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Effect of different nitrogenous fertilizers on Fruit Quality and Yield of apricot (*Prunus armeniaca* L.)

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Abstract
The present study entitled "Evaluation of different nitrogenous fertilizers on soil properties, yield and quality of apricot (*Prunus armeniaca* L.)" was conducted at research farm of the Department of Soil Science and Water Management, Nauni Solan during 2015 and 2016 with 11 treatments. Half dose of nitrogen was applied during spring before flowering and remaining half dose was applied one month after first application. From the foregoing results it may be concluded that treatment T_7 (urea 100%+lime 708 g/tree) was found to be best treatment for TSS, fruit size, fruit set and yield. Whereas, fruit quality in terms of fruit length, fruit breadth and fruit weight improved under T_1 treatment (urea 0%+Ca $(NO_3)_2$ 100%). From the present investigation, it may be concluded that urea and lime application in treatment T_7 (urea100%+lime708g/tree) helped in obtaining, fruit set, fruit quality and yield during both the years of experimentation.

Keywords: nitrogenous fertilizers (urea, calcium nitrate and urea enriched compost), quality yield (apricot)

1. Introduction
Apricot (*Prunus armeniaca* L.) belongs to family rosaceae and is one of the most important fruit crop of mid-hills and dry temperate regions of the India. It is being grown commercially in India in the mid hills of Himachal Pradesh, Jammu and Kashmir, Uttrakhand and to a limited extent in the hills of North- Eastern states. It can be grown successfully at an altitude from 900-2000 meter above mean sea level. Total area under apricot cultivation in Himachal Pradesh is 3577 hectares with a production of 3165 MT during 2013-2014 (Anonymous, 2014). Apricot is a rich source of vitamin A and contains more carbohydrates, proteins, phosphorus and niacin as compared to other common fruits (Teskey and Shoemaker, 1972) [26]. Within certain limits increasing the rate of nitrogen resulted in a corresponding increase in the terminal growth, percentage of foliar N and delayed fruit maturity (Schneider and Mcclung, 1957) [21]. An increase in nitrogen fertilization from 100 to 200 kg N per ha was reported to enhance the N content in apricot leaves and spurs (Margarian *et al*., 1986; Watanable *et al*., 1990) [13, 27]. Further, growth, yield and average fruit weight increased without reduction of fruit quality (Margarian *et al.*, 1986) [13]. Potassium is known to be absorbed by apricot trees in significant quantities (Huguet, 1988) [6]. Potassium was considered to be absorbed at high levels by apricot trees. P fertilization enhanced the growth of leaves and spurs and the yield of apricot trees (Dimitrovski and Cevetkovic, 1981) [5].

2. Materials and methods
The experimental site is situated at the experimental farm of the department of Soil Science and Water Management, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP). It is located between 30º 51′ N latitude and 76º 11′ E longitude, representing mid hill zone of Himachal Pradesh and at an elevation of 1175 m above mean sea level having average slope of 7-8 per cent. Field trials were executed during the years 2015 and 2016 on full grown (26 years) apricot trees, raised on wild apricot (Chulli) root stock, planted at a distance of 6 × 6 m. The proposed study was conducted at the experimental farm of Department of Soil Science and Water Management, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, with the following treatments:-

2.1 Treatments
T_1- urea 0% + Ca $(NO_3)_2$ 100%
T_2- urea 20% + Ca $(NO_3)_2$ 80%
T_3- urea 40% + Ca $(NO_3)_2$ 60%
T_4- urea 60% + Ca $(NO_3)_2$ 40%

2.2 Treatments

T_1- urea 0% + Ca $(NO_3)_2$ 100%
T_2- urea 20% + Ca $(NO_3)_2$ 80%
T_3- urea 40% + Ca $(NO_3)_2$ 60%
T_4- urea 60% + Ca $(NO_3)_2$ 40%
T_5- urea 80% + Ca $(NO_3)_2$ 20%
T_6- urea 100% + Ca $(NO_3)_2$ 0%
T_7- urea 100% + Lime (708 g/tree)
T_8- urea enriched compost 25% + Ca $(NO_3)_2$ 75%
T_9- urea enriched compost 50% + Ca $(NO_3)_2$ 50%
T_{10}- urea enriched compost 75% + Ca $(NO_3)_2$ 25%
T_{11}- urea enriched compost 100% + Ca $(NO_3)_2$ 0%

The recommended dose of NPK i.e N-500g, P_2O_5-250g, and K_2O-700g, was applied. In all treatments, full dose of phosphorus (250g P_2O_5), part of nitrogen (93g N) and part of potassium (125g K_2O) was applied through IFFCO 12:32:16 mixture. The remaining dose of potassium (575g K_2O) was supplemented through MOP. In case of nitrogen, remaining dose of nitrogen (407g N) was supplemented through urea, calcium nitrate and urea enriched compost in different treatment combinations.

