Effect of nitrogen and potassium on growth and flowering of pansy (*Viola* × *wittrockiana* Gams)

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ABSTRACT

The present investigations were carried out to work out the optimum doses of nitrogen and potassium for growth and flowering of pansy. The experiment was laid out in a randomized block design (factorial) with 4 levels of nitrogen (0, 20, 30 and 40 g N/m^2) and 4 levels of potassium (0, 10, 20 and 30 g K/m^2) along with uniform doses of FYM @ 5 kg/m^2 and P @ 20 g/m^2 except the control. In all 16 treatment combinations of nitrogen and potassium were replicated thrice. Among different levels of nitrogen 40 g N/m^2 recorded maximum values wrt time taken to first flowering (82.08 days), plant height (33.30 cm), plant spread (36.28 cm), number of flowers per plant (159.92), number of flowers per plot (1439.25), size of flower (4.37 cm) and duration of flowering (89.17 days). Maximum days to first flowering (77.08 days), plant height (29.96 cm), plant spread (32.65 cm), number of flowers per plant (153.92), number of flowers per plot (1385.25), size of flowers (4.16 cm) and duration of flowering (88.75 days) were observed with the application of 30 g K/m^2. The interaction 40 g N x 30 g K/m^2 recorded maximum values in terms of most of the growth and flowering parameters of commercial importance. Hence it is concluded that for better growth and flowering the pansy plants be fertilized with N:K @ 40:30 g/m^2 along with a constant dose of FYM @ 5 kg/m^2 and P @ 20 g/m^2.

Keywords: Nitrogen; potassium; pansy; growth; flowering; fertilizer

INTRODUCTION

Pansy (*Viola* × *wittrockiana* Gams) is a popular ornamental bedding plant. It is a winter annual and belongs to family Violaceae. It is thought to be derived from *Viola tricolor* and is a native of central Europe (Chattopadhyay 2007). Pansy is commercially propagated by seeds. The growth and flowering of plants are greatly influenced by various environmental factors like temperature, soil, relative humidity, light and nutrition. Nitrogen and potassium are required in sufficient quantities to attain better growth and to promote flowering. In order to achieve maximum plant growth and flowering knowledge on optimum doses of fertilizers is also very important. Therefore the present studies were undertaken to optimize doses of nitrogen and potassium for pansy cultivation.

MATERIAL and METHODS

The present investigations were carried out at the experimental farm of the Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during 2014-2015. The experiment was laid out in a randomized block design (factorial) consisting of four levels of nitrogen viz N_0 (0 g N/m^2), N_1 (20 g N/m^2), N_2 (30 g N/m^2) and N_3 (40 g N/m^2) and 4 levels of potassium viz K_0 (0 g K/m^2), K_1 (10 g K/m^2), K_2 (20 g K/m^2) and K_3 (30 g K/m^2) along with uniform doses of FYM @ 5 kg/m^2 and P @ 20 g/m^2 except the control. In all 16 treatment combinations of nitrogen and potassium were replicated thrice. Half dose of nitrogen and full dose of phosphorus and potassium were applied as basal dose before transplanting of seedlings while remaining

half dose of the nitrogen was applied after 30 days of transplanting. Nitrogen was applied in the form of urea and potassium in the form of muriate of potash (MoP). A uniform dose of phosphorus @ 20 g/m^2 in the form of single super phosphate (SSP) except control and FYM @ 5 kg/m^2 were applied uniformly.

The healthy, bold and disease-free seeds of pansy were sown in nursery and watered properly. Healthy and stocky seedlings at 5-6 leaf stage were selected and transplanted in the beds of 1 × 1 m size with a spacing of 30 × 30 cm. Light irrigation was given soon after transplanting. Irrigation twice a week during summer and once in winter was given. Weeding and hoeing of the field were done from time to time. Observations were recorded on days taken to first flowering, plant height, plant spread, number of flowers per plant, number of flowers per plot, size of flower and duration of flowering. All the data pertaining to growth and flowering characters were subjected to statistical analysis as per Gomez and Gomez (1984).

