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Nutrient management strategies to enhance Litchi production

Litchi **is known as 'Queen of Fruits' due to their attractive pericarp colour and possesses a rich source of neutraceutical, therapeutical and medicinal properties; taste and aroma. It is in a great demand in both domestic and global markets and has emerged as one of the most remunerative and lucrative enterprises. It is commercially grown in the states of Bihar, Jharkhand, Uttar Pradesh, Uttarakhand, West Bengal, Punjab, Haryana, Union Territory of Jammu & Kashmir etc. The litchi industry has expanded rapidly during the last 10 years; wherein, area has increased substantially from 74,400 ha in year 2009-10 to 95,000 ha in the year 2018-19 (IIIrd Advance Estimate, NHB) to the tune of about 27.6%, fruit production over 47.1% and fruit productivity by 17.8% in the country. The litchi fruit industry is growing rapidly in sub-mountainous regions of Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir due to favourable soil and unique agro-climatic conditions. The establishment of litchi-oriented state sponsored projects such as 'Litchi Niche' area in the Jammu region, and Litchi estate in Punjab also further give momentum to litchi cultivation in Northern regions of India.**

AN adequate supply of nutrients to litchi plants is the main criterion which contributes significantly for the higher production of quality fruits. Besides, the potential yields are reduced drastically due to the poor availability of nutrients. New vegetative flushes in litchi depend upon the reserved or availability of photosynthates/ carbohydrates rather than the annual application of recommended fertilizers. The visual symptoms of nutrients deficiency occur due to the lower availability of nutrients, antagonistic soil nutrient interactions, soil *p*H, etc. According to estimates, one tonne of litchi fruit annually removes about 2.2 kg N, 2.2 kg P_2O_5, 6.6 kg K_2O, 1.6 kg CaO and 1.1 kg MgO from the soil. In India, an average fruit productivity of about 7.65 MT/ha has been documented; thus, on an average, fruits remove about 16.8 kg N, 16.8 kg P_2O_5, 50.5 kg K_2O, 12.2 kg CaO and 8.41 kg MgO nutrients from the soil system. To compensate the nutrients loss, growers are applying the organic and inorganic fertilizers regularly for the sustainable fruit production. The plants of litchi produce higher yields of good quality when applied with optimum level of nutrients even under soils inherited low fertility level. Fertilizers contribute about 50-70% towards the fruit yield and the drastic reduction of fruit yield and quality has been witnessed due to improper fertilizers schedule. At the same time, excess application of fertilizers especially N, P, K contents not only results in economic loss but also causes environmental pollution and higher incidence of insect-pests and diseases. The litchi crop needs micro-nutrients in addition to N, P and K fertilizers. Thus, growers should add organic and inorganic fertilizers to sustain fruit yield, quality and soil health. Hence, risk of fruit yield and economic losses resulting from nutrients deficiency may be mitigated. The aim of the nutrient management is to maintain the optimal nutrients level, good plant health and production of maximum fruiting shoots.

Soil and leaf analysis

The soil and leaf analysis are considered as reliable norms and should be linked to ascertain the nutritional status of orchards, nutrient disorders and to guide/develop fertilizers scheduling in fruit crops. The soil samples at the depth of 0-15 cm and 15-30 cm from the orchards should be tested after 2-3 years so that nutrient status may be judged well in advance before the appearance of any nutritional deficiency. Recent studies also revealed that 4-5 months old leaves from autumn flush should be collected from 2nd and 3rd pair of leaflets from the apex of terminal litchi shoots at the advent of panicle initiation (February-March) to assess the nutritional concentrations of litchi orchards. Leaf samples should be collected from North, South, East and West directions from healthy shoots at the workable height of approximate 6-7 feet from the ground level.

