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Effect of inorganic fertilizers on the plant growth and fruit quality in phalsa (*Grewia asiatica* D.C.)

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ABSTRACT : Phalsa plant requires adequate nutrition for proper growth and development. Fulfilling tree nutrition requirements is important for economically profitable fruit production. The optimized standards of fertilizer application are of great importance to get good yield. The present study was undertaken to find out the best possible combination of the inorganic fertilizers which can stimulate production in phalsa plants. A field experiment was laid out in Randomized Block Design with nine treatments and three replications at Khalsa College Orchard, Amritsar during 2009-10. The treatment 200g N + 50g P + 75g K per plant proved to be the best treatment resulting in maximum shoot size, internodal length and also having highest contents of reducing and total sugars. Maximum fruit size and fruit weight were recorded in plants applied with 200g N + 75g P + 100g K per plant. Maximum TSS: acid ratio was recorded in plants fertilized with 200g N + 75g P + 75g K.

KEY **W**ORDS : Phalsa, Inorganic fertilizers, Plant growth, Fruit quality, Shoot size

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Phalsa (*Grewia asiatica* D.C.) is a robust bush belonging to family Tilliaceae. Phalsa is known for its hardy nature and drought resistance hence, can be grown under adverse climatic and soil conditions. Phalsa is used as a filler crop in the orchards of major fruit crops and thus, supplements the farmer's income. As phalsa is a heavy feeder crop, nutrition given to it shows significant effect on the various growth flowering and fruit set parameters (Hayes, 1961 and Nijjar, 1969). Plant nutrient management can influence flowering, fruit set, fruit size and the amount of vegetative growth and other plant characteristics to a greater extent. By carefully choosing the components of fertilizer programme, the grower can nudge a crop toward earlier, heavier fruit set (Ibrahim *et al.*, 2004; Abd-Allah, 2006 and Alva *et al.*, 2006). Until or unless, fertilizer application program is properly designed according to growth cycle, it not possible to improve the plant health and fruit production (Yaseen *et al.*, 2004 and Zaman and Schumann, 2006). Maintaining health of plants by nutrition management demands, to chalk out nutrition programme by keeping in mind plant growth and fruit quality. Out of N, P and K, N has more prominent effect on the growth, yield and quality of fruit. Lower doses of nitrogen results in poor vegetative growth and less yield, while too heavy dose causes mortality in fruits (Bindra *et al.*, 1974). Phosphorus is known to promote cell division, photosynthetic activity and flowering. Since very little information is available

with regard to the standardization of optimum level of fertilizers adopted for phalsa fruit, therefore, present study was conducted to optimize the level of N, P and K for better performance of the phalsa plants.

RESEARCH PROCEDURE

The experiment was carried out on 6 year old phalsa bushes planted at 1 m x 1 m distance at Khalsa College Orchard, Amritsar during 2009-10 with a view to assess the effect of NPK on plant vigour and fruiting of phalsa. The soil of experimental field was sandy loam with pH of 8.45. A uniform dose of 20 kg FYM/bush was applied under every treatment including control in February. Fertilizers as N (200g and 300g), P (50g and 75g) and K (75g and 100g) per plant were used in nine different combinations that were replicated thrice. Half of N, full dose of P and K was applied in the second week of February and second half of N was applied at the time of fruit set in April. The data on growth parameters in terms of shoot length and internodal length of shoots were recorded with the help of a meter rod and expressed in centimeters. The shoot diameter was measured with the help of Vernier calliper. Shoot number was calculated by counting the number of branches at the end of experiment. Number of nodes on each shoot was counted and average per shoot was worked out. Leaf area was measured by randomly selecting leaves with the help of leaf area meter and expressed as square cm per leaf. The fruit size in terms of length and breadth was measured from 10 randomly selected fruits, with the help of Vernier calliper and average was calculated in centimeters. Fruit weight was determined by electronic balance and average weight per fruit was calculated out of a sample of 10 fruits and expressed in g. The berry yield from each bush was taken separately in all the replications under all treatments to calculate the average berry yield in kg and represented as berry yield per plant. The biochemical parameters were analyzed by A.O.A.C (2000) methods. The collected data were analyzed statistically by using Randomized Block Design. Fruits were harvested at optimum maturity and subjected to physico-chemical analysis in the laboratory of Department of Horticulture, Khalsa College, Amritsar.

