Effect of nitrogen and potassium application on growth and quality of ornamental kale (*Brassica oleracea* var *acephala* DC)

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ABSTRACT

The present investigations were carried out at the experimental farm of 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) with 5 levels of nitrogen viz N_1 (10 g N/m^2), N_2 (15 g N/m^2), N_3 (20 g N/m^2), N_4 (25 g N/m^2), N_5 (30 g N/m^2) and 4 levels of potassium viz K_1 (5 g K/m^2), K_2 (10g K/m^2), K_3 (15 g K/m^2) and K_4 (20 g K/m^2). All 20 treatment combinations of nitrogen and potassium were replicated thrice. Among different levels of nitrogen N_5 (30 g N/m^2) recorded maximum values for plant height (59.44 cm), stem length (46.17 cm), stem diameter (22.07 mm) and head size (15.89 cm). However minimum number of days taken for head formation of cut stems (65.33 days) and colour development (78.33 days) was recorded with the lower level of nitrogen ie N_1 (10 g N/m^2). Maximum plant height (51.30 cm), stem length (38.50 cm), stem diameter (18.42 mm) and head size (14.26 cm) were recorded with the application of K_3 (15 g K/m^2). However minimum number of days taken to head formation (72.80 days) was recorded in treatment K_1 (5 g/m^2) and for colour development (85.53 days) in K_4 (20 g K/m^2).

Keywords: Ornamental kale; nitrogen; potassium; growth

INTRODUCTION

Ornamental kale (*Brassica oleracea* var *acephala* DC) is a popular cool season crop which displays attractive foliage with brilliant plant centres. All cultivars of ornamental cabbage and kale are actually true kales with the margins of the leaves determining the horticultural classification of the plant (Nau 1998). Ornamental kales are edible and tend to have a bitter flavour. They are often used in a culinary setting as garnishes. They are primarily prized for adding colour to the home gardens where they are grown for their large rosettes of white, pink, purple red or bicolour leaves (Mahr 2009).

Ornamental kale is a suitable pot plant, cut stem (flower) as well as landscaping plant particularly during fall when there is very little colour available in the garden. They are being grown on patios and decks in containers and in beds for cut stem (flower) purpose. Ornamental kale is one such crop which is new from floriculture point of view especially in Indian context. However this is gaining popularity in the Indian markets as pot plant as well as cut stem (flower).

Ornamental kale is a shallow-rooted crop and nutrients play an important role in its growth and development. Some pioneer works on this aspect were taken up for the vegetable purpose but no work has been done to popularize it as an ornamental plant. Therefore it is important to standardise its nutrient requirements for proper growth and quality of the cut stems (flower) which ultimately affect its vase life. Results obtained from present work will be helpful to understand its utilization as cut stem (flower).

MATERIAL and METHODS

The present investigations were carried out at the experimental farm of Department of Seed Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during 2014-2015. The Krane Red (F_1) seeds from Takki and Co Ltd were used in the experiment. There were 20 treatment combinations of nitrogen and potassium which were laid out in a randomized block design (factorial) with 5 levels of nitrogen viz N_1 (10 g N/m^2), N_2 (15 g N/m^2), N_3 (20 g N/m^2), N_4 (25 g N/m^2) and N_5 (30 g N/m^2) and 4 levels of potassium viz K_1 (5 g K/m^2), K_2 (10g K/m^2), K_3 (15 g K/m^2) and K_4 (20 g K/m^2) replicated thrice. Half dose of nitrogen and full of potassium was applied during field preparation whereas remaining half dose of nitrogen was applied after 30 days of transplanting. Sources of nitrogen and potassium were urea and muriate of potash respectively. Phosphorous was applied uniformly @ 20 g/m^2 in all treatment combinations. Regular intercultural operations such as weeding, hoeing, irrigation etc were carried out as per the the requirement. Different growth and quality parameters were recorded.

RESULTS and DISCUSSION

Data on various growth and quality parameters are given in Table 1.

Plant height: Among different nitrogen doses maximum plant height (59.44 cm) was recorded in the treatment N_5 (30 g/m^2) and minimum (39.14 cm) in N_1 (10 g/m^2). In case of potassium maximum plant height (51.30 cm) was observed in the treatment K_3 (15 g/m^2) and minimum (46.08 cm) in K_1 (5 g/m^2). The interaction effects of nitrogen and potassium were found to be non-significant. The higher concentration of nitrogen has the ability to increase the number of cells of leaves, cell size and overall leaf production including other vegetative growth of the plants (Meyer et al 1973, Sigedar et al 1991). The results in general are in agreement with the findings of Barman and Pal (1999) who observed significant increase in plant height in chrysanthemum cv Chandrama with the application of 30 g N/m^2 in comparison to the lower doses. The increase in vegetative parameters with higher doses of potassium might be due to the fact that potassium plays an essential role in the growth of the plants as it is an activator of enzyme responsible for energy metabolism, starch synthesis, nitrate reduction and sugar degradation. Furthermore it helps to regulate the opening and closing of stomata in the leaves and water uptake by the root cells (Brady 1996). Pal and Ghosh (2010) reported that plant height and other vegetative parameters of *Tagetes erecta* Linn cv Siracole increased with increasing levels of potassium fertilizer from 0 to 200 kg/ha.

Stem length: Among the different nitrogen doses maximum stem length (46.17 cm) was recorded with the application of N_5 (30 g/m^2) and minimum (28.02 cm) with N_1 (10 g/m^2). In case of potassium maximum stem length (38.50 cm) was observed with the application of K_3 (15 g/m^2) and minimum (34.76 cm) with K_1 (5 g/m^2). The interaction effect of nitrogen and potassium was found to be non-significant. These findings are supported by the work of Whipker et al (1998).

