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Effect of different Levels of Nitrogen and Phosphorus on Growth and Development of Pomegranate (*Punica granatum* L.) Cv. Kandhari in Allahabad AgroClimatic condition

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ABSTRACT: A field experiment was carried out at Horticulture Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (U.P.) during November 2015 to April 2016, to study the effect of different Levels of Nitrogen and Phosphorus on Growth and Development of Pomegranate (*Punica granatum* L.) Cv. Kandhari in Allahabad Agro Climatic Condition. The experiment was laid out in randomized block design (RBD) with three replications and 10 treatments. Nitrogen was applied at 0-250g/plant as well as Phosphorus was applied at 0-125g/plant with common dose of Potassium 125g/plant. Control plants were fed no fertilizers. The results indicated 100% recommended dose of fertilizers resulted in maximum plant height (120.40 cm), maximum number of branches (10.17), maximum number of leaves (4360.42), maximum spread of canopy (125.74 cm^2), maximum internode length (8.60 cm), maximum Stem diameter (2.39 cm) and maximum leaf area (7.33 cm^2) and maximum number of flowers (16.21) while Control plants recorded least growth. Therefore 100% recommended dose of fertilizers can be recommended for getting increased plant growth for two years old pomegranate plants cv. Kandhari.

Keywords: Pomegranate, Nitrogen, Phosphorus, Growth, Soil nutrients.

INTRODUCTION

The pomegranate is an important and favourite table fruit. It is commercially grown for its sweet acidic fruits. It is very much liked for its cool refreshing juice and its medicinal properties. It is a fruit-bearing deciduous shrub or small tree growing between 5 and 8 m (16 and 26 ft) tall.

Pomegranate (*Punica granatum* L.) belongs to the family *punicaceae*, subclass *Rosidae* and order Myrtales, is the only known genus of the family. It is a genus of large shrubs or small trees with 2 species. One is *Punica protopunica* which is wild type found in Socotra island of the Arabian Peninsula, and is considered as an ancestral species (Shilikina, 1973) and the other is *Punica granatum* cultivated in tropical and subtropical parts of the world. It has 2n=2x=16 and 18 chromosomes (Smith, 1979). The number of chromosomes in Dholka, Ganesh, Kkandhari, Muscat white and Patiala varieties was found to be 2n=16, while the varieties double flowered had 2n=18 (Nath and Randhawa 1959). The chromosome number in Vellodu and Kashmiri varieties was found to be 2n=18 with 1 or 2 quadrivalent associations at meiosis (Raman *et al*., 1963). Floral biology of pomegranate has revealed that both self and cross pollination take place. The pollen from male flowers gives higher fruit set than those from the hermaphrodite ones (Game, 1987).

In India, pomegranate is commercially cultivated in Maharashtra, Karnataka. At present, Maharashtra with an area of128.65 ha is the leading state with the production of 1197.71 million tonnes pomegranate annually. Other major pomegranate growing states are Karnataka, Gujarat and Andhra Pradesh. In recent years, pomegranate cultivation has also been started in Rajasthan, Orissa, Chhattisgarh, Uttarakhand and Madhya Pradesh at small scale.

India is one of the largest producers of pomegranate in the world. During 2014-15, pomegranate was cultivated over 143.14 thousand ha land with an annual production of 2915 thousand tonnes in India (NHB Database 2019). Pomegranate is currently ranked 10th in terms of fruit consumed annually in the world. Its productivity is greatly increased by the application of manures and fertilizers. Both macro and micro nutrients affect its growth, development and productivity. In general application of 600-700g N, 200-250g P_2O_5, and 200-250g K_2O/tree/year is optimum. Application of 50 kg FYM and 3.5 kg oil cake or 1 kg sulphate of ammonia prior to flowering is ideal for healthy growth and fruiting. Nitrogen and Phospjorus play vital role in growth and development of plant. Nitrogen is primarily responsible for vegetative growth. It is a major component of chlorophyll which helps in photosynthesis and synthesis of amino acids, building blocks of proteins. Phosphorus helps in root

development, crop maturity and seed production. The role of potassium is indirect in plants means that is does not make up any plant part but it is important for a plant's ability to withstand extreme cold and hot temperatures, drought and pests. Nano fertilizer nitrogen produced consistent resulted in highest canopy volume, leaf area, chlorophyll and nutrient content, yield, and fruit quality (El-shereif *et al*., 2023).

Considering the above factors, the present experiment was undertaken to determine the optimum level of NPK fertilizer treatment for better growth and development.

MATERIALS AND METHODS

The experiment was carried out using 2-years-old pomegranate plants with different levels of nitrogen and phosphorus on Growth and development under Allahabad agro climatic conditions at the experimental field of the department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Deemed -to-be University, during the year 2015-2016.

