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Effect of Different Combination of Nitrogen and Organic Manure on Leaf Nutrient Content of Japanese Pear (*Pyrus pyrifolia*) Cv. Punjab Beauty

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Authors' contributions

This work was carried out in collaboration between all authors. Author SK carried out the study, performed the statistical analysis and wrote the manuscript. Author RKG designed the study and managed the analyses of the study. Author JRS managed analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Field experiment was conducted to assess the effect of nitrogen and farmyard manure (FYM) on leaf content of pear cv. Punjab Beauty. The 15 treatments comprised of nitrogen levels i.e. 0, 200, 400, 600 and 800 g per plant and farmyard manure i.e. 30, 60 and 90 kg/plant. The nitrogen leaf content of pear increased with increasing doses of nitrogen whereas phosphorus and potassium leaf content decreased. The pear leaves nitrogen content was 2.43% with 800 g nitrogen/plant. The nitrogen, phosphorus, and potassium nutrient content of leaves increased with increasing doses of FYM. The maximum leaves nitrogen 2.41%, phosphorus 0.20% and potassium 1.37% nutrient content with application of 90 kg of manure/plant. The interaction between nitrogen and FYM is positive impact on leaves nutrient content. The nitrogen 2.51%, phosphorus 0.19% and potassium 1.35% was recorded with 600 g nitrogen and 90 kg/plant. Further, regression analysis revealed that leaf nitrogen content (R^2 = 0.979) influenced the fruit yield and fruit weight significantly. It is concluded from this study that 600 g nitrogen along with 90 kg FYM was optimum doses for Japanese pear for better leaves nutrient status, higher fruit weight, and yield of pear fruit crop.

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Keywords: Farmyard manure; Japanese pear; leaf nutrient content; nitrogen; yield.

1. INTRODUCTION

Pear is the most important pomes fruit after apple and belongs to family Rosaceae [1]. It is mainly grown in temperate regions. However, there is also limited acreage in sub-tropical areas. Pear is considered as the third deciduous fruit and fourth important fruit among all fruit crops throughout the global market [2]. Punjab Beauty is a semi-soft variety of pear, usually upright in growth forms. This cultivar requires low (150-200 h) chilling hours and growers are more enthusiastic to grow due to its regular bearing and high yielding traits. The yield and quality of pear primarily depend on type of cultivar, pollination, and fertilization level [3]. Natural soil fertility and nutrient sources such as manures, organic amendments, and chemical powders can change fertility management strategies. To sustain soil fertility and retain productivity for a longer period, it is essential to enrich soil using chemical fertilizer along with sufficient organic fertilizer. Moreover, fruits are considered to have better shelf life grown with FYM alone [4]. The alternative crop management systems are being promoted on the basis that they are more environmentally benign and specifically enhance soil and water quality relative to conventional practices. Nitrogen, phosphorus, and potassium are most indispensable of all mineral nutrients for growth and development of the plant as these are the basis of fundamental constituents of all living matter [5].

Nitrogen is required in relatively greater amount by fruit plants. The integrated use of mineral manures with chemical fertilizers improves physico-chemical properties of soil besides improving the efficiency of applied chemical fertilizers, which helps in the improvement of yield and other components [6]. The growth and fruitfulness of a plant depends on nutrient status of the leaf. Leaf constitutes a vital organ in plants and accomplishes important metabolic functions relating to the maintenance of growth and reproductive processes. It is the donor organ from which nutrients and other assimilates are translocated to various sinks to support activities and considered, as a most important index tissue to assess the nutrient status of a plant. Thus, analysis of leaves for elemental composition is a better tool to assess the fertilizer requirement by trees [7]. Literature pertaining to use of organic manures alone or in combination to fulfill the nutrient need of pear is very scanty. If correct sampling is adopted, the leaf analysis offers the most accurate and reliable diagnostic strategy for examining the nutritional status of trees [8]. Hence, the present study was undertaken to evaluate the effect of different combination of nitrogen and organic manure on leaf nutrient content of Japanese pear (*Pyrus pyrifolia*) cv. Punjab Beauty.

