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Effect of different levels of nitrogen and phosphorus on growth and flowering of *Salvia splendens* cv. scarlet sage

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Abstract
An experiment to Effect of different levels of nitrogen and phosphorus on growth and flowering of *Salvia splendens* was carried out at Horticulture section, College of Agriculture Allahabad rabi season of 2017-2018 with sixteen treatment combinations in factorial randomized block design. The treatments comprised of four different levels of nitrogen *viz*., 0, 40, 60 and 80 kg ha^{-1} and four different levels of phosphorus *viz*., 0, 50, 100 and 120 kg ha^{-1}. The result of present investigation revealed that, application of 80 kg ha^{-1}nitrogen and 120 kg ha^{-1}phosphorus produced significantly maximum Plant height (cm), Plant spread (cm), Number of branches per plant, Leaves per plant with respect to flowering parameters produced significantly maximum, Number of spikes per plant, Spike length(cm), Number of flowers per spike, Rachis length(cm). The interaction effects were found non-significant. For these parameters, the best treatment combination was 80 kg nitrogen ha^{-1} + 120 kg phosphorus ha^{-1}.

Keywords: Salvia, nitrogen and phosphorus

Introduction
Landscaping is the design and alteration of a portion of land by use of planting material and land reconstruction. Colourful ornamental plants and flowers play a great part in making the environment beautiful and refining the minds of inhabitants through landscaping.
Borders are continuous beds of more length than width containing plants of heterogeneous character as distinguished from flower beds which are composed of plants of one kind. According to the kind of plant material used to fill them; borders are named as shrubbery border, herbaceous border and mixed borders. The borders should be sheltered from high winds and should get full benefit of the sun.
Ornamental plants are those plants that are grown for decorative purposes in gardens and landscape design projects, as houseplants, for cut flowers and specimen display. Ornamental plants are mainly grown for display purposes, rather than functional ones. Ornamental plants are the keystone of ornamental gardening, and they come in a varied range of shapes, sizes and colours suitable to a broad array of climates, landscapes, and gardening needs. Some ornamental plants are grown for showy foliage. Their foliage may be deciduous, turning bright orange, red, and yellow before dropping off in the fall, or evergreen, whereas in some cases it stays green round the year. Some ornamental foliage has a striking appearance created by lacy leaves or long needles, while other ornamentals are grown for distinctively coloured leaves, such as silvery-grey ground covers and bright red grasses, among many others.
A flower bed refers to those plants which on planting in group may produce flower profusely to provide a mass effect. They may be annuals, biennials and perennials. These are a good source of flowers and also for attracting pollinators such as bees and butterflies. They enhance the outdoor scaping of the surroundings. They easily break the monotony effect enhancing the mass effect. These plants irrespective of whether they are perennial, biennial, annual or seasonal have tremendous variety of colour, size and form adding beauty to the garden.
A winter annual includes that ornamental annual plant that blooms during winter seasons. Winter annuals such as Salvia, Antirrhinum, Calendula, Pansy, Phlox etc plays a major role in landscaping by acting as border plants and flower beds. These plants enlighten the different areas of a landscape garden with its colourful flowers thus attracting the viewers.
Nitrogen deficiency results in pale green colouration of foliage and reduction in the number of florets per spike and number of spikes per bulb. The utilization of food reserve in old bulb is also hampered by nitrogen deficiency. The form in which nitrogen is supplied is important. The quality of flower is improved more when nitrogen is applied partly as nitrate and partly as ammonium, than when the nutrient is supplied entirely from either source.

Phosphorus is also one of the most important nutrients producing growth and yield responses in Salvia. There are conflicting reports on the requirement of phosphatic fertilizers in Salvia\. Since the cultivation of Salvia is gaining popularity, it is necessary to find out proper fertilizer doses to ensure healthy growth and yield of quality spikes. The symptoms of phosphorus deficiency are dark green foliage and purple colouration in lower leaves. The new plant readily utilizes the phosphorus in the bulb. It is likely that the plant can take up enough phosphorus at the early stages of growth to last the whole growing period.

Materials and Methods

The present investigation "Effect of different levels of nitrogen and phosphorus on growth and flowering of *Salvia splendens* cv. Scarlet sage" was conducted at the Research farm of Department of Horticulture, Naini Agricultural Institute, Allahabad, during 2017-2018. The experimental site is situated at of latitude of 20^0 and 15^0 North and longitude of 60^0 and 3^0. The observation related to growth and yields were recorded and were subjected to statistical analysis. Starter dose of 80 kg N/ha^{-1} and 120 kg P/ha^{-1} was given uniformly in all the plots and phosphorus was given as per treatment as basal application.

