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A Case Study

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Assessment of changes in soil properties, nutrient availability and yield of paddy as influenced by cultivation of green manuring crop

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Summary

An experiment was conducted at West Tripura district to evaluate the soil properties and nutrient availability as influenced by cultivation of green manuring crop in acidic soil condition of West Tripura district. Soil samples were collected randomly in the fields for analysis of nutrients and organic carbon and other physical properties. The study revealed that the change in soil physical properties and nutrient availability was significantly increased under the green manuring practice. The green manuring crop dhaincha and mung bean was grown on the plots and it was incorporated into the soil by ploughing before attaining the flowering stage. Further the land was left for 24 days for decomposition of green manure. Highest grain yield of paddy (5.5 t/ha) was observed in dhaincha- *aman* paddy- potato cropping system whereas the lowest grain yield of paddy (3.5 t/ha) was obtained in fallow- *aman* paddy- potato cropping system. The grain yield obtained from mung bean- aman paddy- potato cropping system was 4.8 t/ha.

Key words : Green mauring crop, Paddy, Cropping system

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Introduction

Soil fertility is an important consideration in the development of double cropping systems. Double cropping cereals with leguminous species have potential implications for the nitrogen requirement and usage by the cereal component(s) (Hargrove *et al.*, 1983; Narwal *et al.*, 1983) and less frequently on phosphorus use efficiency. Paddy is the major cereal crop grown in the region by taking two crops in a year. This is exacerbated by continuous mono-cropping of cereals without replacing nutrients lost by crop harvest. Moreover, chemical fertilizers are costly for most subsistence farmers to correct the deficiency. Hence, alternate nutrient management technologies like green manuring which could supplement the required nutrients to the soil. Thus, this study attempted with objective to increase the soil fertility and to increase the yield of the poor soils by adding green manure in consistently grown paddy under acidic soil conditions of undivided West Tripura district of Tripura.

Resource and Research Methods

The experiment was conducted in the instructional farm of Krishi Vigyan Kendra, Divyodaya Chebri,

Table A : General physico-chemical properties of experimental soil

Soil properties	Values/description
Soil texture	Sandy loam
Bulk density (g cm^{-3})	1.52
Particle density(g cm^{-3})	2.58
Porosity (%)	41.08
Available P by Bray's method (kg/ha)	20.84
Available N_2 (kg/ha)	217.65
Available K_2O (kg/ha)	171.58

Khowai during the year 2013-2014. Soils of the experimental site was sandy loam (62-65 % sand, 18 % silt, 16-17 % clay), acidic with a pH of 5.80, 0.54 per cent organic carbon, low in available nitrogen (217.65 kg/ha), low in available phosphorus (20.84 kg/ha) and medium in available potash (171.58 kg/ha). The three treatments (T_1: Dhaincha, T_2: Mung bean, T_3: Control) were selected and replicated three times. The RBD design was laid out and the treatments were distributed accordingly. At the beginning the green manuring crops like dhaincha and green gram were grown and they were chopped before them attaining the flowering stage and mixed in the soil by ploughing the land. Then the land was left for 24 days to allow for decomposition. In the beginning and at the end of the green manuring the soil samples were collected randomly in the fields and analysed.

Crop harvesting and data collection:

Mung bean was harvested from first to third week of June 2014, after picking the pod, the remaining biomass of mung bean was incorporated in the soil. The total biomass of dhaincha was incorporated in the soil in the fourth week of June. Rice crop was harvested in the second week of November 2014 at full maturity. For data collection of rice, ten hills from each plot were sampled randomly. The crop was cut at the ground level. Threshing, cleaning, and drying of grain were done separately plot-wise. The weights of grain were recorded plot-wise.

Determination of different soil properties :

Soil samples were collected from the experimental field at the sampling depths (0-15 cm) after the completion of experiment *i.e.*, after the harvest of *aman* paddy and analyzed in the laboratory for pH, OC, N, P, K. following standard procedure. Particle size distribution and textural class analysis of the collected soils was done by hydrometer method (Black, 1965). Bulk density and particle density of the soil samples were determined by core sampler method and Pycnometer method, respectively. The soil porosity was computed from the relationship between bulk density and particle density using the equation (Table A):

$$\text{Porosity (\%)} = \left(1 - \frac{BD}{PD}\right) \times 100$$

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Effect of green manuring on soil physical properties :

