IJBPAS, November, 2017, 6(11): 2233-2244

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

RESPONSE OF *ROSA GRUSS-AN-TEPLITZ* TOWARDS VARIOUS LEVELS OF FERTILIZER APPLICATION

MUMTAZ S[1], KHAN NA[1], NADEEM S[1*], IKRAM S[2], AHMAD S[3] AND ALI Q[4]

[1]Horticulture Research Institute, National Agricultural Research Centre, Islamabad, Pakistan

[2]Horticulture Research Institute for Floriculture and Landscaping, Rawalpindi, Pakistan

[3]Institute of Agricultural Sciences, University of the Punjab, Lahore, 54590, Pakistan

[4]Institute of Molecular Biology and Biotechnology, University of Lahore, Lahore, Pakistan

[*]**Corresponding Author: E Mail: shahidnarc@gmail.com, saim1692@gmail.com**

Received 7th Jan. 2017; Revised 15th March 2017; Accepted 20th June 2017; Available online 1st Nov. 2017

ABSTRACT

The objectives of present research were to examine the influence of different fertilizer application (NPK) on vegetative and reproductive attributes of *Rosa Gruss-an-teplitz*. For this purpose, various treatments of nitrogen (Urea), phosphorus (SSP) and potassium (MOP) "alone and in combination" were applied on one year old plants. Significant difference was noticed among nitrogen applications (alone) for plant height, number of branches plant^{-1}, stem diameter and number of flowers plant^{-1}. Maximum plant height (46cm) and stem diameter (2mm) was observed at T3. More number of flowers plant^{-1} (9.75), flower weight (2.17gm) and flower diameter (4.7mm) was examined at T5. For phosphorus application, maximum number of branches plant^{-1} (3.5), number of flowers plant^{-1} (29), flower weight (4.3g) and flower diameter (5.1mm) was best achieved at T5. Considering the potassium treatments, highest plant height (46.6cm), flower weight (1.88g), flower diameter (4.58mm) and number of flowers plant^{-1} (18.7) was observed at T5. Results pertaining different combinations of NPK, highest plant height (58.3cm) and more number of flowers plant^{-1} (27.50) were produced at T3 while maximum flower diameter (3.87cm) and heaviest flowers (2.25g) were achieved at T_{11} and T_1 respectively.

Keywords: *Gruss-an-teplitz*, Nitrogen, Phosphorus, Potassium, NPK

INTRODUCTION

Roses are called king of flowers and are the most popular ornamental plants that are cultivated systematically [1, 2]. Among 200 rose species and 18000 cultivars, Surkha (Gruss-an-teplitz) is mainly grown as a loose flower for its use in making garlands, wedding ceremonies and other events of joy and grief. It has a remarkable range of flowers with long blooming period which makes it farmer's preference [3]. It likes hot climates and is grown more often in hot areas of Pakistan [4]. Application of fertilizers plays crucial role in quality rose production. Like other rose cultivars, Gruss-an-teplitz responds significantly to balance nutrition for better flower growth and yield.

Plants require adequate amount of macro and micro nutrients for their optimum growth and yield. Among macro nutrients N (Nitrogen) significantly affects vegetative growth and also promotes flower blooming period while K (Pottasium) has positive effect on flower yield but their proper combinations enhance both yield and size of flowers [5, 6]. Nitrogen application at low density also increases plant height, flower weight and yield [7] it also affects dry matter contents and other floral parameters [8]. The applications of NH_4NO_3 (Ammonium nitrate) @ 200 kg hectare^{-1} enhanced growth and physiological characteristics of Narcissus pseudonarcissus [9]. N fertilization produced the longest flower stems for cosmos and both sunflower cultivars [10]. Maximum yield of Gruss-an-teplitz was obtained with FYM (Farmyard manure) @ 5 kg m^{-1} and nitrogen 60 g m^{-1} [11]. The application of 10 g N/m^2 along with 12.5 g P_2O_5/m^2 produced maximum flower diameter in Gerbera [12]. Elevated P_2O_5 concentration in fertilizer solution increased the stem diameter of red pepper in plug culture and chrysanthemum in pot plant culture [13, 14]. Furthermore the elevated P_2O_5 (Phosphorus oxide) concentrations increased the stem hardness in oriental hybrid lily 'Casa Blanca' [15].

