.67	25.64	19.72
S3N2-T ₁₁	40×30 cm + 100 kg	103.67	27.69	23.47
S3N3-T ₁₂	40×30 cm + 140 kg	86.33	26.58	22.54
S. Em. (±)		0.996	0.178	0.937
C. D. at 5 %		2.065	0.369	1.944

Results and discussion

Vegetative characters

Plant height

At 75 DAT, S2 (Spacing of 30 × 30 cm) recorded maximum plant height (23.65 cm) followed by 23.03 cm with S3 (Spacing of 40 × 30 cm) and the minimum (22.75 cm) was recorded with S1 (spacing of 30 × 20 cm).

N2 (100 kg N ha⁻¹) recorded maximum plant height (25.03 cm) followed by 23.50 cm with N3 (140 kg ha⁻¹), whereas, the minimum (21.46 cm) was found with N0 (0 kg N ha⁻¹).

Interacting treatment combination S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recording maximum plant height (25.49 cm) followed by 25.14 cm with S3 N2 (Spacing of 40 × 30 cm + 100 kg N ha⁻¹) and the minimum (21.07 cm) was

recorded with the combination S1N0 (Spacing of 30 × 20 cm + 0 kg N ha⁻¹).

Maximum plant height was recorded with medium spacing (30 × 30 cm). plant height also Increased with the increase in nitrogen up to 100 kg ha⁻¹ at all the stages of growth, however, at 140 kg ha⁻¹ it registered decline.

Plant spread

At 75 DAT, S2 (Spacing of 30 × 30 cm) recorded maximum plant spread (24.53 cm) followed by 23.87 cm with S3 (Spacing of 40 × 30 cm) and the minimum (23.44 cm) was recorded with S1 (spacing of 30 × 20 cm).

N2 (100 kg N ha⁻¹) recorded maximum plant spread (26.14 cm) followed by 24.67 cm with N3 (140 kg ha⁻¹), whereas, the minimum (21.83 cm) was found with N0 (0 kg N ha⁻¹).

Combination S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recording maximum plant spread (26.69 cm) followed by 26.06 cm with S3 N2 (Spacing of 40 × 30 cm + 100 kg N ha⁻¹) and the minimum (21.33 cm) was recorded with the combination S1N0 (Spacing of 30 × 20 cm + 0 kg N ha⁻¹).

Maximum plant spread was recorded with medium spacing (30 × 30 cm). plant spread also Increased with the increase in nitrogen up to 100 kg ha⁻¹ at all the stages of growth, however, at 140 kg ha⁻¹ it registered decline.

Number of branches per plant

At 75 DAT, S2 (Spacing of 30 × 30 cm) recorded maximum Number of branches per plant (9.89) followed by 9.55 with S3 (Spacing of 40 × 30 cm) and the minimum (9.31) was recorded with S1 (spacing of 30 × 20 cm).

N2 (100 kg N ha⁻¹) recorded maximum Number of branches per plant (10.36) followed by 9.71 with N3 (140 kg ha⁻¹), whereas, the minimum (8.85) was found with N0 (0 kg N ha⁻¹).

S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recording maximum Number of branches per plant (11.00) followed by 10.09 with S3 N2 (Spacing of 40 × 30 cm + 100 kg N ha⁻¹) and the minimum (8.44) was recorded with the combination S1N0 (Spacing of 30 × 20 cm + 0 kg N ha⁻¹).

Maximum Number of branches per plant was recorded with medium spacing (30 × 30). Number of branches per plant increased with the increase in nitrogen level up to 100 kg ha⁻¹ at all the stages of growth, but it slightly reduced at 140 kg N ha⁻¹.

Number of leaves per plant

At 75 DAT, S2 (Spacing of 30 × 30 cm) recorded maximum Number of leaves per plant (86.53) followed by 81.14 with S3 (Spacing of 40 × 30 cm) and the minimum (79.75) was recorded with S1 (spacing of 30 × 20 cm).

N2 (100 kg N ha⁻¹) recorded maximum Number of leaves per plant (93.96) followed by 83.78 with N3 (140 kg ha⁻¹), whereas, the minimum (73.04) was recorded with N0 (0 kg N ha⁻¹).

S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recording maximum Number of leaves per plant (103.44) followed by 90.33 with S3 N2 (Spacing of 40 × 30 cm + 100 kg N ha⁻¹) and the minimum (70.78) was recorded with the combination S1N0 (Spacing of 30 × 20 cm + 0 kg N ha⁻¹).

Maximum Number of leaves per plant was recorded with medium spacing (30 × 30). Number of leaves per plant increased with the increase in nitrogen level up to 100 kg ha⁻¹ at all the stages of growth, but it slightly reduced at 140 kg N ha⁻¹.

Flowering characters

Days required for spike initiation

Interacting treatment combination S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recorded earliest spike initiation (91.22 days) while the maximum number of days (91.33) for spike initiation was recorded with S1 N0 (Spacing of 30 × 20 cm + 0 kg N ha⁻¹).

Early spike initiation with medium spacing and higher dose of nitrogen might have been possible due to higher photosynthetic activity as well as better availability of nutrients to the plants.

Number of spikes per plant

Treatment combination S2 N2 (Spacing 30 cm × 30 cm + 100 kg N ha⁻¹) recorded maximum number of spike per plant (13.16) followed by 13.10 with S3 N2 (Spacing of 40 cm × 30 cm + 100 kg N ha⁻¹) and the minimum (7.90) remained with S1 N0 (spacing of 30 cm × 20 cm + 0 kg N ha⁻¹). S2 N2 and S3 N2 were, however, statistically at par.

Higher photosynthetic activity due to greater exposure to light and increased availability of nutrients to the plants with medium spacing might have resulted into higher number of spike per plant.

Number of florets per spike

Treatment combination S2 N2 (Spacing of 40 cm × 30 cm + 100 kg N ha⁻¹) recorded maximum number of florets per spike (105.00) followed by 103.67 with S3 N2 (Spacing of 40 cm × 30 cm + 100 kg N ha⁻¹) and the minimum (76.33) remained with S1N0 (Spacing of 40 cm × 20 cm + 100 kg N ha⁻¹).

Spike length (cm)

Treatment combination S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recorded maximum spike length (28.39 cm) followed by 27.69 cm with S3 N2 (Spacing of 40 × 30 cm + 100 kg N ha⁻¹) and the minimum (22.20 cm) remained with S1 N0 (Spacing of 30 × 20 cm + 0 kg N ha⁻¹).

Longer spike were corresponding to the plant height, plant spread, number of leaves and branches per plant.

Rachis length (cm)

The interacting combination S2 N2 (Spacing of 30 × 30 cm + 100 kg N ha⁻¹) recorded maximum rachis length (25.48 cm) followed by 23.47 cm with S3 N2 (Spacing of 40 × 30 cm + 100 kg N ha⁻¹) and the minimum (18.08 cm) remained with S1 N0 (Spacing of 30 cm × 30 cm + 0 kg N ha⁻¹).

Higher rachis length was corresponding to the spike length.

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