The effect of different cropping patterns alone on soil bulk density was significant. The lowest bulk density(1.45 g cm^{-3}) as recorded in dhaincha- *aman* paddy- potato cropping system whereas it was 1.49 g cm^{-3} in case of green gram- *aman* paddy- potato cropping system before sowing of *aman* paddy. The higher amount of added biomass from dhaincha and green gram and coupled with deep ploughing made soil loose, porous and less squeezed and therefore, the lower bulk density was found. These findings are in agreement with the studies of Husunjak *et al.* (2002) and Rahman *et al.* (2007). The soil particle density ranged from 2.55 to 2.58 g cm^{-3} in the surface layer (0-15 cm) (Table 1). Its value decreased with the increase of organic matter content of the soil. Green manuring had significant effect on soil porosity as it accumulates lot of organic matter in soils. With the addition of more biomass in soil by dhaincha the porosity also increased with the reduction of bulk density and particle density.

Effect of green manuring on soil pH :

The soil pH reduced significantly in both the treatments. This may be due to the fact that green

manuring crops produces lot of organic acids which helps in reduction of soil pH (Table 2).

Effect of green manuring on soil organic carbon :

Oxidizable organic carbon increased with the use of both the green manuring crops; this may be due to the fact that green manuring crops accumulates lot of biomass in soil which increases the oxidizable organic carbon of the soil (Table 3).

Effect of green manuring on soil available nitrogen:

Green manures are often grown to add nitrogen to the soil. In organic systems this represents the main source of nitrogen, whilst for conventional growers; it can be a way of minimising fertiliser inputs. In the present study also both the green manuring crops increased the available nitrogen of the soil due to its capacity to fix atmospheric nitrogen. Available nitrogen status increased to 9 per cent in case of green gram while in case of dhaincha it increased to 6 per cent.

Effect of green manuring on soil available phosphorus (P_2O_5) :

Increased organic carbon results in production of organic acids which is responsible for decreased soil pH and increased in the available soil phosphorus may be due to the reduction of phosphate fixation by formation of chalets with iron and aluminium. Thus, it has been observed that soil available phosphorus increased to 17.25 per cent in case of dhaincha and in case of green gram it was 15.3 per cent.

Effect of green manuring on soil available potassium (K_2O) :

In case of dhaincha soil available potassium increased to 3.7 per cent and in case of green gram it increased to 2.4 per cent.

Impact of cropping patterns on yield of rice :

Different cropping patterns showed a significant impact on grain yields of Gomoti variety of paddy. The highest grain yield of paddy (5.5 ton/ha) was recorded in dhaincha- *aman* paddy-potato cropping system, whereas in case of green gram- dhaincha- potato cropping system it was 4.8 t/ha and in case of fallow-*aman* paddy- potato based cropping system it was only 3.5 t/ha. This might be because of incorporation of biomass in soils using mung bean and *sesbania*. The incorporation of biomass released nutrients to soils, improved physical environment of soil and enhanced crop uptake and thereby increased crop yields (Khaleel *et al.*, 1981). The above study is an agreement with the study done by Singh and Shiray (2005) who reported that, the incorporation of *Sesbania aculeata* (Dhaincha) resulted in significantly higher grain and straw yield of basmati and increased yield in wheat.

Conclusion :

Dhaincha- *aman* paddy- potato and green gram-*aman* paddy- potato cropping pattern have improved the soil physical environment, made the soil softer indicated by reduced bulk density, increased porosity of soil and ultimately favoured in increased yield of rice. The lowest yield of crops was found in under fallow- *aman* paddy-potato cropping pattern. The increased yield of paddy was noticed in the area where the dhaincha was grown but comparatively less paddy yield was noticed in the area where the green gram was used as green manure crop. However, these two treatments are not statistically significant. But still green manuring of dhaincha in the

Table 1 : Change in soil physical character in different treatments

Treatments	Bulk density(g cm^{-3})	Particle density(g cm^{-3})	Porosity (%)
Green gram- aman paddy	1.49	2.58	42.25
Dhaincha- aman paddy	1.45	2.55	43.13

Table 2 : Change in soil pH under different treatments

Treatments	Soil pH
Green gram- *aman* paddy	5.65
Dhaincha- *aman* paddy	5.5

Table 3 : Change in soil organic carbon under different treatment

Treatments	Soil OC (%)
Green gram- aman paddy- potato	0.66
Dhaincha- aman paddy- potato	0.72

paddy has given more yields over control and green gram under acidic soil condition of West Tripura condition. Recommending the dhaincha as a green manure crop is still holding good under this agro climatic condition area where paddy is consistently growing by chemical farming.

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