RESULTS and DISCUSSION

The data on the effect of nitrogen and potassium on growth and flowering parameters of pansy are given in Table 1.

Days taken to first flowering (days)

Data reveal that minimum days taken to first flowering (63.42 days) were recorded in treatment N_0 (0 g N/m^2) and maximum (82.08 days) in N_3 (40 g N/m^2). In case of potassium minimum time to first flowering (66.75 days) was recorded in K_0 (0 g K/m^2) and maximum (77.08 days) in K_3 (30 g K/m^{2-}). Under interactive effect minimum time to first flowering (56.33 days) was in $N_0 \times K_0$ ie in control and maximum (84.67 days) in N_3 (40 g N/m^2) × K_3 (30 g K/m^2) that was statistically at par with $N_3 \times K_2$ (83.33 days) and $N_3 \times K_1$ (81.00 days). With increase in nitrogen, potassium and their combined doses the flowering was delayed linearly. This could be due to encouragement of vegetative phase by nitrogen and potassium which delayed bud formation and flowering as well. Similar results were reported by Sharma et al (2013) in *Barleria cristata* and Thaneshwari (2014) in hydrangea.

Plant height (cm)

Plant height was recorded maximum (33.30 cm) in N_3 (40 g N/m^2) and minimum (19.77 cm) in no nitrogen application (N_0). The higher concentration of nitrogen has the ability to increase the number of cells of leaves, cell size and overall vegetative growth of the plants (Sigedar et al 1991). Sharma (1986) and Kaur and Kumar (1998) reported more plant height in pansy with the application of higher doses of nitrogen. Similarly maximum plant height (29.96 cm) was observed with the higher dose of potassium ie 30 g K/m^2 and minimum (22.36 cm) in K_0. Maximum plant height in African marigold was reported by Kishore et al (2010) and Pal and Ghosh (2010). Taller plants (39.82 cm) were also produced with higher doses of $N_3 \times K_3$ (40 g N/m^2 and 30 g K/m^2). The plant height was recorded minimum (15.43 cm) with interactive effect of $N_0 \times K_0$. Taller plants were recorded in gerbera by Barad et al (2010).

Plant spread (cm)

The application of nitrogen @ 40 g/m^2 recorded maximum plant spread (36.28 cm) while it was minimum (21.71 cm) in control. Kaur and Kumar (1998) recorded maximum plant spread in pansy (*V tricolor* L) with 40 g N/m^2. Similarly maximum plant spread (32.65 cm) was observed with potassium @ 30 g/m^{2-} and minimum (23.06 cm) with no application of potassium. Similar results were reported by Kishore et al (2010) and Pal and Ghosh (2010) in African marigold. The interaction $N_3 \times K_3$ (40 g N/m^2 and 30 g K/m^2) resulted in maximum plant spread (42.89 cm) and it was minimum (16.97 cm) in the control. Similar results were reported by Sharma et al (2013) in *Barleria cristata.*

Number of flowers per plant

N @ 40 g/m^2 resulted in maximum number of flowers per plant (159.92) while minimum (112.58) was in control. Maximum number of flowers per plant (153.92) was in potassium (30 g/m^2) and minimum (114.75) in the control. In case of interaction maximum number of flowers per plant (175.67) was in $N_3 \times K_3$ (40 g N/m^2 and 30 g K/m^2) and minimum (95.00) in control. Kaur and Kumar (1998) reported maximum number of flowers per plant in pansy with the application of 30 g N/m^2. Similar results were reported by Chezhiyan et al (1986) in chrysanthemum and Barad et al (2010) in gerbera.

