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Effect of organic manure and nitrogen on pear: A review

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Abstract
Manuring and fertilizer application play a vital role in the growth and productivity of fruit trees. A well-nourished fruit tree not only produces good yield but also improves quality and remains for longer period in healthy and productive condition. Nitrogen and FYM is important for normal growth of the plants. Nitrogen is the key element of structure of amino acid, plays significant role in protein synthesis, increased chlorophyll content and rate of photosynthesis. The vegetative growth is mainly dependent on the supply of nitrogen and helps better development of root system. Nitrogen increasing the assimilating process through glycolysis and fatty acid synthesis. The effectiveness of inorganic fertilizers is greatly enhanced when it is applied along with FYM, which may be because of the organic matter helps in retaining urea in root zone and making the phosphate and potash available to plant.

Keywords: Farm yard manure, growth, pear, soil application, yield

Introduction
Pear (*Pyrus pyrifolia* Nakai), a member of Rosaceae family, which is next only to apple in importance, acreage and production, is one of the most important temperate fruit crops of Northern India. China ranks first in pear production in the world (Anonymous, 2017) [1]. It is found growing wild in temperate regions of Europe and Western and Central Asia. In India, pear is mainly grown in the hills of Jammu and Kashmir, Punjab, Himachal Pradesh, Uttarakhand and Haryana. However, selection and development of low chill cultivars had made its cultivation possible in subtropical region also. The low chill requiring cultivars like Le Conte, Patharnakh and Baggugosha are quite successful in northern plains of India. In Punjab and Haryana, the major area is under sand pear (Patharnakh) and area under semi-soft pears (Le Conte and Baggugosha) is increasing at a faster rate. The quality of semi-soft pears is good and fetches premium price in the market. The total pear production in world was 24895000 tonne and 352000 tonne in India (Anonymous, 2017) [1]. It is highly nutritious in nature having 0.36 g protein, 3.1 g fiber, 9 mg calcium, 12.0 mg phosphorus, 0.18 mg iron, 20.0 IU vitamin A, 0.012 mg thiamine, energy 57 kcal, 0.26 mg riboflavin, potassium 116 mg, 0.1 mg nicotinic acid and 4.3 mg ascorbic acid per 100 g edible fruit (Anonymous, 2012) [2]. Even the diabetic patients can consume the pear fruit because of low sugar content, and it helps in maintaining a desirable acid base balance in human body (Anonymous, 1969) [3]. Its fruit is mostly used for table purpose, but in Western countries, a substantial portion of the crop is subjected to juice, canning, and wine making. The waste left after canning is good for making vinegar, Brandi, or alcohol. The pear cultivars can be classified according to their chilling requirement. High chill requiring (about 1200 h) cultivars are mainly grown at higher elevation in Jammu and Kashmir and Himachal Pradesh, while low chill requiring cultivars like Patharnakh, Baggugosha can be grown in subtropical parts of the country. In subtropical region mainly Punjab and Haryana, the cultivars like hard pear (Patharnakh) and semi-soft cultivars like Punjab Beauty, Punjab Nectar, and Punjab Soft are recommended for cultivation. These cultivars require low (150-200 h) chilling hours (Bose *et al*., 1991) [4]. The growers are more enthusiastic to grow Punjab Beauty cultivar of semi-soft pear due to its regular bearing and high yielding traits. The nutrition management in crops is a complex subject involving interplay of many factors. The physico-chemical conditions of the soil in the rhizosphere, the agro-climatic parameters and the cultural practices are important considerations for evolving the nutrient strategy. The plant factor in the perennial crops like fruits, adds still more complexities to the subject.

The continuous growth of the trees, changing root zone and its nutrient absorbing efficiency with the advancing age, varying nutrient needs during seasons and age of plant and the dynamic nutrients status of soil are to be satisfied through a regulated supply of the nutrients to meet the demand of plants at a particular stage. It is with this background that the hypothesis of supplemental application of nutrients has been proposed and probed.

The precise manipulation to achieve the desired and response are of course, difficult. It is not only the status of essential nutrients in soil which affects the tree nutrition, the presence and amount of other elements and their forms also play a significant role in determining the availability, transport and absorption of nutrients at the soil:root interphase. Despite these limitations, application of fertilizers is a common practice to ameliorate the level of particular nutrient element in the soil to get favorable response on growth, yield and fruit quality. The pear trees in north-west plain region of India resume growth in February. In Haryana, fertilizer application is recommended as full dose of farmyard manure, phosphate and potash to be given in December. In case of nitrogen, half quantity is added in February and the second half dose in April after setting fruits. However, most of the plantation of semi-soft pears exhibit shy bearing habit. The shy bearing habit may be due to one or more reasons like floral incompatibility, hormonal imbalance, poor tree nutrition, *etc*. One of the possible causes of variation in the cropping performance of apple was the difference in the flower development, which was directly affected by nitrogen nutrition (Williams, 1965) [5].

