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Manuring needs of tea (*Camellia sinensis*) in Southern India

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Tea (*Camellia sinensis*) is an important plantation crop. India has 5, 63, 980 ha land under tea of which 1, 05,685 ha is in Southern India. In India states like Assam (53%), West Bengal (23.9%), Tamil Nadu (11.3%) and Kerala (8.44%) are contributing for major tea production. It is also grown in a small scale in Tripura, Karnataka, Himachal Pradesh, Uttar Pradesh, Sikkim, Bihar, Manipur, Orissa, Nagaland and Arunachal Pradesh. Tea industry in India is more than 150 years old generating the revenue of more than Rs 6,000 crore per annum. The production of tea in India has increased from 250 million kg in 1947 to 1208 million kg in 2013 with 40 per cent increase in area. Optimum application of nutrients in right time ensures optimum tea yield.

In south India, tea areas are located on the hilly terrains. About 31.8 per cent of the tea areas in south India are at an elevation of 1,000 m, 34.5 per cent between 1,000 and 1,500m, 25.7 per cent between 1,500 and 2,000m and 8.20 per cent above 2,000m. The tea soils here are Latosols. Kaolinite is the dominant clay mineral. The soils have under- gone considerable weathering and contain large amounts of sesquioxides and hence phosphorus fixation is very strong. In most of the areas like Valparai (Anamallais) and Idukki soils coarse and fine fractions comprise 62-67 per cent of the soils. The soils of Wynaad and Nilgiris are of clay loam type with a preponderance of clay fraction. The advantage of having higher amount of organic matter in the Nilgiri soils is to a certain extent offset by the disadvantages of clay. The average rainfall in the Nilgiris is 170 cm.

The tea growing area of south India having ferruginous gravel is present on surface. The laterietes are presumed to be sedimentary. According to the geological survey of India, these laterietes soils are poor in organic matter, nitrogen, potassium and lime. The pH of soil falls in the range of 3.6 to 6.1. The productivity of most of the crops is low due to acidic soil reaction and high rate of phosphorus fixation. These soils required suitable amelioration and proper manuring requires to exhibited potentials of tea crop.

Manuring : Manuring of tea enhances vegetative growth for the harvest of tender tea leaves without affecting bush health and the reproductive phase. Manuring is contributing 17-24 per cent of the total inputs used for tea cultivation; hence, it should be used judiciously. Tea yield can be improved from 20-25 per cent by the efficient use of manures. While the basic principles of manuring are the same, the optimum fertilizer application varies from region to region and even from one field to another, depending on the local conditions.

In tea leaf, nitrogen content is found to be highest followed by potassium, calcium, phosphorus, sulphur and magnesium. Zinc has become limiting nutrient in tea growing soils. Foliage and stems are added to the soil at the time of pruning and nutrients present in them are recycled and again utilised by the crop. Similarly, leaf litter from tea bushes and loppings from shade trees also enrich the tea soils. From the total dry matter produced in pruning cycle about 10 per cent diverted to flush tea shoots, 18 per cent to mature foliage, 12 per cent to twigs, 35 per cent to thick wood and 25 per cent to roots.

Fig. 1: Healthy tea estate

Made tea contains approximately 5 per cent N, 1 per cent P_2O_5 and 2 per cent K_2O. An average crop of 2, 000 kg made tea/ha removes 100 kg N, 20 kg P_2O_5 and 40 kg K_2O/ ha/ annum in addition to a large amount of nutrients being locked up in the bushes.

Nitrogen: Nitrogen content in the flush shoot of a healthy tea plant varies between 3.5 and 5.0 per cent of the dry matter. The plant will show the deficiency symptom when

Yellowing of leaves

Fig. 2: Nitrogen deficiency in tea leaves

it decreases below 3 per cent. Nitrogen deficiency is recognised by yellowing of leaves, retardation of growth, formation of small leaves and short internodes. Tea plants are able to use either nitrate or ammonium ion but the later is preferred more.

Under favourable circumstances, the tea yield commences 3-4 weeks after the application of nitrogen fertilizer. The dosage of N is determined on the basis of anticipated yield and organic matter status of the soil. The rate of N application varies in the different years of the pruning cycle (10, 20 and 30 years cycle) depending on the yield trend and the yield built up in the successive pruning cycles. For tea soils with low, medium, high organic matter status 12, 10, 9 kg of N is recommended for tea yield up to 2000 kg/ha. Sulphate of Ammonia (SOA) is considered to be the best source of N for tea through-out the year. Calcium ammonium nitrate (CAN) is the best source of N for winter season. Urea is the cheapest source of N and, therefore, a greater portion of annual N is met by urea during moist soil conditions. In southern India, application of SOA is superior to CAN and urea for the better production of tea.

