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Effect of different nitrogen sources and their levels on leaf and soil nutrient status of apple (*Malus* × *domestica* Borkh.) cv. Starking Delicious

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Abstract
Apple (*Malus* × *domestica* Borkh.) native to Asia Minor, Caucasus and Central Asia and is one of the economically important and widely grown fruit crop in temperate regions of the world. Nitrogenous fertilizers in addition to phosphorus and potassium fertilizers have paramount importance in plant growth and fruit quality production. The present studies investigate the effect of different nitrogen sources and their levels on nutrient status of apple (*Malus X domestica* Borkh) cv. Starking Delicious was conducted during the year 2016-17 at private orchard, Sandhu, Theog (H.P). The study consisted of ten treatments viz; T_1:100% RD of N, 60% through A + 40% through B; T_2: 100% RD of N, 40% through A + 60% through B, T_3:100% RD of N, 50% through A + 50% through B; T_4: 75% RD of N, 60% through A + 40% through B; T_5: 75% RD of N, 40% through A + 60% through B; T_6: 75% RD of N, 50% through A + 50% through B; T_7: 50% RD of N, 60% through A + 40% through B; T_8: 50% RD of N, 40% through A + 60% through B; T_9: 50% RD of N, 50% through A + 50% through B; T_{10}: 100% of RD through Calcium Nitrate. These treatments were given from two sources (Mila complex: 12:11:18 and Nitrobor: 14.5%), replicated three times and experiment was laid out in Randomized Block Design. The results revealed that fertilization with 100% RD of N, 40% through A + 60% through B (T_2) significantly enhanced leaf nitrogen, phosphorus and calcium and soil potassium, whereas, maximum leaf potassium, magnesium, soil nitrogen and soil phosphorus was recorded in T_1 (100% RD of N, 60% through A + 40% through B). The apple trees subjected to lower level of nitrogen i.e. 50% of recommended dose of nitrogen resulted in lowest nutrient status and highest pH of apple plant. 100% recommended dose of N, 60% through A + 40% through B gave better results as compared to 100% of recommended dose of nitrogen through CaNO3.

Keywords: Apple, nitrogen sources, nutrient status, $CaNO_3$

Introduction
Apple (*Malus* × *domestica* Borkh.) originated in the region which includes Asia Minor, Caucasus and Central Asia. It is the most leading fruit crops grown under temperate climates in the both hemispheres of the world. It is commercially grown in Jammu and Kashmir, Himachal Pradesh and Uttrakhand which together accounts to 90% of the total production. In Himachal, there has been a tremendous progress in proliferation of apple orchards and area has increased from 35,076 hectares in 1975 to 1,10,679 hectare with an annual production of 7,77,126 MT in 2016 (Anonymous, 2016) [1]. Factors like climate, soil, cultivars, rootstocks, spacing influence the production of apple and plant nutrition is one of the major factor. Judicious nutrition of apple trees requires careful judgement of the quantity of fertilizers required, time and method of their application.

Nitrogen is the most used nutrient and is usually the first element to be considered in an apple orchard fertilization programme. Nitrogen supply to apple trees affects tree growth, flower bud formation, yield and fruit quality, particularly fruit size and colour (Raese *et al*., 2007) [14]. To meet out the nitrogen requirement of apple trees different sources of nitrogenous fertilizers are used. Till recent past, the calcium ammonium nitrate (CAN) was the most commonly used nitrogenous fertilizer in fruit crops. However, due to non-availability of CAN, the other nitrogenous fertilizers are required to be standardized for soil application in apple orchards. Keeping in view of the importance of nitrogen in apple orchard, the study has been carried out to see the effect of different sources and levels of nitrogen on growth and yield of apple.

Material and Methods

The trial was conducted in the private orchard at Sandhu, Theog (Shimla) situated at an elevation of 2310 metres above mean sea level. Fifteen year old plants of apple cv. Starking Delicious having uniform size and vigour planted at a distance of 6 × 6 m were selected for the study. The plants were maintained under uniform cultural practices during the course of investigations.

