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Growth, Yield and Quality of Rose (*Rosa hybrida*) as Influenced by Fertilizer Doses under Polyhouse

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A B S T R A C T

An experiment was carried out during the period of 2022-23 in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out in Factorial Randomized Block Design with three levels of nutrients i.e. Nitrogen (N), Phosphorus (P), Potassium (K). Each of these has three levels N(N_1,N_2,N_3) where N_1(10 g N/m²), N_2(20 g N/m²) and N_3(30 g N/m²). Similarly, P has three levels where P_1(10 g P_2O_5/m²), P_2(20 g P_2O_5/m²) and P_3(30 g P_2O_5/m²). Again K has three levels where K_1(10 g K_2O/m²), K_2(20 g K_2O/m²) and K_3(30 g K_2O/m²) which replicated three times. The results revealed that, among the N levels, N_2 recorded highest plant height, number of leaves per plant, maximum leaf area in 60 DAP, 90 DAP and 120 DAP and highest bud length, stalk length, flower diameter, number of flowers per plant and vase life. Among the different phosphorus levels P_1 recorded highest plant height, number of leaves per plant, leaf area, plant spread in 60 DAP,90 DAP and 120 DAP and highest stalk length, flower diameter, number of flowers. Again among the different K levels, K_2 recorded highest plant height in 90 DAP and 120 DAP.K_2 recorded highest plant spread in 60 DAP and 90 DAP and K_3 recorded highest leaf area in 90 DAP and 120 DAP and highest plant spread in 120 DAP and again recorded maximum stalk length and number of flowers. Among the interaction treatments, $N_2P_1K_3$ showed best results in terms of most of the growth and flowering characters having B:C ratio of 3.98.

Introduction

Among the important cut flowers throughout the world, rose is one of the most important and demanding one. It is also regarded as the Queen of flowers and one of the most magnificent creations of nature. It can be used as a cut flower and as a loose flower as well. Rose has taken a prominent place among the different flower crops due to its different sizes, various attractive colours, longer stalks and intriguing fragrance. Cut flowers can be used as bouquet, for table and vase decoration purposes, whereas loose flowers are mainly used for making garlands and extraction of essential oil. Nutrient management is one of the most important components for proper growth of the plant and its yield. All the crops require a proper nutrition for their proper growth and development and for completing their life cycle. All plants require more or less the same nutrients to complete their life cycle, yet

the quantities and balances necessary for optimum growth and production of quality produce vary greatly among species (Anuradha *et al.,* 1988). As rose ranks first among all the cut flowers and due to its increasing demand all over the world, increasing its production and yield has become crucial to meet the needs of the domestic and international market. Till now, no research has been done to standardize the fertilizer requirement of the crop in Assam as well as North-Eastern Region. Therefore this research has been planned with an aim of finding the proper fertilizer doses of NPK for growth and flowering of rose.

Materials and Methods

The present investigation was conducted in naturally ventilated polyhouse in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the period of 2022-2023. The experimental site was located at 26°47′ N latitude, 94°12′E longitude and 86.8 m above the mean sea-level. This experiment used a Factorial Randomized Block Design with 27 treatment combinations and three replications containing three levels of nutrients i.e. N, P, K. Each of these has three levels N(N_1,N_2,N_3) where N_1(10 g N/m²), N_2(20 g N/m²) and N_3(30 g N/m²). Similarly, P has three levels where P_1(10 g P_2O_5/m²), P_2(20 g P_2O_5/m²) and P_3(30 g P_2O_5/m²). Again K has three levels where K_1(10 g K_2O/m²), K_2(20 g K_2O/m²) and K3(30 g K_2O/m²). Important growth parameters such as plant height (cm), number of leaves per plant, leaf area (cm²), plant spread (cm) and flower parameters such as bud length (cm), stalk length (cm), flower diameter, number of flowers per plant, self life and vase life were recorded from 5 sampled plants from each treatment.

Results and Discussion

Effect on growth characters

Effect of nitrogen

Growth parameters such as plant height, number of leaves per plant, leaf area and plant spread were significantly influenced by different levels of nitrogen. The highest plant height was observed in the N2(20 g N/m²) level which recorded (44.53 cm, 63.86 cm and 84.99 cm) in 60 DAP,90 DAP and 120 DAP respectively. Similarly N_2 recorded highest means for the number of leaves (69.53, 111.74 and 152.65) and leaf area (37.68cm², 43.67 cm² and 45.46 cm²) in 60 DAP, 90 DAP and 120 DAP respectively. However, maximum plant spread (24.82 cm) was recorded with the application of N3 (30 g N/m²) in 60 DAP and N2(20g N/m²) showed maximum plant spread (28.18 cm and 31.16 cm) in 90 DAP and 120 DAP. Again, Minimum plant height (42.31 cm, 82.83 cm) were recorded by N_1(10 g N/m²) in 60 DAP and 120 DAP. Similarly, minimum number of leaves (64.66, 104.98, 142.04), leaf area (35.19 cm², 40.36 cm², 43.14 cm²) were recorded in N_1(10g N/m²) level in 60 DAP, 90 DAP and 120 DAP. Again lowest plant spread (26.94 cm, 30.14 cm) were recorded by N_1(10 g N/m²).