2. MATERIALS AND METHODS

The present investigation was carried out at CCS Haryana Agricultural University, Hisar**,** India during 2012-13 and was aimed to find out the effects of the nitrogen and farmyard manure doses on fruit quality of pear cv. Punjab Beauty. The study was conducted on 11 years old pear plants, uniformly grown with all optimal cultural practices. The study area is located at 29º 10' N latitude and 75º 46' E longitude with an elevation of 215.2 meters above mean sea level. The climate of the region is semi-arid and sub-tropical having cold winter and hot summer. Monthly metrological data were recorded during the period of experimentation of 2012 by Department of Agricultural Meteorology, CCS Haryana Agricultural University, Hisar (Fig. 1). The soil of the orchard was sandy loam in texture with organic carbon 0.37 per cent, pH 7.8, electrical conductivity 0.48 dSm^{-1}, nitrogen 83 kg ha^{-1}, phosphorus 17 kg ha^{-1} and potassium 348 kg ha^{-1}. The soil fertility status of experimental orchard field was determined before the start of the experiment. The available N (kg/ha) in soil was determined with the help of alkaline permanganate method as suggested by [9]. The available P (kg/ha) in soil was determined with the help of Olsen et al. method [10] and available K (kg/ha) in soil was determined with the help of flame photometric method as suggested by Jackson (1973). Urea as the source of nitrogen were applied to the plants.

FYM characteristic	
Nutrients	**Content**
Nitrogen %	0.57
Phosphorus %	0.23
Potassium %	0.52

The experiment has conducted in completely randomized block design. The experiment has 15 treatments in which nitrogen levels (0, 200, 400, 600 and 800 g) and farmyard manure 30, 60 and

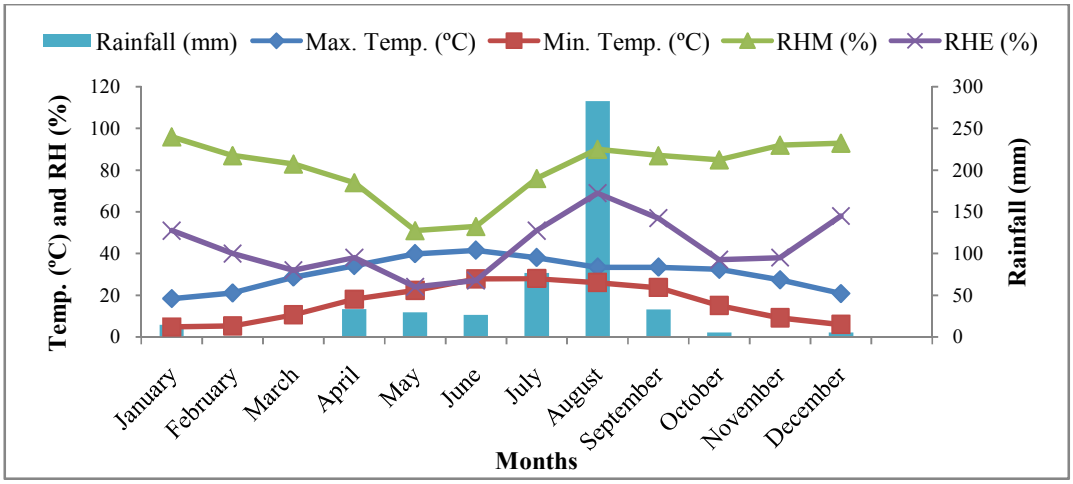

Fig. 1. Monthly metrological data recorded during the period of experimentation of 2012
Source: Department of Agricultural Meteorology, CCS Haryana Agricultural University, Hisar

90 kg/plant. Basal dose of 2 kg single super phosphate and 1.5 kg murate of potash and full FYM per tree and half dose of nitrogen was applied in December and remaining nitrogen in April. For the determination of N, P and K, a ground leaf sample of 0.5 g was placed in a conical flask and 12 ml of diacid mixture (H_2SO_4: $HClO_4$ in 9:1 ratio) was added and digested on a hot plate following the method described by [11] for determination of nitrogen. The leaves phosphorus content was determined by using Vanado-molybdo phosphoric acid yellow colour method of [12] and expressed in percent. The potassium content was determined from the digested extract on Flame photometer. The contents were calculated and expressed in percent on dry weight basis. The obtained results were statistically analyzed by analysis of variance for RBD using IRRISTAT data analysis package (IRRI 2000) at a significance level of $\alpha = 0.05$.

3. RESULTS AND DISCUSSION

The nitrogen content of pear leaves increased with increasing doses of the nitrogen fertilizer application. It was observed that maximum nitrogen leaves content was 2.43% with 800 g nitrogen/plant, and minimum in control 2.15%. The nitrogen content of pear leaves was significantly higher in 800 g nitrogen/plant as compared to control. The FYM application also increased the nitrogen content of pear leaves. The maximum leaves nitrogen 2.41% was found with application of 90 kg FYM/plant that is significantly higher than with 30 kg FYM/plant. There is also positive relationship with nitrogen and farmyard manure on leaf nitrogen nutrient. The maximum leaf nitrogen 2.54% was obtained with 800 g nitrogen and 90 kg FYM. These observations are in close agreement with those of [13] in apple, [14] in peach leaves. [15] reported in leaves of guava cv. Pant Prabhat. The maximum nitrogen leaf content is due to availability of NH_4^+ and NO_3^- in aqueous solution, as sufficient urea and FYM were applied.