Table 1: Quantity of different nitrogenous fertilizers applied under each treatment

Treatment	Nitrogenous Fertilizer	Quantity (g)
T_1	100% RD of N, 60% through A + 40% through B	3500 + 1917
T_2	100% RD of N, 40% through A + 60% through B	2333 + 2876
T_3	100% RD of N, 50% through A + 50% through B	2916 + 2397
T_4	75% RD of N, 60% through A + 40% through B	2624 + 1438
T_5	75% RD of N, 40% through A + 60% through B	1749 + 2157
T_6	75% RD of N, 50% through A + 50% through B	2187 + 1797
T_7	50% RD of N, 60% through A + 40% through B	1750 + 959
T_8	50% RD of N, 40% through A + 60% through B	1166 + 1438
T_9	50% RD of N, 50% through A + 50% through B	1458 + 1198
T_{10}	100% of RD of N through $CaNO_3$	2250 + 2250

(RD= Recommended dose of nitrogen), (N= Nitrogen, A= Mila Complex and B= Nitrobor)

The experiment was laid out in a simple Randomized Block Design and the quantity of Mila Complex fertilizers was calculated to fulfil the recommended dose of phosphorus (350g/tree) and potassium (700g/tree) and the remaining dose was applied through single super phosphate and muriate of potash. The time of application of full dose of P_2O_5 and K_2O along with FYM was in the month of December. Nitrogen was applied in two split doses; half of the amount was applied at bud burst stage and remaining half at fruit set stage.

Leaf Nutrient Estimation

Leaf samples (leaf blade + petiole) from each experimental tree were collected during the first week of August from the middle part of current season's growth around the periphery of the tree (Kenworthy, 1964) [6]. The digestion of the samples for the estimation of nitrogen was carried out in concentrated sulphuric acid (AR grade) by adding digestion mixture. For the estimation of leaf P, K, Ca, Mg, Zn, Fe, Cu, and Mn, digestion was done in di-acid mixture prepared by mixing nitric acid and perchloric acid (AR grade) in the ratio of 4:1.

Result and Discussion

Effect of different nitrogen sources and their levels on Leaf Macro-Nutrient Status

Nitrogen

In present investigation, maximum leaf nitrogen content (2.38%) was recorded in tress subjected to 100% recommended dose of nitrogen, 40% through A + 60% through B (T_2). Nitrogen is the main constituent of protein, amino-acid, enzyme, vitamins and plant hormones which alters the rate of metabolic processes in plants and enhances uptake of other nutrients thus resulting in marked increase in vegetative growth (Verma *et al.* 2005) [20]. Nijjar (1985) [7] reported positive influence of N fertilizer on leaf N status. Smith (1962) [18] reported that N being highly mobile and is efficiently translocated from roots to leaves when the soils have optimum N level.

Phosphorus

Leaf phosphorus was significantly influenced by different nitrogen sources and their levels. Maximum leaf phosphorus (0.16%) was recorded in trees subjected to 100% RD of nitrogen, 40% through A + 60% through B (T_2). Although there was an increase in leaf phosphorus with increase in nitrogen but the leaf phosphorus values does not fall in the optimum range of apple because fertilization with nitrate promotes the magnesium and calcium ions while inhibiting the phosphate uptake.

Potassium

Leaf potassium content in present studies was found to be maximum (1.37%) was recorded in trees subjected to 100% RD of nitrogen, 60% through A + 40% through B (T_1). These results are in accordance with Singh *et al.* (2006) [19] who observed higher accumulation of leaf P and K with application higher rates of NPK combination. Stalin *et al.* (1994) [20] also observed a significant increase in K content of leaves in pomegranate with increased NPK level. Ponder *et al.* (1998) [11] also found increased leaf potassium concentration with application of nitrogen in Walnut.

Calcium

In the present studies, maximum leaf calcium content (2.02%) was observed with trees subjected to 100% RD of nitrogen, (40% through A + 60% through B) (T_2). Higher leaf calcium content with the application of calcium nitrate might be due to adequate quantity of Ca in the soil. Green and Smith (1979) [5] found that soil application of calcium nitrate increased calcium content of leaves in 'Yorking' apple trees. The increase in leaf calcium content with the application of calcium nitrate has also been reported by Raese (1985) [12] in apple and Raese (1996) [13] in apple and pear.

Magnesium

Maximum leaf magnesium (0.41%) was recorded in trees subjected to 100% RD of nitrogen, 60% through A + 40% through B (T_1). The present findings indicate that leaf Mg increased with full dose of nitrogen applied through two N sources. Similar results were reported by (Papp, 2000)[8] who reported that nitrogen application significantly increased leaf nitrogen and magnesium content in a long term experiment on Jonathan apple trees.