Application of 9g N, 8g P_2O_5, 8g K_2O/m^2/week was considered the best dose for achieving higher yield and better quality cut flower rose (Pusa Gaurav, Dr Bharat Ram, Arjun and Nehru Centenary) grown under polyhouse conditions [16]. Maximum number of rose flowers per plant, longest pedicle length, largest flower size and maximum petals per flower were recorded for treatment with (20-00-12) g of NPK (Nitrogen, phosphorus and potassium in combination) plant^{-1}. Maximum flower duration and flower vase life were also recorded in same treatment [17]. Uma and

Gowda [18] observed maximum shoot length as well as maximum fresh weight of 'Super Star' rose flowers with the application of 16g of nitrogen alone and 16g of each of nitrogen in combination with potassium respectively.

In Pakistan the application of NPK fertilizer is very wide, each area has its own requirement [19] therefore present research study was conducted to study the effect of NPK alone and in combinations on growth and flowering of *Gruss-an-teplitz*.

METHODS AND MATERIALS

To study the effect of varying levels of nitrogen, phosphorus and potassium (alone and in combination) on vegetative and reproductive attributes of rose cultivar "Gruss-an-teplitz" the present research was conducted in the field of Floriculture Program, National Agricultural Research Centre (NARC), Islamabad during 2014. The experiment was carried out one year old plants that were planted keeping plant to plant and row to row distance 15cm^2 and 30cm^2 respectively and pruned to 1 feet height. RCBD (Randomized Completely Block Design) design was laid out and plot size of 1×2 m^2 was prepared for each replication (containing 20 plants). Treatments (each containing four replications) of three different fertilizers viz., nitrogen (Urea*), phosphorus (Single Super Phosphate*) and potassium (Muriate of Potash*) were applied on plants in December to observe the effect of these fertilizers on vegetative and flowering attributes of rose plants (Table: 1). Nitrogen treatments were applied in two splits, first half before the onset of flowering and remaining half was applied 60 days after application of first dose. Cultural practices were performed on weekly basis.

Parameters under study:

Plant height (cm), number of branches, stem diameter (mm), number of flowers plant-1, flower diameter (mm) and flower weight (g) were studied under this research study with standard procedures (AOAC, 1990).

Table 1: Application of various levels of Nitrogen, Phosphorus and Potassium (alone and in combination) on *Gruss-an-teplitz*

Nitrogen		Phosphorus		Potassium	
Treatments	**g/plant**	**Treatments**	**g/plant**	**Treatments**	**g/plant**
T1 (control)	**0**	**T1 (control)**	**0**	**T1 (control)**	**0**
T2 (N)	**5g**	**T2 (P)**	**5g**	**T2 (K)**	**10**
T3 (N)	**10g**	**T3 (P)**	**10g**	**T3 (K)**	**20**
T4 (N)	**15g**	**T4 (P)**	**20g**	**T4 (K)**	**30**
T5 (N)	**20g**	**T5 (P)**	**30g**	**T5 (K)**	**40**
N:P:K					
Treatments	**g/plant**	**Treatments**	**g/plant**	**Treatments**	**g/plant**
T1(Control)	**0**	**T6**	**5:5:15**	**T11**	**10:10:20**
T2	**5:5:5**	**T7**	**10:10:10**	**T12**	**10:10:25**

T3	**5:10:5**	**T8**	**10:15:10**	**T13**	**15:10:10**
T4	**5:15:5**	**T9**	**10:20:10**	**T14**	**20:10:10**
T5	**5:5:10**	**T10**	**10:10:15**	**T15**	**25:10:10**

STATISTICAL ANALYSIS

Statistical analysis were conceded out by means of analysis of variance (ANOVA) method and differences among treatment means were analyzed with Least Significance Difference (LSD) Test at 5% *p* level [20].