This might be due to the fact that N_2 nitrogen level fulfils the requirement of the crop and higher dose of this nutrient might exerted some toxic effects to the plant. Again nitrogen has beneficial effect regarding the growth of the crop. Nitrogen is an important element which is required for protein and chlorophyll biosynthesis, which ultimately affects the photosynthetic rate and food reserve accumulation (Thanapornpoonpong *et al.,* 2008). Similar results were recorded by Chaudhary (2007) in tuberose, Sahu *et al.,* (2021) in chrysanthemum.

Effect of phosphorus

All the growth parameters were significantly altered by different levels of phosphorus. Highest plant height (43.65 cm, 64.42 cm and 85.58 cm) and number of leaves per plant (68.01, 110.09, 148.54) were recorded in P_1(10 g P_2O_5/m²) in 60 DAP,90 DAP and 120 DAP. Similarly maximum leaf area (42.45 cm², 44.82 cm²) were showed by P_1(10 g P_2O_5/m²) in 90 DAP and 120 DAP and maximum plant spread (23.76 cm) was recorded by P_1(10g P_2O_5/m²) in 60 DAP. Again minimum plant height of (82.67 cm) and number of leaves per plant (142.85) were recorded under the treatment P_2 (20 g P_2O_5/m²) in 120 DAP. Again, minimum leaf area (43.46 cm²) was showed by P_3(30 g P_2O_5/m²). This might be due to the reason that phosphorus requirement for this crop is usually minimum so this amount of the nutrient becomes sufficient for this crop. Higher dose of phosphorus results in phosphorus fixation in the soil. Similar results were reported by Sahu *et al.,* (2021) in chrysanthemum.

Effect of potassium

Growth parameters were highly influenced by higher levels of potassium as maximum plant height (84.29 cm) was recorded by K_2(20 g K_2O/m²) in 120 DAP. Again highest values for the leaf area (46.64 cm²) and plant

spread (31.25 cm) was showed by the treatment K_3(30 g K_2O/m^2) in 120 DAP. Minimum plant height (41.95 cm, 59.25 cm) were recorded under the treatment K_1(10g K_2O/m^2) in 60 DAP and 90 DAP. Similarly, lowest values for the leaf area (43.03 cm^2) and plant spread (29.78 cm) were showed by K_1(10 g K_2O/m^2) in 120 DAP,which might be due to the fact that potassium helps in cell division and cell differentiation. Potassium also increases the rate of carbon exchange in the plant system, thereby enhances the movement of photosynthates in the phloem tissue which led to an meristematic activity of the plant system, which might have resulted in maximum growth of the plant with higher potassium level. Results are similar with the research done by Chaudhary *et al.,* (2018) in rose.

Effect on flowering characters

Effect of nitrogen

Among the different doses of nitrogen, maximum bud length (3 cm), stalk length (30.34 cm), flower diameter (6.61 cm), number of flowers per plant per month (10.63) and vase life (9.43 days) were showed by N_2(20 g N/m^2). But highest self life (13.75) was recorded by N_3(30 g N/m^2). Again minimum results for the stalk length (27.92 cm), flower diameter (6.04 cm),number of flowers per plant per month (9.71), self life (11.30 days) and vase life (7.34 days) were recorded by N_1(10 g N/m^2). Highest results are showed with the higher doses of nitrogen which might be due to the fact that nitrogen indirectly helps in better flower initiation and flower. Again availability of this nutrient to plant has forced towards the growth of vegetative parts. Nitrogen does not influence the flower initiation directly but serve as substrates for the synthesis of key metabolites that act alone or work with that plant hormone to initiate the flowering process (Lovatt *et al.,* 1988). Similar results were shown by Sahu *et al.,* (2021) in chrysanthemum.

Effect of phosphorus

Flower characters were significantly influenced by different levels of phosphorus. Among the different levels, P_1(10 g P_2O_5/m^2) recorded highest stalk length (29.80 cm), flower diameter (6.49 cm) and number of flowers per plant per month (10.24). This might be due to the fact that higher levels of phosphorus may inhibit the uptake of other nutrients which further affects the growth and flower formation. Maximum bud length (2.92 cm) were showed by P_2(20 g P_2O_5/m^2) which is due to the reason that phosphorus fertilization generally improves the translocation and partitioning to floral section. Again the beneficial effect of phosphorus on improved flowering of the crop, helped in uptake of nitrogen and potassium. Phosphorus also helped in translocation and partitioning of floral section. Minimum stalk length (28.28 cm), flower diameter (6.22) were recorded by P_3(30 g P_2O_5/m^2) and minimum number of flowers per plant per month was showed by P_2(20 g P_2O_5/m^2). This result is in accordance with the result obtained by Sahu *et al.,* (2021); Verma *et al.,* (2017) in chrysanthemum, Samoon *et al.,* (2015) in calendula.