Number of flowers per plot

Maximum number of flowers per plot (1439.25) was recorded due to 40 g N/m^2 and minimum (1013.25) in control. K_3 (30 K g/m^{2-}) resulted in maximum number of flowers per plot (1385.25) whereas minimum (1032.25) was in K_0. The

Table 1. Effect of nitrogen and potassium and their interaction on growth and flowering of pansy (*Viola* × *wittrockiana* Gams)

Treatment	Days taken to first flowering (days)	Plant height (cm)	Plant spread (cm)	Number of flowers/plant	Number of flowers/plot	Size of flower (cm)	Duration of flowering (days)
Nitrogen (N)							
N_0	63.42	19.77	21.71	112.58	1013.25	3.68	76.17
N_1	69.75	23.77	24.94	128.92	1160.25	3.76	81.67
N_2	72.75	26.98	28.90	141.50	1273.50	3.96	84.67
N_3	82.08	33.30	36.28	159.92	1439.25	4.37	89.17
$CD_{0.05}$	1.92	1.16	1.22	2.30	20.72	0.10	0.91
Potassium (K)							
K_0	66.75	22.36	23.06	114.75	1032.25	3.74	77.33
K_1	70.42	24.55	26.73	129.50	1165.50	3.85	80.83
K_2	73.75	26.95	29.39	144.75	1302.75	4.03	84.75
K_3	77.08	29.96	32.65	153.92	1385.25	4.16	88.75
$CD_{0.05}$	1.92	1.16	1.22	2.30	20.72	0.10	0.91
Interaction (N x K)							
N_0K_0	56.33	15.43	16.97	95.00	855.00	3.49	70.67
N_0K_1	60.33	18.53	20.71	102.67	924.00	3.57	74.67
N_0K_2	65.33	21.76	23.23	120.67	1086.00	3.79	77.33
N_0K_3	71.67	23.35	25.91	132.00	1188.00	3.85	82.00
N_1K_0	62.67	21.30	21.06	104.67	942.00	3.59	76.67
N_1K_1	68.67	22.90	24.17	124.33	1119.00	3.70	80.00
N_1K_2	72.67	24.65	26.25	139.33	1254.00	3.86	83.67
N_1K_3	75.00	26.03	28.29	147.33	1326.00	3.95	86.33
N_2K_0	68.67	23.62	25.08	121.00	1089.00	3.79	79.67
N_2K_1	71.67	25.65	27.48	135.67	1221.00	3.84	82.33
N_2K_2	73.67	28.00	29.55	148.67	1338.00	4.02	86.67
N_2K_3	77.00	30.65	33.51	160.67	1446.00	4.21	90.00
N_3K_0	79.33	29.08	29.12	138.33	1245.00	4.09	82.33
N_3K_1	81.00	31.11	34.58	155.33	1398.00	4.29	86.33
N_3K_2	83.33	33.21	38.52	170.33	1533.00	4.47	91.33
N_3K_3	84.67	39.82	42.89	175.67	1581.00	4.63	96.67
$CD_{0.05}$	3.83	2.31	2.44	4.60	41.44	NS	1.82

NS= Non-significant

interaction $N_3 \times K_3$ (40 g N/m^2 and 30 g K/m^2) produced maximum number of flowers per plot (1581.00) and minimum (855.00) was in no nitrogen and potassium application. Similar results were obtained by Singh (1978) in pansy. The results are also supported by Barad et al (2010) in gerbera.

Size of flowers (cm)

Maximum size of flowers (4.37 cm) was observed in treatment N_3 (40 g N/m^2) and minimum (3.68 cm) in N_0 that was statistically at par with N_1 (3.76 cm). The results are in agreement with the work of Kishore et al (2010). K_3 (30 g/m^{2-}) resulted in maximum size of flowers (4.16 cm) and minimum (3.74 cm) was in K_0. Hamlin and Mills (2001) reported that in pansy (*Viola* × *wittrockiana*) more potassium was absorbed after the flowers were opened because potassium ion stimulates petal cell expansion. Interactive effect between nitrogen and potassium was found to be non-significant.

Duration of flowering (days)

Duration of flowering (89.17 days) was maximum in 40 g N/m^2 and minimum (76.17 days) in control. K_3 (30 g/m^{2-}) resulted in maximum duration of flowering (88.75 days) and it was minimum (77.33 days) in control. Similar results were reported by Sharma et al (2013) in *B cristata*. Maximum duration of flowering (96.67 days) was in interaction $N_3 \times K_3$ (40 g N/m^2 and 30 g K/m^2) and minimum (70.67 days) in control. Similar results were observed by Sharma et al (2013) in *B cristata* and Thaneshwari (2014) in hydrangea.

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