It is evident from data that phosphorus and potassium contents in leaves decreased with increasing application of nitrogen but increased with increasing application of FYM. Similar results were reported in orange by [16] [17] and [18] in lemon tree. The maximum phosphorus 0.20% was obtained without nitrogen and minimum with 800 g nitrogen/plant. Maximum phosphorus was observed with application of 90 kg FYM/plant. The potassium nutrient content was decreased significantly with increasing levels of nitrogen. The maximum potassium 1.33% was obtained without nitrogen and minimum 1.24% with 800 g nitrogen/plant. The interaction between nitrogen and farmyard manure was non-significant with related to potassium leaves content. Similar, results were obtained by [19] in litchi cv. Bombai. In addition, FYM improved the physical conditions of soil, root development and more soil moisture of water and nutrients and, consequently improved leaf nutrient status [20]. The P levels in leaf increased by application of different composition of bio and chemical fertilizer due to fact that phosphorus solubilizing microbes present in the soil solubilize fixed phosphorus and make it easily available to the plant [21]. Moreover, farmyard manure is good source of all nutrients resulting in improved leaf nutrient leaf.

Table 1. Effect of Nitrogen and FYM fertilizer application on Nitrogen (%), phosphorus (%) and potassium (%) nutrient content leaf of pear cv. punjab beauty

FYM (kg plant^{-1})	Nitrogen (g/plant^{-1})					
	0	200	400	600	800	Mean
30	2.06	2.12	2.17	2.23	2.31	2.18
60	2.15	2.21	2.27	2.37	2.44	2.29
90	2.24	2.33	2.41	2.51	2.54	2.41
Mean	2.15	2.22	2.28	2.37	2.43	
CD (p = 0.05)	Nitrogen = 0.20, FYM = 0.21, Nitrogen x FYM = N.S					
	Phosphorus (%)					
30	0.18	0.17	0.17	0.16	0.14	0.16
60	0.19	0.18	0.17	0.18	0.16	0.18
90	0.22	0.21	0.20	0.19	0.17	0.20
Mean	0.20	0.19	0.18	0.18	0.16	
CD (p = 0.05)	Nitrogen = N.S, FYM = N.S, Nitrogen x FYM = N.S					
	Potassium (%)					
30	1.26	1.25	1.23	1.21	1.18	1.23
60	1.31	1.30	1.28	1.25	1.22	1.27
90	1.41	1.40	1.37	1.35	1.32	1.37
Mean	1.33	1.32	1.29	1.27	1.24	
CD (p = 0.05)	Nitrogen = 0.02, FYM = 0.02, Nitrogen x FYM = N.S					

Table 2. Correlation coefficient and regression equations between independent (X) and dependent variables (Y) on mean basis

Dependent variable (Y)	Independent variable (X)	Correlation coefficient (r)	R^2	Regression equations Y= a + b X
Yield per plant	N	0.989^{**}	0.979	Y = 41.826-69.006 X
Yield per plant	P	-0.107^{NS}	0.011	Y = -31.339 + 32.422 X
Yield per plant	K	0.128^{NS}	0.016	Y = 10.986 + 12.638 X
Fruit weight per plant	N	0.954^{**}	0.910	Y = 75.985 – 75.048 X
Fruit weight per plant	P	0.089^{NS}	0.008	Y = 49.465 + 90.139 X
Fruit weight per plant	K	0.320^{NS}	0.103	Y = 51.811 + 32.207 X

NS = Non significant, **Significant at 1 per cent level of probability

Further, Table 2 shows that fruit yield per plant is positively correlated with leaf nitrogen, but leaf P & K contents do not show significant correlation with fruit yield. Similarly, fruit weight is also positively correlated with leaf nitrogen. Among independent variables leaf nitrogen content (r = 0.989), exhibited high significance at 1% level and positively correlated with fruit yield per plant. Fruit weight also showed positive correlation with leaf nitrogen. Further, the relationship (Y = a + b X) between fruit yield per plant, fruit weight and NPK content in leaf showed that leaf N content alone was responsible for 99% predictability of fruit yield and 95% of fruit weight.

4. CONCLUSION

Analysis of leaves for elemental composition is a better strategy to assess the fertilizer requirement by tree. By knowing the status of leaf, we can diagnose the crop nutrient status, and predict the fruit weight and fruit yield. It is concluded from this study that 600 g nitrogen/plant along with 90 kg FYM was optimum doses for Japanese pear for better leaves nutrient status, higher fruit weight and yield of pear fruit crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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