The experimental design was a randomized block design with 10 treatments and three replications. Recommended fertilizer schedule was adopted with the dosage of (250:125:125 g / plant). Fertilization schedule adopted for the plants: $T_0(N_0\ P_0\ K_0)$, $T_1(N_{312.5}\ P_{156.25}K_{125})$, $T_2(N_{250}\ P_{125}K_{125})$, $T_3(N_{187.5}\ P_{125}\ K_{125})$, $T_4(N_{312.5}\ P_{93.75}\ K_{125})$, $T_5(N_{187.5}\ P_{156.25}\ K_{125})$, $T_6(N_{187.5}\ P_{93.75}\ K_{125})$, $T_7(N_{312.5}\ P_{125}\ K_{125})$, $T_8(N_{250}\ P_{156.25}\ K_{125})$, $T_9(N_{250}\ P_{93.75}\ K_{125})$. The first dose of fertilizers were applied immediately after weeding (4th October, 2015). Intercultural operations like weeding, irrigation, disease and insect management were done as per required. Data on growth characters were taken duly. Data were statistically analyzed using computer MSTATC program.

RESULT AND DISCUSSION

The present investigation "Effect of Different Levels of Nitrogen and Phosphorus on Growth and Development of Pomegranate (*Punica granatum* L.) Cv. Kandhari in Allahabad Agro Climatic Condition". The results of the investigation, regarding the pomegranate on growth and development have been presented below.

The maximum plant height was recorded (Table 1) in T_2: 250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (120.40 cm) followed by T_9: 250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (114.79 cm). However minimum plant height was recorded in T_0: control (91.39 cm). The maximum tree height (120.40 cm) in T_2 might be due to the increased nutrient availability due to the application of 100% RDF and the minimum tree height (91.39 cm) in control treatment (T_0) might be due to without application of nutrients and ultimately the supply of insufficient quantity of nutrients needed for the growth of the plant as also reported by Thakur (2010); Sheikh and Rao (2005); Dhillon *et al*. (2011); Gill *et al*. (2013).

The maximum number of branches was recorded (Table 1) in T_2 :250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (10.17) followed by T_9: 250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (9.50). However minimum number of branches was recorded in T_0: control (6.00). This increase might be due to the availability of nutrient elements at optimum proportion in the soil and assimilation of food material within the plant reported by Mohamed *et al*. (2014); Dheware *et al*. (2010).

The maximum number of leaves was recorded (Table 1) in T_2:250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (4360.42) followed by T_9: 250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (4259.24). However minimum number of leaves was recorded in T_0: control (2938.38). The maximum number of leaves could be attributed to the easy availability of required quantity of nutrients and improved soil conditions due to the addition of NPK, while the lower values of these traits in control treatment (T_0) could be attributed to non- availability of required quantum of nutrients. Similar findings were reported by Thakur (2010).

Table 1: Effect of Different Levels of Nitrogen and Phosphorus on Growth and Development of Pomegranate (*Punica granatum* L.)

Treatments	Plant Height (cm)					No. of branches					No. of Leaves				
	30 days	60 days	90 days	120 days	150 days	30 days	60 days	90 days	120 days	150 days	30 days	60 days	90 days	120 days	150 days
T_0	77.30	81.04	86.43	89.31	91.39	5.33	5.33	5.67	5.83	6.00	2414.35	2565.38	2701.47	2831.72	2938.38
T_1	79.29	83.50	88.68	92.32	94.72	5.50	5.67	5.83	6.00	6.33	2575.57	2723.09	2881.63	3021.15	3134.49
T_2	96.45	102.15	111.03	116.19	120.40	8.50	9.00	9.50	9.67	10.17	3474.02	3686.08	3962.27	4196.31	4360.42
T_3	88.08	93.19	100.14	104.92	107.63	7.00	7.33	7.67	7.83	8.17	3038.21	3238.18	3466.42	3675.96	3812.23
T_4	83.07	87.42	93.31	96.44	99.11	6.17	6.67	6.83	7.17	7.33	2683.44	2852.16	3034.3	3185.54	3303.04
T_5	85.15	90.17	97.81	101.67	104.78	6.83	7.17	7.33	7.50	7.83	2928.05	3123.15	3341.04	3527.38	3659.34
T_6	84.89	89.59	96.45	100.06	103.68	6.33	7.00	7.17	7.33	7.50	2811.47	2984.43	3176.53	3340.41	3465.67
T_7	81.12	85.86	92.13	95.41	97.56	6.00	6.17	6.50	6.83	7.00	2629.73	2792.67	2967.34	3114.54	3226.58
T_8	90.26	95.39	103.98	107.98	111.51	7.33	7.67	7.83	8.00	8.50	3110.06	3305.89	3555.62	3777.8	3924.92
T_9	92.89	98.04	106.08	110.81	114.79	8.17	8.50	9.00	9.33	9.50	3370	3595.92	3867.35	4094.97	4259.24
F- test	NS	NS	S	S	S	NS	NS	S	S	S	S	S	S	S	S
S. Ed. (±)	5.518	5.978	6.569	6.333	6.216	0.966	1.060	0.889	0.911	0.897	282.145	271.4359	276.7215	277.1511	276.2638
C. D. at 5%	11.594	12.560	13.801	13.305	13.059	2.029	2.226	1.868	1.914	1.884	592.7647	570.2657	581.3703	582.2728	580.4087