Effect of potassium

Potassium also showed significant results to different flower characters. As maximum bud length (2.97 cm), stalk length (29.44 cm) and number of flowers per plant per month (10.36) were recorded under the treatment K_3 (30 g K_2O/m^2). Again highest flower diameter (6.48 cm) and self life (13.01 days) were showed by K_2 (20 g K_2O/m^2). Potassium has direct impact on flower initiation whereas minimum bud length (2.82 cm), flower diameter (6.28 cm), self life (12.77 days) were recorded under the treatment K_1(10 g K_2O/m^2).

Potassium helps in production of more branches, more dry matter and partitioning of dry matter into floral organs (Sahu *et al.,* 2021). These results may be due to the fact that adequate supply of potassium ensured and enhanced the quality of the crop and also potassium helps in production of dry matter and their partitioning to different floral organs. Similar results were reported by Ayemi *et al.,* (2017) in gerbera, Saeed and Amin (2019) in rose.

Interaction

Among the different interaction treatments of NPK, the treatment $N_2P_1K_2$ recorded highest growth parameters such as plant height (49.84 cm, 71.59 cm, 93.12 cm) in 60 DAP, 90 DAP and 120 DAP and $N_2P_1K_3$ recorded highest stalk length (33.69 cm) and number of flowers per plant per month (14)

From the above findings, it can be revealed that among the different interaction, $N_2P_1K_3$ (T_{12}) i.e. NPK @20:10:30 g/m^2 is found to be best as it showed highest results for most of the growth and flower characters.

Table.1 Effect of different levels of nitrogen, phosphorus and potassium on growth parameters

Treatments	Plant height (cm)			Number of leaves per plant			Leaf area (cm²)			Plant spread(cm)		
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
N_1	42.31	59.71	82.83	64.66	104.98	142.04	35.19	40.36	43.14	23.22	26.94	30.14
N_2	44.53	63.86	84.99	69.53	111.74	152.65	37.68	43.67	45.46	22.52	28.18	31.16
N_3	42.76	59.30	84.76	67.83	106.78	143.54	36.78	41.28	44.20	24.82	27.69	30.88
S.Ed±	0.91	0.63	0.46	0.35	0.55	0.95	0.45	0.73	0.76	0.56	0.43	0.51
$CD_{0.05}$	1.83	1.26	0.92	0.71	1.12	1.91	0.91	1.47	1.54	1.12	0.87	NS
P_1	43.65	64.42	85.58	68.01	110.09	148.54	37.10	42.45	44.82	23.76	27.45	30.44
P_2	42.14	58.51	82.67	66.95	104.96	142.85	37.71	42.11	44.53	23.52	27.70	30.93
P_3	42.82	59.94	84.33	67.07	108.45	146.85	34.83	40.75	43.46	23.29	27.65	30.81
S.Ed±	0.91	0.63	0.46	0.35	0.55	0.95	0.45	0.73	0.76	0.56	0.43	0.51
$CD_{0.05}$	NS	1.26	0.92	0.71	1.12	1.91	0.91	NS	NS	NS	NS	NS
K_1	41.95	59.25	84.24	67.99	108.75	147.51	35.60	40.59	43.03	23.20	27.10	29.78
K_2	43.15	63.01	84.29	67.01	107.03	145.04	37.14	40.84	43.14	23.71	28.03	31.15
K_3	43.51	60.62	84.04	67.02	107.72	145.67	36.90	43.88	46.64	23.65	27.68	31.25
S.Ed±	0.91	0.63	0.46	0.35	0.55	0.95	0.45	0.73	0.76	0.56	0.43	0.51
$CD_{0.05}$	NS	1.26	0.92	0.71	1.12	1.91	0.91	1.47	1.54	NS	NS	1.03

Table.2 Effect of nitrogen, phosphorus and potassium on flowering characters

Treatments	Bud length(cm)	Stalk length (cm)	Flower diameter (cm)	Number of flowers per plant per month	Self life	Vase life
Nitrogen						
N_1	2.84	27.92	6.04	9.71	11.30	7.34
N_2	3.00	30.34	6.61	10.63	13.63	9.43
N_3	2.79	29.05	6.51	9.84	13.75	7.80
S.Ed±	0.06	0.49	0.07	0.91	0.19	0.17
$CD_{0.05}$	0.12	0.99	0.14	1.83	0.39	0.36
Phosphorus						
P_1	2.80	29.80	6.49	10.24	12.44	8.12
P_2	2.92	29.24	6.45	9.90	13.06	8.12
P_3	2.91	28.28	6.22	10.04	13.18	8.33
S.Ed±	0.06	0.49	0.07	0.91	0.19	0.17
$CD_{0.05}$	NS	0.99	0.14	NS	0.39	NS
Potassium						
K_1	2.82	29.09	6.28	9.96	12.77	8.33
K_2	2.83	28.79	6.48	9.86	13.01	7.99
K_3	2.97	29.44	6.40	10.36	12.89	8.24
S.Ed±	0.06	0.49	0.07	0.91	0.19	0.17
$CD_{0.05}$	0.12	NS	0.14	NS	NS	NS

Author Contribution

Priya Biswas: Investigation, formal analysis, writing—original draft. Sangita Mahanta: Validation, methodology, writing—reviewing. Kankana Deka:—Formal analysis, writing—review and editing. Sunita Dhar: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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