Effect of organic manure and nitrogen on growth parameters

Lombard *et al*., (1982) [6] reported an increase in shoot growth with three consecutive annual applications of nitrogen to Bartlett pear tree @ 120 kg/ha. Sugar *et al*., (1992) [7] observed that nitrogen applied late in the season, immediately before harvest, is not partitioned to the fruits but is stored then remobilized in the following spring during flower development. Roan *et al*., (1997) [8] reported that nitrogen application after June drop significantly increased the horizontal shoot length and number of leaves in pear. Singh *et al*., (2003) [9] reported maximum shoot growth (44.1 cm) in pear cv. Punjab Beauty as compared to Punjab Gold and Punjab Nectar. In pear cv. Bagugosha, Yadav and Bist (2003) [10] observed that the lateral and terminal shoot growth increased significantly with the application of nitrogen beyond 50 g/tree/year. The shoot length of plant gradually increased with the application of higher doses of nitrogen in pear cv. Red Bartlett (Kumar and Chandel, 2004) [11]. Lombard *et al*., (1982) [6] reported that three consecutive annual nitrogen applications to Bartlett pear tree at 120 kg/ha increased the number of expanded shoot leaves. Among different cultivars of pear, Singh *et al*., (2003) [9] reported the highest leaf number (49.83/plant) in Punjab Gold in comparison to Punjab Nectar. In case of Le Conte pear, the application of urea as autumn sprays (2% and 6%) had no effect on fruit set (Khattab *et al*., 1981) [12]. A single spray of urea (5% or 10%) to Comice pear tree at post-harvest stage did not increase fruit set significantly (Sanchez *et al*., 1990) [13]. In similar studies conducted on Comice pear, Khemira *et al*., (1998) [14] reported that fruit set increased with autumn application of urea (5 or 10%) as spray immediately after harvest. Yadav and Bist (2003) [10] observed that the percent fruit set increased significantly with nitrogen application beyond 50 g/tree/year and the maximum being with highest dose of nitrogen, i.e., 100 g/tree/year, in pear cv. Bagugosha. Ystaas, (2009) [15] studied the nitrogen fertilization of 'Moltke' pear trees soil applications with different rates of N application. No effect of different nitrogen applications on trunk cross-sectional area was found in pear. Fawzi *et al*., (2010) [16] noted that, the best results with regard to vegetative growth (shoot length and leaf area) were obtained when "Le Conte" pear trees treated with compost 45kg/tree + biofertilizes 20g/tree. Kumar *et al*., (2013) [17] reported that application of NPK (600:400:400 g) + 20 kg FYM plant^{-1} significantly increase per cent increase in plant growth, plant spread and fruit set as compared to control in pear cv. Gola. Xie *et al*., (2013) [18] showed that, in pear different organic fertilizer treatments could improve the soil microbial quantity and contents of soil microbial biomass carbon (SMBC) and soil microbial biomass nitrogen (SMBN) in the whole growth period compared with the no fertilization and organic inorganic compound fertilizer. Khan *et al*., (2016) [19] observed that application of 800 g nitrogen and 90 kg FYM plant^{-1} significantly improved shoot length, number of leaves per branch, fruit set and fruit retention in pear cv. Punjab Beauty.

Effect of Organic Manure and Nitrogen on Yield parameters

It is well known fact that application of manure and fertilizers not only affects growth and vigour but also affects the crop yield. Lombard *et al*., (1982) [6] reported that three consecutive annual nitrogen applications to Bartlett pear trees at 12 kg/ha increased yield as compared to no nitrogen application. Roan *et al*., (1997) [8] found that application of nitrogen fertilizer to sand pear at bud burst stage produced more number of fruits and yield per tree. Kumar and Chandel (2004) [11] obtained maximum fruit yield with the application of 700 g nitrogen/tree, 350 g phosphorus/tree, and 700 g potassium/tree in pear cv. Red Bartlett. Kumar and Chandel (2004) [11] observed maximum fruit weight with the application of NPK (700:300:600 g/tree) but found no effect on fruit length in pear cv. Red Bartlett. Dhillon *et al*. (2007) [20] recorded more (55.65%) juice content in cultivar Punjab Gold as compared to Punjab Beauty (55.40%). Jordao *et al*., (2008) [21] conducted an experiment and observed that application of nitrogen 50 kg ha^{-1} produced maximum yield of in Portuguese pear cv. Rocha. Ystaas (2009) [15] studied the nitrogen fertilization of 'Moltke' pear trees soil applications with different rates of N application. No effect of different nitrogen applications on fruit set, yield, yield efficiency, and fruit size was found. Kumar *et al*., (2013) [17] reported that application of NPK (600:400:400 g) + 20 kg FYM plant^{-1} significantly increase fruit weight, number of fruit per tree and fruit yield as compared to control in pear cv. Gola. Khan *et al*., (2016) [19] observed that application of 600 g nitrogen along with 90 kg FYM had significantly improved fruit set (6.95%), fruit retention (25.14%), fruit weight (113.87 g), number of fruits/tree (318.0) and yield (36.23 kg/tree) as compared to control in pear. Arba *et al*., (2017) [22] studied the impact of different levels of nitrogen and phosphorus on pear. It was observed that nitrogen mineral fertilization improved fruit yield, mainly fruit size (weight and dimensions).