RESULTS AND DISCUSSION

Effect of Nitrogen on Growth and Flowering of Gruss-an-Teplitz

Plant Height, stem diameter and number of branches plant^{-1}: There was significant difference among nitrogen applications for plant height, number of branches plant^{-1} and stem diameter as explicated in Table 2. Highest plant height (46cm) and stem diameter (2mm) was noticed at T_3 while lowest plant height (38.4cm) and stem diameter (0.97mm) was achieved at T_1 (control) and T_2 respectively. Number of branches plant^{-1} was significantly higher (2.3) at T_2 and least number of branches plant^{-1} (0.9) was noticed at T_5. Our outcomes show that nitrogen has deliberate effect on plant height, stem diameter and number of branches plant^{-1}. Although increased nitrogen level enhances the vegetative growth [4, 21] but optimum level of nitrogen may be required for best growth of *Rosa hybrida*, any deviation from optimum levels negatively effects growth. The same observations were reported by Ghaffar *et al*. [22].

Number of flowers plant^{-1}, Flower weight (g) and diameter (mm):

Data explicated in Table 2 elaborates significant differences among nitrogen treatments and their impact on number of flowers plant^{-1}, flower weight and diameter at $p < 0.01$. More number of flowers plant^{-1} (9.75), flower weight (2.17gm) and flower diameter (4.7mm) was achieved at T_5. Whereas, minimum number of flowers plant^{-1} (4.3), flower weight (1.21g) and flower diameter (4.12mm) were attributed under T_1 (control). It is clear from the results that nitrogen has positive impact on number of flowers plant^{-1}. With increase in nitrogen level from control to 20g plant^{-1}, number of flowers plant^{-1}, flower weight and flower diameter also rises. Our findings are in line with the work of Kilian *et al*. [23] and Avinash *et al.,* [24] who reported that nitrogen application significantly affects the flower yield and quality.

Effect of Phosphorus on Growth and Flowering of Gruss-an-Teplitz

Plant height (cm) and stem diameter (mm):

Statistical analysis showed considerable difference among all the treatments for plant height and stem diameter. Maximum plant height (50cm) and stem diameter (2.02mm) on average basis was observed at T_2 while minimum plant height (33.2cm) and stem diameter (0.4 mm) was attained at T_3. Further increase in P concentration does not have deliberate effect on plant height and stem diameter. Sedibea and Allemannb [25] in his trial confirmed these results.

Number of branches plant^{-1}, Number of flowers plant^{-1}, flower weight and flower diameter: For number of branches plant^{-1} results of ANOVA indicated that there is a significant difference among treatment at p<0.01. Maximum number of branches plant^{-1} was observed at T_5 with 3.5 branches plant^{-1} followed by T_4 with 3.0 branches plant^{-1}. Minimum number of branches plant^{-1} was observed at T_1 (control) with 2 branches plant^{-1}. Data regarding quantitative traits in the form of flower numbers plant^{-1} showed significant variation (p<0.001). Maximum number of flowers plant^{-1} was observed at T_5 with 29 number of flowers plant^{-1}, followed by T_4 with 24 number of flowers plant^{-1} were obtained. Minimum number of flowers plant^{-1} were obtained at T_1 (control) with 13.2 flowers plant^{-1}.

More flower weight (4.3g) was observed at T_5, followed by T_4 with 3.8g weight. Lower flower weight was achieved at T_1 (control) with 2.2g weight. Diameter of flower varied significantly among all the treatments. Highest mean flower diameter was exhibited at T_5 with 5.1mm followed by T_4 with 4.5mm. Lowest flower diameter was observed at T_1 (control) with 3mm. By increasing the concentration of P, the number of flowers plant^{-1}, number of branches plant^{-1}, flower weight and flower diameter increased significantly, this shows that P have significant effect on number of flowers plant^{-1}, number of branches plant^{-1}, flower weight and flower diameter. The same observation was recorded Mishra *et al*. [21].

Effect of Potassium on Growth and Flowering of Gruss-an-Teplitz

Plant height (cm), flower weight (g) and flower diameter (mm): Statistically all potassium treatments varied significantly for plant height, flower weight and diameter of Gruss-an-teplitz at p<0.01 (Table 2). The most superior interaction was noticed at T_5 in terms of plant height (46.6cm), flower weight (1.88g) and flower diameter (4.58mm). Whereas, lowest plant height

(38.7cm), 0.90g flower weight was obtained at T_1 (control) while minimum flower diameter was attained at T_3. Application of K significantly affects the plant height, flower weight and flower diameter. Waikar and Jadhav, [26] is in agreement that addition of K positively increased the vegetative as well as floral parameters.