2.3 Composition of urea enriched compost

10 kg of urea + 45 kg of sieved soil + 20 kg FYM + 20 kg vermicompost + 5 kg lime

2.4 Preparation of urea enriched compost

For the present study, urea enriched compost was prepared on polythene sheet over the ground by spreading a layer of sieved soil. The urea (liquid) was sprinkled into the layer of soil. Afterwards, enrichment with vermicompost, FYM and lime was done @ 20kg, 20 kg and 5kg respectively per layer. Five layers were laid out and heap was raised to a height of about 50 cm above the ground level and then mixed properly. Urea enriched compost was left as such for 72 hours in wrapped polythene sheet. Urea enriched compost was mixed at 72 hours interval until the smell of urea vanished. The nitrogen content of urea enriched compost used in the experiment was determined by following the standard procedure (Jackson, 1973) [7] and value recorded was 7.28%.

Table 1: Chemical properties of FYM, VC and Urea enriched compost

Sr. No.	Nutrients	Value		
		FYM	VC	Urea enriched compost
1	pH	7.69	8.12	7.9
2	EC (dS m^{-1})	1.60	1.69	1.63
3	N (%)	0.58	1.33	7.28
4	P (%)	0.60	1.24	1.60
5	K (%)	0.54	0.72	0.32
6	Zn (ppm)	138.5	119.55	61.80
7	Cu (ppm)	24.6	38.08	21.14
8	Fe (ppm)	119.8	252.25	198.44
9	Mn (ppm)	106.3	290.38	91.54

2.5 Experimental Design : Randomized Block Design (RBD)
Number of treatments : 11
Number of replications : 3
Crop : Apricot
Cultivar : New Castle

3. Results and Discussion

Effect of different nitrogenous fertilizers on fruit quality and fruit yield in apricot

3.1 Fruit Set and Fruit Yield

- Highest fruit set (62.08%) was recorded with T_7 consisting of urea 100% + lime 708 g/tree. Similarly, maximum fruit yield (30.03 kg/tree) was recorded under treatment T_7.

Fruit set was markedly improved by the application of nitrogenous fertilizers. The results are in line with those of Stassen *et al*. (1981) [25], Singh (1982) [24], Yogaratnum and Greenham (1982) [28], Khan *et al*. (2000) [11], Joolka and Sharma (2000) [9] and Sharma and Bhargava (2003) [22] who have also reported increased fruit set in various temperate fruits with the nitrogenous fertilizers having its role in the synthesis of protein, nucleic acids and enzymes in plants (Nijjar, 1996) [15]. Saini *et al*. (2013) [19, 20] reported highest fruit set with urea + lime (500 and 600 g N/tree) in plum. Highest fruit set (62.08%) was recorded with T_7 consisting of urea 100% + lime 708 g/tree. Similarly, maximum fruit yield (30.03 kg/tree) was recorded under treatment T_7. The higher yield with treatment consisting of urea + lime might be attributed to sustained availability of macro as well as micro elements which is evident from higher accumulation of nutrient elements in plum leaves and more balanced C/N ratio (Rathi and Bist, 2004) [17].

3.2 TSS

- TSS contents of apricot fruit were markedly influenced by various nitrogenous fertilizers. Highest TSS (15.60 ºBrix) was recorded under treatment T_7 (urea 100% + lime 708 g/tree).
- The total soluble solids were recorded highest under treatment T_7 (urea 100% + lime 708 g/tree). This may possibly be attributed to more efficient nitrogen uptake because of efficient nitrogen absorption which consequently resulted into more luxuriant vegetative growth at the expense of translocation of metabolites to the developing fruits. The total soluble solids increased with the application of N. The results are in conformity with those of Sharma and Bhargava (2003) [22] and Badyal (1980) [1]. Similar results were reported by Ritter (1961) [18], Joon *et al*. (1990) [10] and Jia *et al*. (1999) [8] who reported that TSS increased with the increased rate of N in different stone fruits.