The maximum spread of canopy was recorded (Table 2) in T_2:250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (125.74 cm^2) followed by T_9: 250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (124.56 cm^2). However minimum spread of canopy was recorded in T_0: control (97.81 cm^2). The maximum spread of canopy may be due to the increase in shoot length and number of leaves which might have

occurred due to higher nutrient availability supporting higher accumulation of photosynthesis in the plant body. While, the minimum values of tree spread in control treatment may be due to poor availability of nutrients. These findings are in accordance with the findings of Dhillon *et al*. (2011); Rao and Sheikh (2005); Gill *et al*. (2013) in pomegranate.

The maximum length of internodes was recorded (Table 2) in T_2: 250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (8.60 cm) followed by T_9: 250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (8.07 cm). However minimum length of internodes was recorded in T_0: control (4.61 cm). The maximum internode length in the application of NPK fertilizers is a result of the interaction to them which helped in increasing the soil nutrient availability and their uptake by the plants that resulted in better vegetative growth.

The maximum stem diameter was recorded (Table 2) in T_2: 250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (2.39 cm) followed by T_9: 250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (2.20 cm). However minimum stem diameter was recorded in T_0: control (1.32 cm). The maximum stem diameter may be due to the increase in shoot length and number of leaves which might have resulted to production of more quantum of carbohydrates and subsequently their translocations towards the stem. These findings can be very well supported with the findings of Rao and Sheikh (2005); Dhillon *et al*., (2011); Mohamed *et al*. (2014); Thakur (2010); Abd-Alhamid *et al*. (2015).

Table 2: Effect of Different Levels of Nitrogen and Phosphorus on Growth and Development of Pomegranate (*Punica granatum* L.)

Treatments	Spread of Canopy (cm^2)					Internode Length (cm)					Stem Diameter (cm)				
	30 days	60 days	90 days	120 days	150 days	30 days	60 days	90 days	120 days	150 days	30 days	60 days	90 days	120 days	150 days
T_0	86.48	90.42	93.57	95.75	97.81	4.28	4.38	4.49	4.57	4.61	0.76	0.90	1.14	1.26	1.32
T_1	87.21	91.50	95.42	97.93	100.36	4.62	4.79	4.91	4.99	5.12	0.88	1.09	1.33	1.48	1.61
T_2	106.59	112.50	119.02	122.89	125.74	7.95	8.16	8.38	8.51	8.60	1.23	1.47	1.77	2.06	2.39
T_3	98.07	103.30	109.53	113.25	115.87	6.99	7.17	7.31	7.40	7.49	1.11	1.33	1.62	1.82	2.04
T_4	90.28	95.97	101.30	103.92	106.37	5.30	5.58	5.73	5.82	5.93	0.96	1.15	1.42	1.57	1.78
T_5	97.21	102.18	107.94	110.94	113.53	7.27	7.59	7.77	7.85	7.93	1.02	1.23	1.53	1.73	1.95
T_6	95.28	101.86	107.11	109.28	111.36	6.43	6.68	6.83	6.92	7.04	0.97	1.18	1.48	1.68	1.89
T_7	89.24	94.34	98.61	101.81	103.76	5.28	5.52	5.73	5.83	5.94	0.93	1.11	1.39	1.55	1.75
T_8	100.26	106.58	112.56	115.43	118.42	7.36	7.61	7.80	7.94	8.05	1.14	1.37	1.66	1.87	2.11
T_9	103.65	110.49	117.49	121.34	124.56	7.45	7.67	7.86	7.97	8.07	1.17	1.41	1.67	1.89	2.20
F- test	NS	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S. Ed. (±)	6.323	5.806	5.475	5.650	5.582	0.360	0.380	0.372	0.384	0.378	0.080	0.091	0.115	0.120	0.126
C. D. at 5%	13.285	12.198	11.502	11.871	11.728	0.756	0.798	0.781	0.806	0.795	0.168	0.190	0.241	0.253	0.266

The maximum leaf area was recorded (Table 3) in T_2:250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (7.33 cm) followed by T_9:250 g/ plant Nitrogen, 93.75 g/plant Phosphorus and 125 g/plant Potash (7.17 cm). However minimum leaf area was recorded in T_0: control (6.11 cm). It has been well documented that the beneficial effect of inorganic fertilizers help in improving the soil health in terms of nutrient availability as well as by improving the soil physical and biological conditions thereby, increasing the nutrient availability for the growth and developmental processes of the plant. The present findings are in accordance with the report of Rao and Sheikh (2005); Mohamed *et al*. (2014).