Number of branches plant^{-1} and stem diameter: Non-significant interaction was noticed between treatments for number of branches plant^{-1} and stem diameter (Table 2). More number of branches plant^{-1} [27] was found at T_1 (control) and least number of branches plant^{-1}(1.25) were observed at T_5. Increasing level of K do not results in increase in number of branches and it is clear from the observations that K does not have strong relation with the number of branches/plant. For stem diameter maximum stem diameter (0.98mm) was observed at T4 while minimum (0.84mm) was found at T_1 (control).

Number of flowers plant^{-1}: Data exhibited in Table 2 substantiates significant interaction ($P<0.01$) between treatments and number of flowers/plant. 18.7 flowers plant^{-1} was observed at T_5 (K: 40g plant^{-1}), followed by T_4 with 17.5 flowers plant^{-1}. Least number [28] of flowers plant^{-1} was achieved at T_2. Haq *et al*. [29] and Gurav *et al*., [4] are in agreement that high dose of K is necessary for more number of flowers plant^{-1} in *rosa spp.*

Effect of N:P:K on Growth and Flowering of Gruss-an-Teplitz

Plant height (cm): The statistical data related plant height of rose as effected by the application of NPK presented in Table 2 reveals that there is no significant difference among all treatments and the results are at par with each other. Highest plant height (58.38cm) is produced by T_3 and the smallest (42.39cm) by T_{14} the rest of the treatments contributed to the plant height of 42cm, 45.17cm, 55.03cm, 54.81cm, 55.85cm, 49.08cm, 47.85cm, 52.05cm, 51.64cm, 55.10cm, 47.93cm, 44.38cm and 46cm respectively. Our findings are in contradiction with the work of De-wit [30] who reported that the maximum plant height (65cm) was recorded with combined application of (200 kg N and 400 kg K_2O/ ha) this may be due to inappropriate soil pH or EC because of which the nutrients were not available to the plants. Soil physical and chemical properties affect soil nutrients and their availability to plants [31, 32].

Stem diameter (cm): Statistically analyzed data of stem diameter as presented in Table 2 shows insignificant difference among the means of treatments, the thickest stem of

1.66cm is contributed by T_2 and thinnest stem of 0.85cm is produced by T_6. Other treatments contributed to the stem diameter with 0.94cm, 0.95cm, 0.89cm, 0.98cm, 0.88cm, 1.08cm, 0.92cm, 1.29cm, 1.03cm, 1.41cm, 1.30cm, 1.13cm and 0.91cm respectively. The previous findings as reported by Hagag *et al.* [33] state that increasing NPK rate decreased the stem diameter.

Number of branches plant^{-1}: Data pertaining to number of branches plant^{-1} prompted by NPK illustrate that application of NPK in different combinations have similar effect on number of branches plant^{-1}. Maximum number of branches plant^{-1} (2.5) were counted for T_5 and minimum of 1.5 for T_3 whereas rest of the treatments contributed to 1.75, 1.75, 2.00, 1.75, 1.75, 1.75, 2.00, 2.00,1.50, 1.50 and 1.75 respectively. Our outcomes are in contrary with the previous findings of Qasim *et al*. [34] who reported that fertigation of NPK combination @ 2 days interval on (*Rosa hybrida* L.) cultivars had a marked increasing effect on vegetative as well as reproductive parameters, the possible reason for this may be inappropriate combinations of fertilizer under study or abiotic factors interfering with plant growth.

Number of flowers plant^{-1}: Statistical analysis of number of flowers plant^{-1} proved that the application of NPK in different combinations has a significant increasing effect on number of flowers plant^{-1}. More number of flowers plant^{-1} (27.50) were counted for T_3 and minimum number of flowers plant^{-1} [28] were achieved at T_2. The research findings are in line with the work of Younis *et al*. [35] and Katwate *et al*., [29] who reported that combination of NPK have significant effect on flower diameter and length of flower bud whereas maximum number of flower per bush is reported by Sharma *et al*., [36].