Experimental Techniques

The experiment was laid out in Factorial randomized block design. There were sixteen treatments including control replicated four times with variable proportions of nitrogen (0, 40, 60 and 80 kg ha^{-1}) and phosphorus (0, 50, 100 and 120 kg ha^{-1}).

Results and Discussion

Vegetative characters

In the current investigation maximum plant height was recorded with the nitrogen level N_3P_3(80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}), while the minimum plant height was recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The maximum number of leaves per plant was recorded with the application of nitrogen N_3P_3 (80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}) and the minimum number of leaves per plant was recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The maximum Plant spread (cm) was recorded with N_3P_3 (80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}), while the minimum Plant spread (cm) was recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The increase in plant height and number of leaves per plant due to the dose of nitrogen, i.e. (N3) might be due to the fact that nitrogen increases transport of metabolites and rate of photosynthesis in plants, which enables the plant to have quick and better upward vegetative growth. Similar results were also reported by Patel *et al*. (2006) [8], Kadu *et al*. (2009) [4] and Devi and Singh (2010) [9] in tuberose.

2. Flowering characters

Number of spikes per plant

In the current investigation maximum number of spike per plant was recorded with the nitrogen level N_3P_3 (80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}), while the minimum number of spike recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). All the levels of nitrogen increased the number of spikes per plant over control. Increase in number of spikes due to nitrogen application may be because of increase in plant height. Nitrogen is the essential component of protoplasm and chlorophyll materials and its adequate quantity is essential to maximum photosynthetic activities for synthesis of carbohydrate in plant and their conversion into plant lipids. In the current investigation maximum number of spikes per plant was recorded with the phosphorus level P3 (120 kg /ha.). While the minimum number of spikes per plant was recorded with control i.e. P1 (0 kg/ha). Similar results were also reported by Patel *et al*. (2006) [8] and Kadu *et al*. (2009) [4] in tuberose.

Length of spike (cm)

In the current investigation maximum length of spike was recorded with the N_3P_3 (80 Kg N ha^{-1} + 120kg P_2O_5 ha^{-1}) while the minimum length of spike was recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The maximum length of spike might be because nitrogen was most important nutrient in increasing spike length in tuberose. The proportionate increase in number of florets and length as a consequence of nitrogen fertilization might be as a result of substantial increase in the flower stem length. In the current investigation maximum length of spike was recorded with the phosphorus level P3 (120 kg /ha.), while the minimum length of spike was recorded with control i.e. P1 (0 kg/ha). Similar results were also reported by Patel *et al*. (2006) and Kadu *et al*. (2009) [4] in tuberose.

Number of florets per spike

In the current investigation maximum number of florets was recorded with the N_3P_3 (80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}), while the minimum number of florets was recorded control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The proportionate increase in number of florets and length as a consequence of nitrogen fertilization might be as a result of substantial increase in the flower stem length. In the current investigation maximum number of florets was recorded with the phosphorus level P3 (120 kg /ha.). While the minimum number of florets was recorded with control i.e. P1 (0 kg/ha). Similar results were also reported by Patel *et al*. (2006) [8] and Kadu *et al*. (2009) [4] in tuberose.

Length of florets (cm)

In the current investigation maximum length of florets was recorded with the N_3P_3 (80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}), while the minimum length of florets recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The proportionate increase in number of florets and length as a consequence of nitrogen fertilization might be as a result of substantial increase in the flower stem length. In the current investigation maximum length of florets was recorded with the phosphorus level P3 (120 kg /ha.) while the maximum length of florets was recorded with control i.e. P1 (0 kg/ha). Similar results were also reported by Patel *et al*. (2006) [8], Kadu *et al*. (2009) [4], and Kumar *et al*. (2009) [5] in tuberose.

Rachis length (cm)

In the current investigation maximum Rachis length (cm) was recorded with the N_3P_3 (80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}), while the minimum length of florets was recorded with control i.e. N_0P_0 (0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}). The role of nitrogen in improving the Rachis length (cm) may be attributed to the translocation of metabolites to the site of floret development. In the current investigation maximum diameter of florets was recorded with the phosphorus level P3 (120 kg /ha.), while the minimum length of florets was recorded with control i.e. P1 (0 kg/ha). These results are in congruence with Kumar *et al*. (2009) [5], Patel *et al*. (2006) [8] and Kadu *et al*. (2009) [4] in tuberose.