The maximum no. of flowers was recorded (Table 3) in T_2: 187.5 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (16.21) followed by T_9:250 g/ plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash (15.32). However minimum number of flowers was recorded in T_0: control (7.76). Similar findings were reported by Mohamed *et al*. (2014).

Table 3: Effect of Different Levels of Nitrogen and Phosphorus on Growth and Development of Pomegranate (*Punica granatum* L.).

Treatments	Leaf Area ($cm^{2)}$					No. of Flowers				
	30 days	60 days	90 days	120 days	150 days	30 days	60 days	90 days	120 days	150 days
T_0	5.16	5.44	5.83	6.05	6.11	3.44	4.88	6.21	7.32	7.76
T_1	5.38	5.66	6.05	6.22	6.33	4.11	5.77	7.43	8.76	9.65
T_2	6.27	6.66	7.05	7.22	7.33	5.99	8.88	11.88	14.21	16.21
T_3	5.94	6.22	6.50	6.83	7.00	5.22	7.88	10.32	12.32	13.87
T_4	5.77	6.05	6.33	6.61	6.72	4.66	6.55	8.43	9.98	11.09
T_5	5.89	6.16	6.44	6.77	6.94	4.89	7.11	9.55	11.43	12.87
T_6	5.83	6.11	6.38	6.66	6.89	4.77	6.77	9.10	10.88	12.21
T_7	5.66	5.89	6.16	6.44	6.61	4.22	6.11	7.77	9.21	10.21
T_8	6.11	6.38	6.66	6.94	7.05	5.33	8.10	10.88	12.99	14.65
T_9	6.16	6.50	6.89	7.05	7.17	5.44	8.33	11.21	13.43	15.32
F- test	NS	NS	NS	S	S	S	S	S	S	S
S. Ed. (±)	0.345	0.338	0.357	0.282	0.334	0.235	0.327	0.375	0.345	0.426
C. D. at 5%	0.725	0.711	0.751	0.592	0.701	0.493	0.686	0.788	0.725	0.894

Table 4: Effect of different levels of nitrogen and phosphorous on soil nutrient status.

Treatment	pH	EC(dsm^{-1})	N(kg/ha)	P(kg/ha)	K(kg/ha)
Initial	7.25	0.28	191.00	19.10	209.19
0	7.25	0.28	191.00	19.10	209.19
1	7.16	0.29	193.00	19.66	211.75
2	6.52	0.36	212.28	22.23	231.76
3	7.18	0.32	199.25	23.64	216.19
4	6.74	0.32	208.38	18.64	225.42
5	6.79	0.31	201.44	20.65	220.38
6	7.81	0.33	203.48	19.77	224.90
7	6.86	0.33	219.51	20.71	223.69
8	7.14	0.31	200.55	22.46	219.97
9	6.62	0.35	210.58	21.52	227.66
F- test	NS	S	S	S	S
S. Ed. (±)	0.398	0.008	6.868	0.494	0.426
C. D. at 0.05%	0.836	0.017	14.429	1.039	0.894

Data in Table 4 revealed that soil nutrient increased significantly with combined application of manure and fertilizer. The maximum increased of nitrogen, phosphorus and potassium was observed in treatment T_2. Regarding this experiment of all parameters results showed significant variations under different treatments. So, treatment T_2 recommended to be followed in pomegranate cultivation for better growth and development. However, the finding of this investigation needs to be further confirmed by long term studies for sustainable fruit production in pomegranate.

CONCLUSIONS

On the basis of the results obtained, it is concluded that the treatment T_2 : 250 g/plant Nitrogen, 125 g/plant Phosphorus and 125 g/plant Potash was found to be the best in treatment combinations in terms of maximum plant height (120.40 cm), maximum number of branches (10.17), maximum number of leaves (4360.42), maximum spread of canopy (125.74 cm^2), maximum internode length (8.60 cm), maximum Stem diameter (2.39 cm), maximum leaf area (7.33) and maximum number of flowers (16.21) and the minimum was recorded in T_0 : control. and nutrient status of soil like EC, nitrogen, phosphorus and potassium were also higher with treatment T_2.

FUTURE SCOPE

It can carrier the yield of pomegranate at higher level with the use of different levels of Nitrogen and Phosphorus in the development of canopy internodes, leaves and flowering they can initiate the yield of pomegranate.

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Conflict of interest. None.

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