Flower diameter (mm): Application of NPK presented in Table 2 shows a significant difference among means of different treatments (P<0.05) for flower diameter. Maximum flower diameter of 3.87cm is produced by T_{11} and the minimum of 2.5cm is contributed by T_7. Other treatments contributed to flower diameter of 3.12cm, 3.14cm, 3.33cm, 3.53cm, 3.66cm, 2.70cm, 3.10cm, 3.32cm, 3.35cm, 3.60cm, 3.42cm, 3.74cm and 3.75cm respectively. Our results are in line with the previous findings [35] who reported that foliar application of micronutrients along with NPK significantly increases the plant growth characteristics like plant height, number of flowers plant^{-1}, bud diameter, flower

diameter, flower quality, flower stalk length, fresh and dry weight of flower of roses.

Flower weight (g): Effect of NPK application on flower weight reveals a significant change in flower weight when NPK applied in different combinations. Heaviest flowers (2.25g) were produced by T_1 (control) and lightest (0.71g) by T_9. Fresh and dry weights of plant are parameters indicating plant biomass and previous study [37] revealed that increase in biomass were found to initial fresh weight for root and shoot of *Amaranthus palmeri* when NPK was applied.

Table 2: Effect of Nitrogen, Phosphorus and Potassium (alone and in combination) on growth and flowering of *Gruss-an-teplitz*