3.3 Titratable Acidity

- Titratable acidity was significantly influenced by various nitrogenous fertilizers. The lowest acidity (0.94%) was recorded under T_7 (urea 100% + lime 708 g/tree).
- A marked increase in titratable acidity with N application was recorded. Similar results have been reported by Bhutani *et al*. (1983) [2] in plum. These results are in conformity with those of Chadha and Bajwa (1966) [3], Nijjar *et al*. (1972) [14] and Chandel (1985) [4]. The increase in acidity with N application might be due to increased synthesis of amino acids, proteins and other metabolites and their consequent translocation to the fruits.

3.4 Fruit Length and Breadth

- Maximum fruit length (39.97 mm) and fruit breadth (43.64 mm) was recorded under treatment T_1 (urea 0% + Ca $(NO_3)_2$ 100%).
- Present findings indicate that quality parameters of fruits were markedly improved by different nitrogenous fertilizers during both the years of study. Maximum fruit size in terms of length and breadth was obtained under T_1

treatment (urea 0% + calcium nitrate 100%). The improvement in the fruit size might be due to calcium nitrate, which significantly increased calcium content in apricot leaves. These results are in agreement with the findings of Singh *et al*. (2001) [23] in strawberry. Leopold and Kridemann (1975) [12] observed that the fruit growth may be expression of wide variety of events from the development of air spaces to the loading of sugars into the fruits without corresponding increase in volume. Saini *et al*. (2013) [19, 20] reported increased in fruit size due to the application of calcium nitrate (500 g N tree^{-1}).

3.5 Fruit Weight

- Fruit weight increased markedly with the application of various nitrogenous fertilizers. Maximum fruit weight (23.95 g) was recorded under treatment T_1 (urea 0% + Ca $(NO_3)_2$ 100%).
- Fruit weight of the apricot fruits were significantly improved by calcium nitrate 100%. The present results are in line with the findings of Raese (1997) [16] who reported that fruit weight was higher in the trees treated with Ca $(NO_3)_2$. Saini *et al*. (2013) [19, 20] reported increased in fruit weight due to the application of calcium nitrate (500 g N tree^{-1}).

Table 2: Effect of different nitrogenous fertilizers on Fruit Quality and Yield of apricot (pooled data)

Treatments	Fruit Set (%)	Fruit Yield (kg/tree)	TSS (°Brix)	Titratable acidity (%)	Fruit length (mm)	Fruit breadth (mm)	Fruit weight (g)
T_1	53.27	17.11	12.44	1.11	39.97	43.64	23.95
T_2	51.24	18.51	13.30	1.13	38.08	41.66	21.95
T_3	50.33	20.30	13.36	1.14	36.61	36.78	18.98
T_4	48.90	21.57	13.47	1.18	35.35	34.41	17.14
T_5	46.08	22.31	13.68	1.15	32.93	32.19	14.44
T_6	47.99	24.71	14.02	1.23	31.76	31.67	13.99
T_7	62.08	30.03	15.60	0.94	38.51	42.45	22.61
T_8	54.14	27.25	14.93	0.96	38.23	40.43	21.36
T_9	55.56	28.11	14.87	0.99	37.05	38.50	18.81
T_{10}	56.70	27.20	14.76	1.03	32.88	36.17	17.50
T_{11}	52.71	25.70	14.58	1.06	32.15	32.59	15.37
$CD_{(0.05)}$	1.89	1.83	0.45	0.03	1.20	0.94	0.72

6. Conclusion

From the foregoing results it may be concluded that treatment T_7 (urea 100% + lime 708 g/tree) was the best nitrogenous fertilizer for optimum fruit set and yield. Whereas, fruit quality in terms of fruit length, fruit breadth and fruit weight improved under T_1 treatment (urea 0% + Ca $(NO_3)_2$ 100%).

From the present investigations, it may be concluded that urea and lime application, treatment T_7 (urea 100%+ lime 708 g/tree) helped in obtaining optimum fruit set and yield during both the years of experimentation.

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