The efficiency of nitrogenous fertilizers can be increased by split application of nitrogen. Broadcasting of fertiliser N in 4 -6 splits are recommended generally. Under certain conditions, foliar application is also considered to be efficient method. However, full N requirement for tea cannot be met out solely by foliar application. It can be a supplement for the soil application especially when the roots are unable to absorb sufficient nutrients due to drought or waterlogged conditions. The optimum concentration of urea for foliar application is 1-2 per cent and it should be sprayed one day after plucking of leaves.

Phosphorus: It is one of the essential nutrient elements and it would be a limiting nutrient in tea growing acid soils. On an average, normal P content of dried flush shoot ranges from 0.18 to 0.39 per cent and less than 0.18 per cent is considered to be deficient. P deficiency is characterized by dull bronzing of recently matured lower leaves with or without brown spots and loss of glossiness. The stems become thin and the internodes of shoots become shorter and finally shedding of leaves and occasionally leading to death of plants. Phosphorus is chemically fixed as iron and aluminium phosphates and it will become unavailable to the plants. The use of rock phosphate is recommended for tea growing acid soils and it is a cheap source of P. Application of rock phosphate is recommended on the basis of soil available P and yield level. For the yield upto 3,500 kg, 60-80 kg of P_2O_5/ha is recommended when the soil P is below 22 ppm. Similarly, for the yield more than 3,500 kg of made tea/ha, 80-100kg of P_2O_5/ha is recommended provided the soil P is between 22 to 44 ppm. Broadcasting of P in tea soils had been found ineffective and therefore placement of P in holes made nearby plant is recommended. It reduces the P fixation and creates a concentration gradient which helps in the movement of P and better utilization by exploring roots. To meet the nutritional requirement, soil application of P in alternate years, supplemented by annual foliar application of DAP is practiced. The recommended rate for foliar application is 10 kg of P_2O_5/ha/annum in 5 splits

Dull bronzing of recently matured

Fig.3: Phosphorus deficiency in tea leaves

in alternate month. The most suitable source of fertilizer for foliar application is DAP at the rate of 22 kg /ha/annum (Equivalent to 10 kg P_2O_5). For each foliar spray, 4.4 kg of DAP in 250 litres of water/ha may be used.

Potassium: Potassium is one of the major nutrients for tea. Its content in dried flush shoots is 1.5 – 2.0 per cent and less than 0.7 per cent is deficient. Potassium deficiency leads to marginal necrosis of mature leaves, premature leaf fall, development of thin and twiggy wood and ultimately death of bushes. In strong acid soils with pH below 4.0, hydrogen or aluminium ions interferes with the uptake of potassium. The significance of N and K interaction was recognized as early as 1950 and the emphasis was given for adequate application of K along with N to maintain high yield. It is now recommended that N: K_2O ratio for young tea is 2:3 up to 3 years and 1:1 thereafter. In pruned year, N: K_2O ratio depends on the height of pruning. For a pruning height below 45 cm, N: K_2O ratio should be 1:2, between 45 and 60 cm at 2:3 and above 60cm, it is 1:1. In no-pruned year, the recommended N: K_2O ratio for sulphate of potash is 2:1 and for urea and CAN, it is 4:3.

The foliar application of urea and MOP imparts drought tolerance in young and mature tea. About 4-6 foliar applications of urea and MOP @ 1 per cent concentration, at monthly interval during the dry period helps to maintain turgidity of cells, reduce proline content, enhance carbohydrate reserve, reduce banji shoot formation, improve water-use efficiency and enhance the yield.

Fig.4: Potassium deficiency in tea leaves

Calcium: Tea requires fairly low amount of Ca nutrient. On an average, normal Ca content of dried flush shoot ranges from 0.3 to 0.9 per. Calcium content below 0.6 per cent is deficient and it depress the crop growth. The uptake of K is also inhibited by excess Ca in soil, especially when the soil pH is above 6.0. The pH between 4.5 and 5.0 is optimum for calcium availability for tea. The deficiency of Ca is characterized by brittleness in older leaves and discoloured laminar edges of young leaves which become dark brown in later stage. On the other hand, excess quantity of Ca in soil slows down the plant growth, young leaves become yellow and its edges curl inwards and tips turning black.

Liming: Most of the tea growing soils in southern India are acidic in nature which leads to several nutritional problems. Tea plants growing in soils with pH above 6.0 have a tendency to flower profusely. The pH of tea soil is amended once or twice in a pruning cycle by applying dolomitic lime. Liming is recommended only for mature tea plants which are under regular plucking. It is not suggested for areas to be replanted or for young tea fields. The rate of application of dolomite is decided on the basis of pH, rainfall, yield and length of the pruning cycle. However, the maximum quantity of dolomitic lime in one application should be restricted to 4 tonnes/ha and should be avoided during dry months. Liming materials do not move laterally and therefore, should be uniformly broadcasted over the soil. Application of lime improves the soils structure by flocculation and promoting crumb structure which leads to desirable aeration. It increases the availability of P by reducing the solubility of iron, aluminium and manganese which releases P from insoluble forms. Nitrifying bacterial activity is also enhanced by liming and thus the rate of organic matter decomposition better.

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