Table 2: Effect of different nitrogen sources and their levels on leaf nutrient status (N, P, K, Ca and Mg) of apple cv. Starking Delicious

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
T1 (100% RD of N, 60% through A + 40% through B)	2.33	0.15	1.37	1.89	0.41
T2 (100% RD of N, 40% through A + 60% through B)	2.38	0.16	1.36	2.02	0.40
T3 (100% RD of N, 50% through A + 50% through B)	2.36	0.14	1.32	2.01	0.39
T4 (75% RD of N, 60% through A + 40% through B)	2. 27	0.12	1.24	1.90	0.37
T5 (75% RD of N, 40% through A + 60% through B)	2.31	0.12	1.21	1.98	0.35
T6 (75% RD of N, 50% through A + 50% through B)	2.31	0.11	1.26	1.96	0.36
T7 (50% RD of N, 60% through A + 40% through B)	2.16	0.12	1.24	1.70	0.34
T8 (50% RD of N, 40% through A + 60% through B)	2.20	0.13	1.20	1.83	0.32
T9 (50% RD of N, 50% through A + 50% through B)	2.22	0.10	1.16	1.80	0.34
T10 (100 % RD of N through CaNO3)	2.32	0.13	1.29	1.93	0.36
CD(0.005)	0.11	0.03	0.09	0.17	0.02

Effect of different nitrogen sources and their levels on Soil pH and Macro-Nutrient Status

Soil pH

Maximum pH (7.10) was recorded in T_8 (50% recommended dose of nitrogen, 40% through A + 60% through B). In the present investigations, the soil pH was significantly affected by levels of nitrogenous fertilizers and the pH values declines as a level of nitrogen applied through two sources increased. These observations are in agreement with Patten (1989) [9] in peach. Pesek *et al*. (1971) [10] found that pH values get affected with nitrogenous fertilizers because of their acid or base equivalent factors and acidity increases when NH_4^+- N is converted to NO_3^- in the soil. Clark *et al*. (1989) [3] also found that soil pH was lowered when nitrate levels rose with increasing nitrogen rate.

Soil Nitrogen

It is evident from Table 3 that nitrogen level of soil increased with increasing levels of nitrogen. The highest (351.91kg/ha) was recorded in T_1 (100% recommended dose of nitrogen, 60% through A + 40% through B) treatment. Similar results were obtained in apple (Romaniuk *et al.* (1979) [15], peach (Sharma, 1987) [17] and mango (El-Wakeel, 2005) [4]. Increase in the available N of soil may be anticipated due to marked increase in both NH_4^+ and NO_3^- and the availability of ammonium ions to the soil bacteria for nitrification to produce nitrate ions and thus increasing the availability of nitrogen in the soil.

Table 3: Effect of different nitrogen sources and their levels on soil pH, N, P, K of apple cv. Starking Delicious

Treatment	pH	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1 (100% RD of N, 60% through A + 40% through B)	6.43	351.91	71.61	277.31
T_2 (100% RD of N, 40% through A + 60% through B)	6.91	340.10	70.51	277.63
T_3 (100% RD of N, 50% through A + 50% through B)	6.73	343.72	71.21	268.33
T_4 (75% RD of N, 60% through A + 40% through B)	6.85	301.98	69.87	267.47
T_5 (75% RD of N, 40% through A + 60% through B)	7.01	303.56	68.50	262.99
T_6 (75% RD of N, 50% through A + 50% through B)	6.95	292.90	64.83	250.21
T_7 (50% RD of N, 60% through A + 40% through B)	7.04	261.04	57.00	246.48
T_8 (50% RD of N, 40% through A + 60% through B)	7.10	262.16	54.00	249.48
T_9 (50% RD of N, 50% through A + 50% through B)	7.07	267.81	57.06	231.93
T_{10} (100 % RD of N through $CaNO_3$)	6.64	346.81	60.87	243.62
$CD_{(0.005)}$	0.22	12.51	5.19	9.92

Soil Phosphorus

The soil phosphorus was significantly affected by different nitrogen sources and their levels. The maximum soil phosphorus (71.61kg/ha) was recorded in trees fertilized with 100% recommended dose of nitrogen 60% through A + 40% through B. These results are in line with those of Saini (2011) [16] who also observed an increased in available soil phosphorus with application of NPK combination. Similarly, Clark *et al.* (1989) [3] revealed that soil phosphorus content was highest with 13:13:13 fertilizers treatment in 'Bluecrop' blueberry.

Soil Potassium

Maximum soil potassium 277.63kg/ha was recorded in trees subjected to 100% of recommended dose of nitrogen 40% through A + 60% through B (T_2). The results are in conformity with those of Chandel (1985) [2] and Xie and Cumming (1995) [22], who also reported increase in soil K with application of nitrogenous fertilizers.