Treatment	PH (cm)	NB	SD (mm)	NF	FW (g)	FD (mm)
Nitrogen						
T1	38.4±1.27^{c}	1.65±0.34^{b}	1.09±0.22^{b}	4.3±0.47^{e}	1.21±0.4^{c}	4.12±0.3^{a}
T2	42.2±3.11^{abc}	2.3±0.34^{a}	0.97±0.15^{b}	4.85±0.25^{d}	1.88±0.6^{ab}	4.61±0.58^{a}
T3	46±4.66^{a}	1.17±0.17^{bc}	2.0±0.08^{a}	5.9±0.47^{c}	1.34±0.25^{c}	4.3±0.18^{a}
T4	44.1±2.29^{ab}	1.0±0.33^{c}	1.06±0.2^{b}	6.92±0.58^{b}	1.5±0.16^{bc}	4.49±0.34^{a}
T5	40.75±3.42^{bc}	0.9±0.39^{c}	1.10±0.15^{b}	9.75±0.77^{a}	2.17±0.45^{a}	4.7±0.46^{a}
Phosphorus						
T1	42±1.1^{c}	2±0.08^{c}	1.1±0.14^{c}	13.2±1.8^{d}	2.2±0.25^{d}	3±0.25^{c}
T2	50±1.56 ^{a}	2.2±0.21^{c}	2.02±0.16^{a}	15.6±0.98^{cd}	2.7±0.61^{cd}	3.4±0.22^{c}
T3	33.2±3.01^{e}	2.6±0.31^{bc}	0.4±0.15^{d}	18±1.4^{c}	3.3±0.18^{bc}	4.1±0.2^{b}
T4	45.55±2.26^{b}	3±0.45^{ab}	1.5±0.36^{b}	24±4.7^{b}	3.8±0.62^{ab}	4.5±0.38^{b}
T5	37±1.73^{d}	3.5±0.64^{a}	0.7±0.21^{d}	29±1.7^{a}	4.3±0.63^{a}	5.1±0.33^{a}
Potassium						
T1	38.7±0.32^{e}	2±0.5^{a}	0.84±0.08^{a}	17.25±0.5^{b}	0.90±0.05^{c}	3.67±0.99^{c}
T2	44.5±0.47^{b}	1.75±0.5^{a}	0.86±0.06^{a}	15±0.81^{c}	0.91±0.09^{c}	3.77±0.06^{c}
T3	41±1.31^{d}	1.75±0.57^{a}	0.85±0.23^{a}	16±0.81^{c}	1.22±0.19^{b}	3.35±0.06^{d}
T4	42.5±0.9^{c}	1.5±0.5^{a}	0.98±0.22^{a}	17.5±0.57^{b}	0.97±0.07^{c}	4.16±0.04^{b}
T5	46.6±0.66^{a}	1.25±0.95^{a}	0.95±0.17^{a}	18.7±0.5^{a}	1.88±0.09^{a}	4.58±0.09^{a}
N:P:K						
T1	42.64 +2.16^{a}	1.75+1^{a}	0.94+0.02^{a}	15.25+1^{fg}	2.25+0.05^{a}	3.12+0.26^{abc}
T2	45.17+4.25^{a}	1.75+0.5^{a}	0.95+0.05^{a}	15+0.8^{g}	0.95+0.09^{ef}	3.14+0.34^{abc}
T3	58.38+2.66^{a}	1.5+0.57^{a}	0.89+0.04^{a}	27.5+0.57^{a}	1.29+0.16^{cd}	3.33+0.18^{abc}
T4	55.03+10.91^{a}	2+0.0^{a}	0.98+0.17^{a}	19.75+0.95^{cd}	1.30+0.11^{cd}	3.53+0.37^{ab}
T5	54.81+13.11^{a}	2.5+0.57^{a}	0.88+0.1^{a}	22+0.81^{bc}	1.59+0.02^{b}	3.66+0.53^{ab}
T6	55.85+3.51^{a}	1.75+0.5^{a}	0.85+0.03^{a}	22+0.81^{bc}	0.97+0.12^{ef}	2.7+0.14^{bc}
T7	49.08+6.51^{a}	2.00+0.0^{a}	1.08+0.25^{a}	19+0.81^{d}	1.37+0.15^{bc}	2.5+1.0^{c}
T8	47.85+2.96^{a}	1.75+0.5^{a}	0.92+0.12^{a}	18.75+0.95^{d}	1.05+0.12^{de}	3.1+0.14^{abc}
T9	52.05+6.90^{a}	1.75+0.5^{a}	1.29+0.04^{a}	24.25+0.95 ^{b}	0.71+0.08^{f}	3.32+0.09^{abc}
T10	51.64+5.87^{a}	1.75+0.5^{a}	1.03+0.07^{a}	17.50+0.57^{def}	1.05+0.12^{de}	3.35+0.05^{abc}
T11	55.1+11.2^{a}	2+0.0^{a}	1.41+0.50^{a}	27.25+0.95^{a}	1.53+0.04^{bc}	3.87+0.79^{a}
T12	47.93+4.75^{a}	2+0.81^{a}	1.66+1.02^{a}	21.75+1.25^{c}	1.35+0.05^{bc}	3.60+0.47^{ab}
T13	44.38+1.29^{a}	1.50+1.29^{a}	1.30+1.29^{a}	18.00+1.29^{de}	1.29+1.29^{cd}	3.42+1.29^{abc}
T14	42.39+1.29^{a}	1.50+1.29^{a}	1.13+1.29^{a}	15.75+1.29^{efg}	1.08+1.29^{de}	3.74+1.29^{a}
T15	46+4.63^{a}	1.75+0.95^{a}	0.91+0.19^{a}	16.00+0.81^{efg}	1.31+0.07^{cd}	3.75+0.2^{a}

Means±S.D of four replicates of 20 plants, Means showing same letter do not differ significantly

PH: Plant height; SD: Stem diameter; NB: Number of branches plant^{-1}; NF: Number of flowers plant^{-1}; FW: Flower weight; FD: Flower Diameter

CONCLUSION

Nitrogen and phosphorus alone had significant effect on both vegetative and reproductive characteristics, while potassium considerably affected plant height, flower weight, diameter and number

of Flowers. Whereas, the NPK in combination caused more efficient affects for better flower weight and diameter.

REFERENCES

[1] Peter, B. T. 1990. Botanical Rose. Grange Books, London, England.

[2] Wylie, A.P. 1955. The history of garden roses. J. Royal Hort. Soc. 80(2):77-87.

[3] Nadeem, M., M.A. Khan, A. Riaz and R. Ahmad. 2011. Evaluation of growth and flowering potential of Rosa Hybrida cultivars under Faisalabad climatic conditions. Pak. J. Agri. Sci. 48(4):283-288.