Effect of organic manure and nitrogen on quality parameters

Optimum nutrition is the most important factor governing sweetness of fruits. The TSS of fruit increased with the

application of higher doses of nitrogen in guava. Raese *et al*., (1989) [23] observed that excessive soil N availability may delay fruit maturation, have negative impact on fruit T.S.S and decrease plant tolerance to pest and disease as psylla (Cacopsylla pyri L.). Sugar *et al*., (1992) [7] concluded that excessive soil nitrogen application decrease plant tolerance to pest and occurrence of post-harvest disease blue mould (*Penicillium expansum*) on Conference. In pear cv. Bagugosha, Yadav and Bist (2003) [10] observed no significant effect of increasing levels of nitrogen on total soluble solids of fruits. However, acidity of fruits decreased significantly beyond 60 g/tree/year and lowest being in fruits obtained from the trees supplied with nitrogen 90 g/tree/year. Kumar and Chandel (2004) [11] observed that different levels of nitrogen did not influence the TSS and acidity of pear cv. Red Bartlett. Acidity in fruits present in reasonable limit imparts desirable taste and its absence in optimum concentration gives an insipid taste. However, in excess, it may make the fruits unpalatable even if other components are optimum. In pear cv. Bagugosha, Yadav and Bist (2003) [10] noticed no significant effect of nitrogen on total sugars. Similar results were obtained by Kumar and Chandel (2004) [11] in pear cv. Red Bartlett. The maximum TSS and sugars were recorded with application @ 800 g nitrogen and 90 kg FYM/plant and minimum in control. Daugherty *et al*., (2007) [24] concluded that excessive soil nitrogen application decrease plant tolerance to pest and disease as psylla on Bartlett pear. Kumar *et al*., (2013) [17] reported that application of NPK (600:400:400 g) + 20 kg FYM plant^{-1} significantly increase fruit T.S.S, ascorbic acid, total sugars, reducing sugar and non-reducing sugars of fruit as compared to control in pear. Rai *et al*. (2009) [25] showed that, application of 40 kg vermicompost per tree significantly increased the yield and yield attributing characters of pear. The quality parameters TSS, acidity, ascorbic acid content and reducing sugars content of pear cultivar Gola were also found best with the application of 40 kg vermicompost/tree. Ystaas, (2009) [15] studied the nitrogen fertilization of 'Moltke' pear trees soil applications with different rates of N application. No effect of different nitrogen applications on fruit quality was found on pear. Arba *et al*., (2017) [22] studied the impact of different levels of nitrogen in pear. The result showed that fruit quality was not significantly affected with different levels of nitrogen. Khan *et al*. (2017) [26] conducted an experiment with different levels of nitrogen and FYM on pear. It was observed that application of fertilizer also increased sugar content of fruits up to 600 g nitrogen 90 kg FYM and after it was not increase.

Effect of organic manure and nitrogen on Leaf NPK content

The leaf analysis offers the most accurate and reliable diagnostic tool for examining the nutritional status of trees (Srivastava *et al*., 1993) [27]. Sanchez *et al*., (1991) [13] applied nitrogen fertilizers on different dates on pear (*Pyrus communis*). It was reported that was reported nitrogen fertilizers applied 3-6 weeks before harvest increased N in above-ground storage tissues without producing excessive N in shoot and fruit. Fawzi *et al*. (2010) [16] observed application of FYM along with biofertilizers help gave best uptake of potassium which in turn and accounted for the highest leaf K content in pear. Kumar *et al*., (2013) [17] reported that application of NPK (600:400:400 g) + 20 kg FYM plant^{-1} significantly increase fruit leaf content of pear as compared to control in pear cv. Gola. Ystaas (1980) [28] studied and reported that foliar application of 6% urea increase leaf content of pear. Khan *et al*. (2017) [29] conducted an experiment with different levels of nitrogen and farm yard manure on leaf content of pear. It was observed that maximum nitrogen content of leaf (2.43%) was obtained with highest dose of nitrogen @ 800 g and FYM 90 kg FYM per plant in pear.

Conclusion

The perusal of the literature suggests that farm yard manure and nitrogen fertilization rate are the most important agro-inputs which describe the pear yield and quality to a major extent. The effectiveness of inorganic fertilizers is greatly enhanced when it is applied along with FYM. Farm yard manure is a valuable soil improver which enhances and restores a range of natural properties including soil fertility. Nitrogen application is utmost important to a certain level and excessive nitrogen application decrease plant tolerance to pest and disease in pear.

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