Table A : Treatments details

T_1	:	200 N + 50P + 75K
T_2	:	200N + 50P + 100K
T_3	:	200N + 75P + 75K
T_4	:	200N + 75P + 100K
T_5	:	300N + 50P + 75K
T_6	:	300N + 75P + 100K
T_7	:	300N + 75P + 75K
T_8	:	300N : 75P : 100K
T_9	:	0N + 0P + 0K (Basal doze of 25 kg FYM applied)

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Plant growth:

Vegetative growth of plants was greatly influenced with the application of fertilizers. The data revealed that the different fertilizers significantly increased the shoot length and diameter, number of nodes and leaf area (Table 1). Maximum shoot size (175.56 cm x 3.42 cm) and internodal length (5.78 cm) was recorded in plants applied with 200 + 50 + 75 g NPK per plant. This effect on increased growth may be due to the fact that use of N accelerated the protein synthesis, amino acid and chlorophyll synthesis, whereas phosphorus promotes the cell division which directly affects the growth of plants (Sharma *et al.*, 2008). Singh and Gaur (1989) and Sharma *et al.* (2003) reported similar findings in phalsa with the application of NPK. The fertilizers showed non-significant effect on number of shoots per bush. However, maximum number of shoot per plant was observed in plants treated with 200 + 75 + 100 g NPK and 300 + 50 + 100 g NPK per plant. Significant number of nodes was produced in plants treated with 200 + 50 + 100 g and internodal length in plants treated with 200 + 50 + 75 g NPK per plant. Maximum leaf area (62.21 sq. cm) was found in plants treated with 200 + 75 + 75 g NPK closely followed by 200 + 75 + 75 g NPK and 300 + 75 + 75 g NPK treatments. These results were confirmed by the findings of Singh and Gaur (1989) and Chahal and Bal (2005). This increase might be due the increase in P content which increases cell division through increased photosynthetic activity and also due to the change in composition of phospholipids and nucleic acid. Similar results were also given by Kumar and Dhandar (1996) in pomegranate.

Fruit physical characters :

Maximum fruit size (1.16 cm x 1.30 cm) and fruit weight (0.83 g) was recorded in plants applied with 200 N: 75 P: 100 K g per plant (Table 2). Singh *et al.* (2004)

and Wali *et al*. (2005) reported similar results in phalsa. This may be due to the fact that combined application of N and K might have increased the assimilatory power of leaves to synthesis more metabolites.

Fruit biochemical characters:

A significant increase in TSS contents was observed in fruits of phalsa with increase in fertilizer doses (Table 2). Significantly higher TSS (22.72 %) was recorded in fruits of plants applied with 200 + 75 + 75 g NPK per

Table 1 : Effect of inorganic fertilizers NPK on vegetative growth of phalsa plants

Treatments	Shoot length	Shoot diameter	Number of shoots per bush	Number of nodes	Internodal length	Leaf area
T_1 - 200g N + 50g P + 75g K	175.76	3.42	23.00	20.78	5.78	52.46
T_2 - 200g N + 50g P + 100g K	169.44	3.29	22.56	21.00	5.21	49.50
T_3 - 200g N + 75g P + 75g K	169.00	3.28	22.45	20.33	5.40	62.21
T_4 - 200g N + 75g P + 100g K	164.11	3.18	23.11	19.89	5.36	58.24
T_5 - 300g N + 50g P + 75g K	163.67	3.32	22.89	19.22	5.61	57.71
T_6 - 300g N + 75g P + 100g K	168.78	3.22	23.11	19.22	5.49	57.04
T_7 - 200g N + 75g P + 75g K	166.33	3.31	22.56	18.22	5.44	58.17
T_8 - 300g N + 75g P + 100g K	165.33	3.34	22.78	18.56	5.62	57.10
T_9 - 0g N + 0g P + 0g K	162.67	3.18	21.89	17.56	5.64	53.79
Mean	167.21	3.28	22.70	19.42	5.50	56.24
C.D. (P=0.05)	4.18	0.12	NS	1.02	NS	3.87

NS=Non-significant

Table 2: Effect of inorganic fertilizers NPK on fruit physical and biochemical characters

