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# Integrated nutrient management (INM) in small tea gardens of Tinsukia district of Assam

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**Abstract**
Field experiment was conducted as a part of On Farm Trial (OFT) in three different villages of Tinsukia district under Krishi Vigyan Kendra, Tinsukia, Assam during 2018-2021 on Integrated Nutrient Management (INM) in small tea gardens. From the experiment, it was observed that the INM practice proved to be the best in improving yield in tea cultivation. The highest yield of 141.30q/ha was recorded in improved practice plot in the year 2020-21 and lowest yield of 125.17q/ha was recorded in the year 2018-19 in all the three locations. Similarly, highest BC ratio was observed in all the plots of the district in the year 2019-20 and lowest in farmers practice. Likewise per cent increase in yield over farmers practice was recorded from 18 to 49% which is quite satisfactory.

**Keywords:** BC ratio, improved practice, INM, on farm trial, tea plantation

## Introduction
Tea, *Camellia sinensis*, is a tree or small shrub in the family Theaceae grown for its leaves which are used to make beverages. The tea plant is branching with alternate elliptical leaves. The state of Assam is the World's largest tea growing region. Southern China and Assam are the only two regions in the World with native tea plants. Today in most of the tea producing countries, tea cultivation depends on small tea growers.

Assam has the largest tea-growing region in the world with a record number of 68,465 small tea gardens (area of 3–15 acre) and 825 large tea gardens (15 acres) (Anonymous, 2014) [1]. However, there are some problems in tea fertilization inducing large nutrient loss, higher production cost and environmental risks. These problems are mainly excessive nutrient input, low proportion of specialized compound fertilizer for tea, low substitution rate of organic nutrients and low efficient application methods such as surface broadcasting.

Compatible properties of beneficial organisms with synthetic and or organic fertilizers could be very much useful to agriculture crops for higher yield and healthy soil environment. The NK mixture at a lower dose supported bioinoculants, whereas a higher dose suppressed them. Similarly, the populations of Azotobacter and Azospirillum in the soil after harvest were markedly increased with the integrated use of biofertilizers, organic manure and chemical fertilizer system and were reduced with the exclusive application of chemical fertilizers (Rao & Venkateswaralu, 1985a, 1985b) [7, 8].

Integrated nutrient management (INM) is the maintenance and adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Bio fertilizers improve soil fertility and promote plant growth, and they are broadly classified into nitrogen fixers, phosphate solubilizers and phosphate mobilizers, and organic matter decomposers. They enhance certain biological processes by which nutritionally important elements are made available to the plants (Lian, 2002) [6].

Nutrient management of plantation crops has greater importance particularly to sustain and improve soil health. In a given locality, however, soil characteristics as well as nutrient parameters play a significant role for sustainable tea production (Hamid, 2004; Sarwar *et al.*, 2011) [3, 10]. Tea is a non-leguminous crop that hosts colonizing asymbiotic nitrogen fixers and phosphate-solubilizing bacteria in its rhizosphere (Katznelson, 1965) [5]. The increased uptake of nutrients from soil due to the application of chemical nutrients and biofertilizers might have produced enough carbohydrate in leaves for translocation to the sink for maximum productivity. The use of organic fertilizer could alleviate soil acidification, resulting in

increased plant yields (Li *et al*., 2018) [11]. Literature reviews that focus on INM in tea plants are barely available, and hence the objective of this paper is to review INM of tea plants (Heydorn, 1988) [4].

The present study summarized a formulated technical strategy of integrated nutrient management in tea plantation (INMT) including optimizing nutrient input amounts, properly replacing part of chemical fertilizer with organic fertilizers, choosing right fertilizer products, improving fertilization methods and ameliorating soil properties with an objective to increasing the soil fertility and to increase the yield of the poor soils by applying INM practice in consistently grown tea crops under acidic soil conditions of Tinsukia district of Assam as part of On Farm trial (OFT).