Diagnosis of deficiency symptoms

Nitrogen: Nitrogen is a mobile nutrient in plant system; thus, it is translocated easily from older leaves to younger

Deficiency symptoms of Nitrogen in litchi

Deficiency symptoms of Phosphorus in litchi

Deficiency symptoms of Potassium on litchi

Deficiency symptoms of Calcium in litchi

Deficiency symptoms of Magnesium in litchi

Deficiency symptoms of Zinc in litchi

Deficiency symptoms of Iron in litchi

Deficiency symptoms of Boron in litchi

Deficiency symptoms of Manganese in litchi

Deficiency symptoms of Copper in litchi

leaves under low soil nitrogen content. The deficiency of N nutrient causes yellowing of older lower leaf and mostly entire plant foliage shows light green colour appearance. Under severe deficiency conditions, a pale-yellow chlorosis starts from the tip of older leaf and gradually whole leaf portion becomes pale brown in colour. The N deficiency also leads to poor branching, reduces fruit yield by increasing the proportion of undersized fruits and defoliation throughout the year. In litchi, N deficiency generally retards the leaflet size, new growth, emergence of panicles and root growth. The deficiency of nitrogen generally appears in the soils with lower organic carbon content, light textured soils, intensive cropping system and water logged conditions.

Phosphorus: The deficiency of phosphorus causes stunted vegetative growth, smaller leaflet size and lower fruit production. Older leaves develop a characteristics dark to light green colouration that tends to change towards the reddish-brown or purple tinge. Interveinal leaf necrosis and leaf dropping are also visualized. As the deficiency becomes severe, brown necrosis starts to appear on leaf tip and proceeds further to midrib, leaves curl and premature leaf drop. The P deficiency generally appears in the regions with low soil organic carbon content, soils exhausted by intensive or inter cropping, acidic soils and soils where topmost soil has been removed.

Potassium: The deficiency of K content causes reduction of internodal length, and generally losses its healthy and dark green leaf growth. The K being a mobile nutrient in plant system, the actively growing younger leaves translocate K from older leaves, while younger leaves generally remain green. The deficiency symptoms include the appearance of pale-yellow chlorosis on the tips of old leaves and finally cause necrosis of leaf margins. The deficiency of K is also responsible for the poor fruit set, fruit size, pericarp colour and pulp/stone ratio. The deficiency of K nutrient generally appears in the soils with light texture, lower in organic content and soils higher in Na, Mg, Ca concentrations, soils irrigated with high bicarbonate content and soil with pH < 6.0.

Calcium: The branches of the litchi remain stunted, short and yield is also reduced drastically due to Ca deficiency. The Ca nutrient is relatively immobile in the plant system; thus, its deficiency first appears on the younger leaves. The newly emerged leaves usually malformed and gives plant a shabby appearance. The deficient leaf shows necrotic patches in the interveinal tissues which grow towards leaf margin. The deficiency appears in sodic soils with high exchangeable sodium percentage, low calcium content, and highly leached acidic sandy soils.

Magnesium: The magnesium is a mobile nutrient and it is easily mobilised from older leaves under lower soil moisture conditions. Older leaf becomes pale green and the develops into pale yellow interveinal chlorosis, low branching, necrotic leaf margins and leaf dropping. The plant doesn't grow vigorously and shows dull appearance. The deficiency symptoms generally appear in the soils with high Ca or K content, acidic soils with low cation exchange capacity and leaching due to heavy rainfall.

Zinc: Zinc deficiency causes stunted vegetative growth, pale, smaller leaflets; bronzing, smaller fruits with lower pulp/stone ratio and sugars content. The deficiency of Zn content generally appears on fully mature newly emerged leaf as irregular interveinal chlorosis where veins remain green. It has also been observed that the fruit does not develop its characteristic colour under severe Zn deficiency. Deficiency appears in soils with pH >7.5, leached sandy soils, soils with excessive application of phosphoric fertilizers and high bicarbonate content. The deficiency of zinc intensifies under higher application of nitrogen fertilizers.

Iron: The iron nutrient is immobile in the plant system; thus, it is not transferred from older to younger leaves so its deficiency appears as chlorosis of young leaves, spread to older leaves and die back of branches take place under severe conditions. The iron deficiency appears in the soils with low organic matter and high pH, calcareous soils with high bicarbonates reduces the solubility and uptake and soils with excessive application of phosphatic fertilizers.