Treatments	Fruit length	Fruit breadth	Fruit weight	TSS	Acidity	TSS : Acid	Reducing sugars	Total sugars
T_1 - 200g N + 50g P + 75g K	1.06	1.22	0.73	22.29	2.27	9.81	12.37	8.27
T_2 - 200g N + 50g P + 100g K	1.03	1.23	0.81	21.57	2.19	9.81	12.53	8.47
T_3 - 200g N + 75g P + 75g K	1.03	1.20	0.72	22.72	2.25	10.20	12.22	8.23
T_4 - 200g N + 75g P + 100g K	1.16	1.30	0.83	19.61	2.35	8.20	11.23	8.02
T_5 - 300g N + 50g P + 75g K	1.02	1.21	0.78	21.03	2.44	8.53	11.56	8.04
T_6 - 300g N + 75g P + 100g K	1.02	1.21	0.74	20.39	2.27	9.06	11.66	8.08
T_7 - 200g N + 75g P + 75g K	1.06	1.20	0.79	21.63	2.29	9.44	12.50	8.34
T_8 - 300g N + 75g P + 100g K	1.03	1.22	0.77	20.69	2.26	9.22	11.83	8.13
T_9 - 0g N + 0g P + 0g K	1.01	1.16	0.70	19.56	2.38	8.21	10.88	7.94
Mean	1.04	1.21	0.76	21.05	2.30	9.16	11.86	8.16
C.D. (P=0.05)	0.07	NS	0.05	1.43	NS	NS	0.33	0.32

NS=Non-significant

Table 3 : Effect of inorganic fertilizers NPK on yield characteristics in plants of phalsa

Treatments	Number of pickings	Yield per bush
T_1-200g N + 50g P + 75g K	6.67	2.22
T_2-200g N + 50g P + 100g K	6.00	1.97
T_3-200g N + 75g P + 75g K	5.00	2.21
T_4-200g N + 75g P + 100g K	5.66	2.02
T_5-300g N + 50g P + 75g K	6.33	2.21
T_6-300g N + 75g P + 100g K	7.00	2.19
T_7-200g N + 75g P + 75g K	5.33	2.18
T_8-300g N + 75g P + 100g K	6.33	2.27
T_9-0g N + 0g P + 0g K	5.06	1.90
Mean	5.93	2.13
C.D. (P=0.05)	0.42	0.017

plant. The present results are in accordance with the findings of Wali *et al*. (2005) in phalsa. The improvement in TSS of fruits could easily be explained by the fact that urea is helpful in photosynthesis which ultimately led to the accumulation of carbohydrates and helped to increase the TSS of phalsa. The fertilizers found to exert non-significant effect on acidity and TSS: acid ratio of phalsa. Minimum acid contents (2.19 %) recorded in fruits of plants applied with 200 + 50 + 100 g NPK and minimum (2.44 %) was recorded in fruits obtained from plants applied with 300 + 50 + 75 g NPK per plant. Singh and Singh (2003) also found that with the increase in nitrogen level does not have any influence on fruit acidity in phalsa. Maximum TSS: acid ratio (10.20) was recorded in plants applied with 200 + 75 + 75 g NPK. Maximum reducing sugars (12.53 %) and total sugars (8.47 %) were recorded under treatment 200 N: 50 P: 100 K than control. Increase in sugar contents with the application of fertilizers might be due to the fact that urea is helpful in improving photosynthesis which ultimately led to the accumulation of carbohydrates and in turn increased the sugar contents in fruits of phalsa. Increase in sugars with the combined spray of urea and potassium sulphate (2%) was also noticed by Wali *et al.* (2005) in phalsa.

Yield characters:

Significant effect of NPK was also found on the number of pickings and yield per bush in phalsa (Table 3). Maximum number of pickings (7.00) found in plants treated with 300 + 50 + 100 g NPK followed by treatment 200 + 50 + 75 g NPK and 300 + 50 + 75 g NPK; whereas maximum yield (2.27 kg) per bush was recorded in plants fertilized with 300 + 75 + 100 g NPK as compared to control. These results are in accordance with the findings of Sharma and Azad (1991) in mandarin, Singh and Gaur (1989) and Wali *et al.* (2005) in phalsa.

Conclusion :

The study reveals that the orchard nutrition management plays a very crucial role in tree growth and productivity. Overall results suggest definite role of macronutrients in plant health and fruit production of phalsa. These results also provide information that plants should be applied nutrients at critical growth stages when plants really have a demand of nutrition. The information obtained from the trial is helpful to design nutrition program according to plant growth.

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