Stem diameter: Maximum stem diameter (22.07 mm) was recorded with the application of N_5 (30 g/m^2) and minimum (13.00 mm) with N_1 (10 g/m^2). Maximum stem diameter (18.42 mm) was recorded with the application of K_3 (15 g/m^2) which was at par with K_4 and minimum (16.01 mm) with K_1 (5 g/m^2). The interaction N x K was found to be non-significant. These findings are in line with the work of Meyer et al (1973 and Sigedar et al (1991).

Time taken for head formation of cut stems: Among different N doses the minimum time taken for head formation of cut stems (65.33 days) was recorded in treatment N_1 (10 g/m^2) while maximum (84.33 days) in N_5 (30 g/m^2). In case of potassium minimum (72.80 days) time taken for head formation of cut stems was recorded in K_1 (5 g/m^2) while maximum (77.80 days) and in K_4 (20 g/m^2). The interaction effect revealed minimum time for head formation (62.33 days) in N_1 x K_1 (10 g/m^2 + 5 g/m^2) and maximum (86.00 days) in N_5 x K_4 (30 g/m^2 + 15 g/m^2) These findings are in conformity with those of Mengel and Kirkby (1987) who concluded that an increase in nitrogen encouraged vegetative growth and development and kept plants in vegetative phase for longer period which delayed bud formation and opening of flowers.

Head size: Maximum head size (15.89 cm) was observed in N_5 (30 g/m^2) and minimum (12.02 cm) in N_1 (10 g/m^2). The potassium application showed maximum head size (14.26 cm) in K_3 (15 g/m^2) which was at par with K_4 and minimum (13.37 cm) in K_1 (5 g/m^2). The interaction effect was found to be non-

Table 1. Effect of nitrogen and potassium application on various growth and quality parameters of ornamental kale (*Brassica oleracea* var *acephala* DC)

Treatment	Plant height (cm)	Stem length (cm)	Stem diameter (mm)	Time taken for head formation (days)	Head size (cm)	Time taken for colour development (days)
Nitrogen dose (g/m²)						
N_1 (10)	39.14	28.02	13.00	65.33	12.02	78.33
N_2 (15)	42.95	30.26	15.04	70.75	12.91	85.75
N_3 (20)	48.13	36.41	17.38	78.17	13.68	87.83
N_4 (25)	53.01	43.43	19.87	79.00	14.73	92.00
N_5 (30)	59.44	46.17	22.07	84.33	15.89	95.58
$CD_{0.05}$	1.93	1.78	0.52	1.80	0.30	1.25
Potassium dose (g/m²)						
K_1 (5)	46.08	34.76	16.01	72.80	13.37	90.73
K_2 (10)	47.36	36.34	17.22	74.40	13.73	88.80
K_3 (15)	51.3	38.5	18.42	77.07	14.26	86.53
K_4 (20)	49.4	37.82	18.25	77.80	14.01	85.53
$CD_{0.05}$	1.72	1.60	0.46	1.61	0.27	1.12
Interaction						
$N_1 \times K_1$	36.4	26.93	11.62	62.33	11.72	81.67
$N_1 \times K_2$	38.67	27.77	12.96	64.33	11.92	79.67
$N_1 \times K_3$	41.53	28.33	13.69	67.67	12.28	76.67
$N_1 \times K_4$	39.97	29.03	13.72	67.00	12.15	75.33
$N_2 \times K_1$	39.67	28.07	13.43	68.00	12.24	88.00
$N_2 \times K_2$	41.07	29.2	14.73	69.33	12.93	86.67
$N_2 \times K_3$	47.03	32.83	16.02	73.33	13.36	85.00
$N_2 \times K_4$	44.03	30.93	15.99	72.33	13.09	83.33
$N_3 \times K_1$	46.1	33.53	16.07	74.67	13.25	94.00
$N_3 \times K_2$	45.57	35.13	16.91	78.33	13.42	87.67
$N_3 \times K_3$	52.33	38.93	18.28	78.33	14.25	85.00
$N_3 \times K_4$	48.53	38.03	18.28	81.33	13.79	84.67
$N_4 \times K_1$	51.5	40.53	18.23	74.67	15.53	93.00
$N_4 \times K_2$	52.57	43.63	19.68	76.00	15.93	93.67
$N_4 \times K_3$	54.1	45.37	21.15	83.00	16.22	91.00
$N_4 \times K_4$	53.87	44.17	20.44	82.33	15.87	90.33
$N_5 \times K_1$	56.73	44.73	20.71	84.33	15.53	97.00
$N_5 \times K_2$	58.93	45.97	21.81	84.00	15.93	96.33
$N_5 \times K_3$	61.5	47.03	22.95	83.00	15.87	95.00
$N_5 \times K_4$	60.6	46.93	22.8	86.00	16.90	94.00
$CD_{0.05}$	NS	NS	NS	3.52	NS	2.50

NS= Non-significant

significant. Maximum head size was observed with the application of higher doses of N and K. These findings are in agreement with the work done by Whipker et al (1998).

Time taken for colour development: Minimum time (78.33 days) taken for colour development was observed in N_1 (10 g/m²) and maximum (95.58 days) in N_5 (30 g/m²). On the other hand the potassium treatment K_4 (20 g/m²) recorded the minimum time (85.53 days) for colour development while K_1 (5 g/m²) recorded the maximum (90.73 days). The interaction effect of N x K was found to be significant with the minimum time (75.33 days) recorded in the treatment N_1 x K_4 (10 g/m² + 20 g/m²) and maximum (97.00 days) in N_5 x K_1 (30 g/m² + 5 g/m²). Early development of colour in lower doses of nitrogen may be due to the lesser vegetative growth which resulted in early maturity and thus in early colour development.

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