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Poran Kishore Dutta
Subject Matter Specialist (Soil Science), Krishi Vigyan Kendra, Chirang, Assam, India

Chandan Kumar Deka
Senior Scientist and Head, Krishi Vigyan Kendra, Chirang, Assam, India

Pompy Deka
Assistant Professor (Agronomy), SCSCA, Assam Agricultural University, Jorhat, Assam

Rupak Kumar Nath
Assistant Professor (Entomology), SCSCA, Assam Agricultural University, Jorhat, Assam

Corresponding Author
Poran Kishore Dutta
Subject Matter Specialist (Soil Science), Krishi Vigyan Kendra, Chirang, Assam, India

INM for improving soil health and increasing the yield of Toria in Chirang district of Assam

Poran Kishore Dutta, Chandan Kumar Deka, Pompy Deka and Rupak Kumar Nath

Abstract
Field experiment was conducted as a part of front line demonstration (FLD) of Chirang district of Assam under Krishi Vigyan Kendra, Chirang during 2019-20 and 2020-21 at different villages to evaluate the effect of Integrated Nutrient Management (INM) for improving soil health and yield of toria. From the experiment, it was observed that integration of different nutrient sources proved to be the best treatment which significantly improves the physical properties and nutrient availability of soil. The yield of toria was recorded 18.75% and 21.43% higher under INM treatment over the farmers' practice during 2019-20 and 2020-21, respectively.

Keywords: INM, Toria, physical properties of soil

Introduction
In Assam, rapeseed-mustard is one of the most important oilseed crop. It is grown on an area of 2.85 lakh hectares with annual seed production of 1.99 lakh tonnes and productivity 698 kg/ha (Govt. of Assam 2016) respectively, which is poor as compared to national average productivity. Therefore, to reduce the gap of productivity, integrated nutrient management is very useful in this context. Only one source of nutrients like chemical fertilizers, organic manures, and biofertilizer is unable to improve the production or maintain sustainability of production and health of the soil. To counter the continuous increasing prices of chemical fertilizers, it becomes important to reduce the expenses of fertilizers by using alternative sources like vermicompost, FYM, enrich compost, crop residues, green manuring for sustaining soil health and productivity of crops. Integrated nutrient management is a management system that maintains plant nutrient supply and soil fertility in recommended amounts so that soil and crop productivity is sustained through optimum benefits of all the possible plant nutrients sources in an integrated manner. Through integrated nutrient management, mining of extra nutrients will have to maintain soil health. When integration of chemical fertilizers and organic sources of nutrients are applied on a long term basis, they show a beneficial effect on soil quality (Swarup, 2010) [6]. Thus, both organic and inorganic sources of plant nutrients and biofertilizer not only manage long-term fertility and productivity of the soil but also take care of environmental pollution (Antil and Narwal, 2007) [1]. Therefore, the experiment was carried out to find out the effect of integration of organic and inorganic sources of nutrient on sustaining the soil health as well as production of toria.

Materials and Methods
The experiment of INM on toria as a part of front line demonstration (FLD) was conducted in 5 different villages of Chirang districts of Assam during 2019-2020 and 2020-2021. There were 2 treatments consisting of I NM trial and farmers practice. The details of the experiment were described in table 1. Initial soil samples (0-15 cm depth) were collected from each location to analyze the soil properties before the sowing of toria (Table 2). Soil parameters at the time of harvesting of toria, were again determined. Rapeseed was sown as second crop just after harvesting of winter rice in residual soil moisture. The yield of demonstration plot as well as farmers' practice plot was recorded from the net area. Qualitative data of yield was converted into quantitative form and expressed in terms of per cent increase in yield of toria (Narasimha Rao *et al.*, 2007). The data were collected from both FLD plots as well as farmers practice plots and growth and yield-attributing characters were recorded at harvesting time. Plant height was measured by selecting ten representative plants at random

from each of the plots. The total numbers of branches per plant, number of siliquae per plant and number of seed per siliqua were recorded at the time of harvesting from ten randomly selected plants in each plot. Subsequently, ten siliquae were selected at random from each plot to measure the number of seeds per siliqua. For test weight, 1000 grains were randomly counted from each treatment. The benefit cost ratio was calculated on the basis of prevailing market prices of toria and other inputs. Benefit cost ratio (BCR) was calculated as follows:

$$BCR = \frac{\text{Gross return}}{\text{Total cost}}$$

Results and Discussion

From the experiment it was observed that INM treatments increases all the growth and yield attributing characters (Table 3) of toria *viz.* number of branches per plant, number of siliquae per plant and number of seeds per siliqua and test weight as compared to the farmer's practice. The yield of the toria was also increased by combined application of organic and inorganic sources of nutrients. This might be due to availability of N, P and K resulting better utilization of nutrients from the soil rhizosphere leading to proper growth of all biometrical parameters of toria plants. Similar results were also reported by Deka *et al*. (2018) [2]. The Productivity and benefit-cost ratio of Rapeseed grown under FLDs and existing farmer's package of practices was also recorded (Table 4). The cultivation of toria under INM recorded the higher B:C as compared to farmer's practice in both the year. Likewise per cent increase in yield of toria under INM over farmers practice was recorded from 18.75 and 21.43% during both the year which is quite satisfactory. It may be due to higher yield obtained from INM plot compared to farmers practice.

Soil Fertility Status

The average value of initial soil fertility status of the villages that were collected before conducting the study, are present in table number 5. After the harvesting of crops, there is change in the fertility status of soil during both the year. The year wise average value of residual soil fertility status of the villages is given in table number 5. It was observed that there is increase in organic carbon (OC) in the demonstration plot during the study; this increase was also seen as compared to the check plot. Similar increase was also observed in case of Av. N and Av. P_2O_5, although highest Av. K_2O was observed during both the year.

Table 1: Comparison between demonstration practices and farmer's practices

Particulars	Demonstration practices	Farmer's practices
Land situation	Rainfed medium land	Rainfed medium land
Variety	TS-46	Local
Time of sowing	Mid Oct to Mid Nov	Last week of Nov to 1st week of Dec
Seed treatment	Metalaxyl 35 WS @ 6 g /kg of seeds	Nil
Method of sowing	Line sowing (Spacing 25 cm × 10 cm)	Broadcasting
Seed rate	10 kg/ha	12 kg/ha
Fertilizers dose (NPK)	INM package (45: 22.5:30 kg N:P_2O_5: K_2O/ha along with Azotobacter and PSB each @40 g/kg seed)	FYM and lower rate of NPK
Borax	10 kg/ha	Nil
Plant protection	Need based application of pesticide	Nil
Intercultural operation	Weeding at 15-20 DAS	Nil

Table 2: Methods used for the analysis of soil parameters

Sl. No.	Parameters	Method
1.	Organic C	Walkley and Black wet digestion method (Walkley and Black, 1934) [7]
2.	Available N	Alkaline potassium permanganate method (Subbiah and Asija, 1956) [5]
3.	Available P	Olsen's method (Olsen *et al.*, 1954) [4]
4.	Available K	Ammonium acetate method (Merwin and Peech, 1951) [3]

Table 3: Average yield parameters under FLD s and existing farmer's package of practices

Year	Trial	Plant height (cm)	No. of branches/ plant	No. of silique/ plant	No. of seeds / siliqua	Test weight (g)
2019-20	Demonstration	113	8	107	13	2.04
	Farmers' practice	105	7	98	12	2.03
2020-21	Demonstration	118	9	113	13	2.04
	Farmers' practice	111	8	105	12	2.04

Table 4: Productivity and benefit-cost ratio of Rapeseed grown under FLDs and existing farmer's package of practices

Year	Seed Yield (q/ha)		% increase over control	B:C ratio	
	D	FP		D	FP
2019-20	8.5	7.0	21.43	2.5	2.13
2020-21	9.5	8.0	18.75	2.23	2.0

Table 5: Initial and Final Soil Fertility Status before and after harvest of the toria crop

Year	Trial	pH	OC %	N (kg/ha)	P (kg/ha)	K (kg/ha)
2019-20	Initial	5.08	0.8	335	18.50	129.45
	Demonstration	5.15	0.89	352	24.09	148
	Farmers' practice	5.10	0.81	338	19.84	135.31
2020-21	Initial	5.10	0.71	311	20.40	146
	Demonstration	5.52	0.82	329	29. 80	162
	Farmers' practice	5.31	0.75	320	26.78	156

Conclusion

Continuous applications of chemical fertilizers are ecologically unsound that leads to the loss of soil fertility as it disturbs microbial diversity, and as a result productivity and profitability of soil reduces. This demands, eco-friendly and economically feasible strategies that reduce the use of chemical fertilizers. So integration of inorganic and organic sources of nutrient is the better option for balance nutrition of the rapeseed mustard crop that enriches the soil fertility status, improves growth and yield attributes of crop and also accelerates the nutrient uptake and availability in soil and ultimately the productivity and profitability and quality of food.

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