Table 1: Vegetative characters

Treatment 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
T_0-N_0P_0- 0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	21.52	21.79	9.26	71.77	86.07
T_1-N_0P_1 -0 kg N ha^{-1} + 50 kg P_2O_5 ha^{-1}	22.96	22.85	10.04	79.75	88.51
T_2-N_0P_2 -0 kg N ha^{-1} + 100 kg P_2O_5 ha^{-1}	23.50	24.85	10.38	82.77	86.53
T_3-N_OP_3 -0 kg N ha^{-1} + 120 kg P_2O_5 ha^{-1}	24.96	26.13	10.82	89.10	89.30
T_4-N_1P_0- 40 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	22.61	22.80	9.93	73.52	84.29
T_5-N_1P_1 -40 Kg N ha^{-1} +50 kg P_2O_5 ha^{-1}	23.18	24.68	10.38	81.07	88.07
T_6-N_1P_2 -40 Kg N ha^{-1} +100 kg P_2O_5 ha^{-1}	24.78	25.35	10.71	85.18	86.29
T_7-N_1P_3-40 Kg N ha^{-1} +120 kg P_2O_5 ha^{-1}	25.98	27.15	11.77	92.18	89.29
T_8-N_2P_0-60 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	21.69	22.29	9.82	72.66	85.85
T_9-N_2P_1-60 Kg N ha^{-1} +50 kg P_2O_5 ha^{-1}	23.08	23.35	10.26	80.21	88.18
T_{10}-N_2P_2-60 Kg N ha^{-1} +100 kg P_2O_5 ha^{-1}	23.68	25.18	10.49	84.32	86.51
T_{11}-N_2P_3 -60 Kg N ha^{-1} +120 kg P_2O_5 ha^{-1}	25.63	26.52	10.91	91.32	89.40
T_{12}-N_3P_0 -80 kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	22.55	23.15	10.68	77.66	86.71
T_{13}-N_3P_1 -80 kg N ha^{-1} +50 kg P_2O_5 ha^{-1}	23.94	24.21	11.12	80.77	89.04
T_{14}-N_3P_2 -80 kg N ha^{-1} +100 kg P_2O_5 ha^{-1}	24.54	26.04	11.35	87.21	87.37
T_{15}-N_3P_3-80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}	26.49	27.38	11.82	104.43	90.26
SEm (±)	0.602	0.207	0.123	0.461	0.351
C.D. at 5%	1.229	0.423	0.251	0.942	0.717

Table 2: Flowering characters

Treatment combination	Number of spike per plant	Number of florets per spike	Spike length (cm)	Rachis length (cm)
T_0-N_0P_0- 0 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	5.84	74.40	20.24	20.19
T_1-N_0P_1 -0 kg N ha^{-1} + 50 kg P_2O_5 ha^{-1}	8.13	82.81	23.30	21.29
T_2-N_0P_2 -0 kg N ha^{-1} + 100 kg P_2O_5 ha^{-1}	9.11	83.74	25.23	24.45
T_3-N_OP_3 -0 kg N ha^{-1} + 120 kg P_2O_5 ha^{-1}	11.06	86.40	24.96	25.21
T_4-N_1P_0- 40 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	6.91	78.07	22.17	21.00
T_5-N_1P_1 -40 Kg N ha^{-1} +50 kg P_2O_5 ha^{-1}	8.68	83.40	24.56	23.26
T_6-N_1P_2 -40 Kg N ha^{-1} +100 kg P_2O_5 ha^{-1}	10.94	85.40	26.59	24.92
T_7-N_1P_3-40 Kg N ha^{-1} +120 kg P_2O_5 ha^{-1}	11.43	102.60	26.43	26.38
T_8-N_2P_0-60 Kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	6.73	77.07	20.61	20.44
T_9-N_2P_1-60 Kg N ha^{-1} +50 kg P_2O_5 ha^{-1}	8.19	82.74	23.68	21.77
T_{10}-N_2P_2-60 Kg N ha^{-1} +100 kg P_2O_5 ha^{-1}	9.66	84.40	24.62	24.59
T_{11}-N_2P_3 -60 Kg N ha^{-1} +120 kg P_2O_5 ha^{-1}	11.37	101.74	25.73	25.52
T_{12}-N_3P_0 -80 kg N ha^{-1} + 0 kg P_2O_5 ha^{-1}	7.59	77.93	21.47	21.30
T_{13}-N_3P_1 -80 kg N ha^{-1} +50 kg P_2O_5 ha^{-1}	9.05	83.60	24.54	22.63
T_{14}-N_3P_2 -80 kg N ha^{-1} +100 kg P_2O_5 ha^{-1}	10.52	85.26	25.48	25.45
T_{15}-N_3P_3-80 kg N ha^{-1} +120 kg P_2O_5 ha^{-1}	12.23	103.07	26.63	27.53
SEm (±)	0.276	0.455	0.329	0.377
C.D. at 5%	0.564	0.929	0.672	0.769

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