[4] Gurav, S.B., S.M. Katwate, S.D. Patil, B.R. Singh, R.L. Misra and S. Misra. 2002. Fertigation of roses under natural ventilated polyhouse condition. Ind. Soci. Orn. Hort. 25(27):222-223.

[5] Kumar, R. and A.S.P. Gill. 1983. Effect of nitrogen application on the flower yield of young plants of Jasminum sambac. South. Ind. Hart. 31(1):20-21.

[6] Natarajan, S., K.M.P. Nambisan, B.M. Krishnan and K.C. Shanmugarelu. 1981. Effect of application of N, P and K on flower yield of Jasminum sambac. Ind. perfumer. 25(3/4):89-92.

[7] Yadav, P.K., S. Singh, A.S. Dhindwal and M.K. Yadav. 2000. Effect of Nand FYM application on floral characters and yield of African marigold (Tagetes erecta L.). Haryan. J. Hart. Sci. 29(1-2):69-71.

[8] Halepyati, A.S., K. Sujata and M. Prabhakar. 2001. Effect of irrigation and nitrogen levels on the growth, yield and water use of marigold. J. Orn. Hort. New series. 4(1):30-32.

[9] Haadi-e-vincheh, M., D. Naderi and A. Golparvar. 2013. Growth and physiological characteristics of Narcissus pseudonarcissus at different nitrogen levels. Int. J. Farming. Allied. Sci. 2:1325-1329.

[10] Ahmad, W., W. Ahmad, M.A. Shehzad and M. Shahid. 2012. Nitrogen and phosphorus: impact on forage oat (Avena sativa L.) growth, yield and its quality attributes. Pak. J. Agri. Sci. 49:473-479.

[11] Singh, A.K. 2006. Effect of farmyard manure, Azotobacter and nitrogen on leaf nutrient composition, growth, flowering and

yield in rose. Ind. J. Hort. 63(1):62-65.

[12] Pimple, A.G., S.R. Dalal, D.R. Nandre, S.M. Ghawade and S. Utgikar. 2006. Yield and quality of Gerbra influenced by nitrogen and phosphorus levels under polyhouse conditions. Int. J. Agric. Sci. 2(2):320-321.

[13] Choi, J.M., C.Y. Shim and J.S. Choi. 2002. Effect of phosphorus fertilization on changes of nutrients in rice hull based root media, crop growth, and nutrient contents of chrysanthemun. J. Kor. Soc. Hort. Sci. 43:235-238.

[14] Shim, Y.A., K.Y. Kim, J.W. Lee, J.H. Chung and H.Y. Park. 2000. Growth regulation of red pepper seedling by controlling phosphorus concentration in plug system. J. Kor. Soc. Hort. Sci. 41:46-48.

[15] Lee, K.H and J.M. Choi. 2005. Effect of phosphorus concentrations in fertilizer solution on growth of and nutrient uptake by oriental hybrid lily 'Casa Blanca'. Acta. Hort. 673(2):761-767.

[16] Singh, M.K. and K. Sanjay. 2010. Effect of NPK Growth and Flowering of Cut Flower Rose (Rosa hybrida) under Polyhouse Conditions. Envir. Ecol. 28(3):1498-1501.

[17] Ghafoor, A.M. Shaheen, M. Iqbal, K. Waseem and M.A. Nadeem. 2000. Impact of various combinations of NPK fertilizers on growth, yield and quality parameters of Rose. Pak. J. Biol. Sci. 3(10):1560-1562.

[18] Uma, S. and J.V.N. Gowda. 1987. Studies on the effect of pruning, nutrients and their interaction on growth and flowering of rose cv. August 4, 2000 super Star. Mysor J. Agric. Sci. 21:455-460.

[19] Ahmad, N. and A. Jalil, 1992. Balanced fertilization through phosphate promotion at farm level. NDFC Publication. No. 5192. Research Report National Fertilizer Development, Islamabad.

[20] Steel, R.G.D., J.H. Torrie and M.A. Boston. 1997. Principles and procedures of statistics. 2nd Ed. McGrew-Hill Book Co. Inc. USA., 633 pp.