Conclusion

On the basis of results obtained in present studies, it can be concluded that among various treatments, the application of recommended dose of nitrogen, irrespective of their combination (100% RD of N, 60% of N through A + 40% of N through B, 100% RD of N, 40% of N through A + 60% of N through B and 100% RD of N, 50% of N through A + 50% of N through B) enhanced leaf and soil nutrient status of apple plant.

References

1. Anonymous. Horticulture development in Himachal Pradesh at a glance, 2016. https://www.hphorticulture.nic.in
2. Chandel CK. Studies on the nutrition of apricot cv. New Castle. M.Sc. Thesis. HPKV, Palampur, India, 1985.
3. Clark JR, Fernandez GE, Maples R, Bordelon B. Nitrogen fertilization of high bush blueberry. Research Series Arkansas Agricultural Experiment Station. 1989; 398:1-3.
4. El-Wakeel HF. Preliminary studies on fertilization of mango trees under U.A.E conditions: II-response of Amrapali mango trees to nitrogen and potassium fertilization. Annals of Agricultural Sciences Cairo. 2005; 50:563-572.

5. Green GM, Smith CB. Effects of calcium and nitrogen sources on corking of apples. Communications in Soil Science and Plant Analysis. 1979; 10:129-139.
6. Kenworthy AL. Fruit, nut and plantation crops, deciduous and evergreen. In: A guide for collecting foliar samples for nutrient elements. Horticulture Department of Michigan State University, Mieneo, 1964, 1-39.
7. Nijjar GS. Nutrition of fruit trees. Kalyani, New Delhi, 1985, 10-20.
8. Papp J. Effect of nitrogen dressings to Jonathan apple trees in a long term experiment. International Journal of Horticultural Sciences. 2000; 6:128-130.
9. Patten K, Nimr G, Neuendorff E. Fertilization method and liming rate effects on peach tree growth and soil pH. Acta Horticulturae. 1989; 254:323-327.
10. Pesek J, Stanferd G, Case NL. Reaction of nitrogen sources with soils, 1971, 240-251.
11. Ponder FJ, Jones JF, Haines J. Annual application of N, P and K for four years moderately increases nut production in black Walnut. Hort Science. 1998; 33:1011-1013.
12. Raese JT. Response of 'Delicious' apple trees in the greenhouse to rates and forms of nitrogen and phosphorus in a low phosphorus soil. Hort Science. 1985; 20:234-236.
13. Raese JT. Calcium nutrition affects cold hardiness, yield, and fruit disorders of apple and pear trees. Journal of Plant Nutrition. 1996; 19:1131-1155.
14. Raese JT, Drake SR, Curry EA. Nitrogen fertilizer influences fruit quality and cold hardiness of 'Golden Delicious'. Journal of Plant Nutrition. 2007; 30:1585-1604.
15. Romaniuk J, Soczek Z, Niezborala B, Ceglowski M. Effect of Alar and differentiated nitrogen fertilization on the yield, mean fruit size and chemical composition of McIntosh apple leaves. PraceInstytutu Sadownictwa Kwiaciarstwa Skierniewicach. 1979; 21:67-76.
16. Saini P. Comparative studies on effects on nitrogenous fertilizers on growth, fruit set and yield in plum cv. Santa Rosa. Ph.D. Thesis. Dr. YS Parmar University of Horticulture and Forestry, Solan, India, 2011.
17. Sharma YP. Response of peach trees to nitrogen and weed management practices. Ph.D. Thesis. Dr. YS Parmar University of Horticulture and Forestry, Solan, India, 1987.
18. Smith CB. Mineral analysis of plant tissues. Plant Physiology. 1962; 13:81-108.
19. Singh SR, Sharma AK, Sharma MN. Effect of different NPK combinations on fruit yield, quality and leaf nutrient composition of apple (*Malus X domestica* Borkh.) cv. Red Delicious. Environment and Ecology. 2006; 24:71-75.
20. Stalin P, Vasudevan P, Rangaswamy P. Studies on the NPK requirement of pomegranate (*Punica granatum* L.) South Indian Horticulture. 1994; 42:11-14.
21. Verma HS, Kumar J, Thakur S. Effect of various fertilizers on growth and productivity of apple cv. Golden Delicious. Acta Horticulturae. 2005; 696:205-210.
22. Xie HS, Cummings GA. Effect of soil pH and nitrogen source on nutrient status in peach. Journal of Plant Nutrition. 1995; 18:541-551.