Boron: Leaf becomes short, bloom show wilting and necrotic symptoms, reduction in pollen viability, poor fruit set and causes fruit cracking due to boron deficiency. The boron deficiency also causes flower and fruit drop, produces misshapen fruits. The deficiency symptoms appear in light textured leached soils, calcareous soils, soils excessive fertilizes with potassic fertilizers, etc.

Table 1. Application of fertilizer

Age of plant (Years)	Urea (g/plant)	SSP (g/plant)	MOP (g /plant)	FYM (kg/plant)
1-3	150-500	200-600	60-150	10-20
4-6	500-1000	750-1250	200-300	25-40
7-10	1500-1500	1500-2000	300-500	40-50
10 or more	1600	2250	600	60

Table 2. Application of micro-nutrients

Nutrient	Dose and Fertilizer	Mode of application	Time of application
Zinc	0.2% Zinc Sulphate	foliar application	February-March
Copper	0.2% Copper Sulphate	foliar application	February-March
Manganese	0.2% Manganese Sulphate	foliar application	Vegetative growth
Boron	0.2 % Boric acid	foliar application	Fruit development

Copper: The copper deficiency symptom appears on older leaves due to its immobile nature in the plant system. Leaf remains short with symptoms of interveinal pale greenish to pale yellow colour. New emerging branches shows die back symptoms and downward bending of leaf margin under severe deficiency. The copper deficiency appears in alkaline and calcareous soils, leaching in acidic soils, higher organic matter that binds the copper nutrient and reduces its availability. The availability of Cu to plant reduces due to excess soil N, P and Zn levels.

Manganese: It is an immobile nutrient in plant, so retranslocation from older leaves and woody parts is very slow. The symptoms are characterized as development of pale-yellowish interveinal chlorosis in the middle portion of the older leaves that proceeds towards the tip and further to leaf base. The purplish lustre may also develop on the upper surface of the leaves. The Mn deficiency is not common but it may appear in the light textured soils.

Nutrient management through fertilizer applications

Fruiting is an exhaustive process that removes a large amount of nutrients from the soil. To prevent the adverse affects of nutrient deficiency in the plant, fertilizer is applied according to the tree age.

Time of fertilizers application

The proper fertilizers schedule needs to be followed with the plantation of the litchi seedlings in the orchard. In the early phase of orchard establishment, the goal of the farmers should be to establish health plantation, instead of realizing any yield from the plants. Generally, the newly established plantation doesn't require the substantial quantity of fertilizer; however, FYM is applied in sufficient quantity under low fertile soils. This practice not only provides nutrients to the growing plant but also improves soil health and water and nutrients holding capacity of the soils. During the pre-bearing stage, Urea should be applied in three equal split doses in February-March, June-July and August-September. During bearing stages, urea should be applied in two equal splits, half in the mid-February and other half dose after fruit set during April. FYM, SSP and MOP should be applied in the month of December. If plant shows any symptom of the micro-nutrient that nutrient may be sprayed as and when it is required.

Method of fertilizer application

The roots of the litchi do not penetrate deep in the sub soil and remains concentrated in the top 60-90 cm soil layer. The fertilizers should not be applied near the base of the plants to avoid any injury to the plant. The manures and fertilizers should be applied in the circle about one metre inside the canopy of the plant and be mixed in the soil. If the soil moisture is low at the time of fertilizer application, light irrigation may be applied.

A pit of 1 m × 1 m × 1 m should be dug to facilitate better root penetration. Pit is exposed to sunlight for at least 15 days to disinfect the soil. Add 15 ml Chlorpyriphos 20 EC after mixing in about 2 kg of soil to each pit for protection against white ants. The soil in pit for litchi plantation should be mixed with soil collected from the root zone of litchi orchards as it contains *Mycorrhizae* fungus which helps in the improvement of nutrients uptake and roots development. The pits must be filled to the height of about 2-5 cm above the ground level with the mixture of well rotten farmyard manure, silt and top soil in equal proportions. Irrigation is then applied thoroughly, so that the loose soil settles down properly.

SUMMARY

The widespread nutrient deficiencies can be managed with the application of the recommended dose of fertilizers that will be helpful in realizing higher litchi production in the country.

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