[21] Mishra, H.N., S.K. Palai, M.Mishra, R.L. Misra and S. Misra. 2002. Nutritional requirement of

rose. Ind. Soc. Orn. Hort. 27(25):230-231.

[22] Ghaffar, A., M. Shaheen, M. Iqbal, K. Waseem and M.A. Nadeem. 2012. Yield and Quality parameter of Rose. Pak. J. Biol. Sci. 3(10):1560-1562.

[23] **[23].** Kilian, M., U. Steiner, B. Bonn, B.J. Aegerter and B.E.J. Wheeler. 2003. Epidemiology and control of Rose. J. nat. Cancer Inst. 5(3):473-485.

[24] Avinash, C.R. and J.N. Singh. 2013. Effect of graded levels of nitrogen on production of flower, oil and bulb of tuberose (Polyanthes tuberosa). Hort. Res. Spec. 2(1):60-63.

[25] Sedibea, M.M. and J. Allemannb. 2012. Yield and quality response of rose geranium (Pelargonium graveolens L.) to sulphur and phosphorus application. South. Afr. J. Pl. Soil. 29(3-4):151-156.

[26] Waikar, A.U. and S.B. Jadhav. 2012. Response of different potassium fertilizer levels through fertigation on rose (Rosa indica) cv. Passion under protected cultivation. Int. J. Agric. Engin. 5(1):12-15.

[27] Ahmad, W., W. Ahmad, M.A. Shehzad and M. Shahid. 2012. Nitrogen and phosphorus: impact on forage oat (Avena sativa L.) growth, yield and its quality attributes. Pak. J. Agri. Sci. 49:473-479.

[28] Haq, M.A. Pervez, F.M. Tahir and M. Ahmad. 1999. Effect of nitrogen, phosphorus and potassium on vegetative and reproductive growth of rose (Rosa centifolia). Int. J. Agri. Biol. 1(2):027-029.

[29] Katwate, S.M., S.D. Patil, B.R. Singh, R.L. Misra and S. Misra. 2002. Fertigation of roses under natural ventilated polyhouse condition. Ind. Soc. Orn. Hort. 25(27):222-223.

[30] De-Wit, J.C., H.F. Esendam, J.J. Honkanen and U. Tuominen. 1990. Somatic embroyogenesis and regeneration of flowering plant in rose. Pl. cell. 9(6):456-458.

[31] Andres-de-Prado, R., M. Yste-Rojas, X. Sort, C. Andres-Lacueva, M. Torres and R.M. Lamuela-Raventos. 2007. Effect of soil type on wines produced from vitis vinifera L. Cv. Grenache in

commercial vine-yards. J. Agric. Food. Chem. 55:779-786

[32] Tomasi, D., P. Belvini, G. Pascarella, P. Sivilotti, and C. Giulivo. 2006. Leffetto del suolo sulla resa e sulla qualita dei vitigni Cabernet Sauvignon, Cabernet franc e Merlot VigniVini 33:59-65.

[33] Hagag, L.F., M.F.M. Shahin and M.M.M. El-Migeed. 2011. Effect of NPK and humic substance applications on vegetative growth of Egazy olives. Amer-Eurasian. J. Agric. Environ. Sci. 11(6):807-811.

[34] Qasim, M., I. Khan and M.A. Ziaf. 2005. Efficacy of varying nitrogen levels on growth,flower yield and leaf N contents of Rosa chinensis cv. Gruss-an-teplitz. Pak. J. Agric. Sci. 42(3/4):16-20.

[35] Younis, A., A. Riaz, M. Sajid, N. Mushtaq, M. Ahsan, M. Hameed, U. Tariq and M. Nadeem. 2013. Foliar application of macro- and micronutrients on the yield and quality of Rosa hybrida cvs. Cardinal and Whisky Mac. Afr. J. Biol. 12(7):702-708.

[36] Sharma, R., R. Singh, S. Bhardwaj and A. Singh. 2013. Agri-Bio-Publishers, Hisar. Ind. Annals. Biol. 29(2):217-220.

[37] Mohil, P. and U. Jain. 2014. Application of NPK and farmyard manure on biomass production of Amaranthus palmeri Wats. Asian. Pl. Sci. Res. 4(2):7-12.