## Materials and Methods

The study was located in 3 different villages *viz*., Dighalhaku, Lakhipather and Matiakhana of Tinsukia district of Assam, India which is the land of thousands of small tea growers famous for producing very good quality Assam tea. Tinsukia district extends from tropical longitude 27° 30' to 27.5° North and 94° 22 ' to 94.37° East longitudes and average elevation of 116 m above the mean sea level (MSL) during 2018- 2021 as part of On farm trial

There were 2 treatments – Improved practice and farmers practice. The details of the experiment were as follows-

**$T_1$: Improved practice (IPM trial)**

- Treatments/ Intervention: Vermicompost @2 q/ha
- PSB @ 5.62 q/ ha
- Azatobacter @ 5.62 q/ ha

**$T_2$: Farmer's practice (Inorganic)**

**Source of technology**: Tea research Association, Tockolai, Jorhat, Assam.

**Area:** 0.13 ha

## Results and Discussion

On an average incorporation of INM in the tea cultivation has given more yield over the plots where INM was not given. Moreover, INM improved the soil physical environment, made the soil softer indicated by reduced bulk density, increased porosity of soil, increased the availability of major nutrients and ultimately favoured in increased yield . The incorporation of biomass released nutrients to soils, improved physical environment of soil and enhanced crop uptake and thereby increased crop yields (Reddy *et al*., 2004) [9].

From the experiment, it was observed that the INM practice proved to be the best in improving yield in tea cultivation. The highest yield of 141.30q/ha was recorded in improved practice plot in the year 2020-21 and lowest yield of 125.17q/ha was recorded in the year 2018-19 in all the three locations. Similarly, highest BC ratio was observed in all the plots of the district in the year 2019-20 and lowest in farmers practice. Likewise per cent increase in yield over farmers practice was recorded from 18 to 49% which is quite satisfactory. Likewise, the available nitrogen, phosphorous and potash has also been increased after INM practice in the tea gardens (Table 3).

These findings are in conformity with the findings of Bordoloi *et al* (2021) [2] who reported that compared to the forest soil, significantly lower concentration of soil organic matter (0.35%) and nitrogen (207.56 kg ha-1) was observed in various tea plantations. Soil phosphorus was observed highest (45.76 kg ha-1) in organically treated soil as compared to forest soil and other two tea plantations. High potassium concentration (173.73 kg ha-1) was observed in chemically treated garden.

**Table 1:** On farm trial on INM during 2018-2020

| Location | Crop | Year |
|---|---|---|
| Dighalhaku<br>Lakhipather Matiakhana | Tea | 2018-19<br>2019-20<br>2020-21 |

**Table 2:** Yield, per cent increase in yield and BC ratio for different treatments in three locations (Average of three locations)

| Year | Treatments | Net profit | Yield (q/ha) | % increase in yield | BC ratio |
|---|---|---|---|---|---|
| 2018-19 | Improved practice | 96210.00 | 125.17 | 49.27 | 2.78 |
| | Farmers practice | 51120.00 | 83.85 | | 2.00 |
| 2019-20 | Improved practice | 195075 | 130.05 | 31.56 | 3.54 |
| | Farmers practice | 148275 | 98.85 | | 2.96 |
| 2020-21 | Improved practice | 157950 | 141.30 | 18.49 | 2.92 |
| | Farmers practice | 127875 | 119.25 | | 2.51 |

**Table 3:** Effects of INM on Different soil parameters

| Soil Properties | Values/Description (Before INM practice) | Values/Description (After INM practice) |
|---|---|---|
| Soil Texture | Sandy clay loam | Sandy clay loam |
| Bulk Density(g cm-3) | 1.30 | 1.28 |
| Particle Density(g cm-3) | 2.49 | 2.46 |
| Porosity(%) | 44.01 | 48.62 |
| PH | 5.1 | 5.4 |
| OC(%) | 0.78 | 0.92 |
| Available N(Kg/ha) | 285.12 | 298.26 |
| Available $P_2O_5$ by Bray"s method(Kg/ha) | 22.64 | 26.71 |
| Available $K_2O$(Kg/ha) | 155.06 | 161.22 |

(Data represents the average of three locations)


Application of PSB, Azatobacter with Vermicompost

**Conclusion**

INM practice in tea crops has the potential to improve the soil physical, chemical and biological environment and ultimately soil health and at the same time increased yield of tea can be obtained. Changes in methods of tea cultivation often affect the properties of soil. By analyzing soil nutrient status in different tea plantations, serious acidification was found to be caused by intensive tea cultivation. In our study, tea garden with organic treatment showed better soil condition compared to the chemically treated tea garden soil. INM in tea has given more yield over farmers practice and significant changes brought in soil fertility as well as improved physical characters under acidic soil condition of Tinsukia district of Assam.

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