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SHORT COMMUNICATION

Effect of paddy straw enrichments on nitrogen availability in sandy regosol

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Introduction

Sandy regosol is the major soil group existing in Batticaloa District, Eastern Province, Sri Lanka. They are largely dominant in the cultivated area in this narrow strip along the sea. Regosols of sandy are usually nutrient-poor. Humus accumulation in the topsoil improves the nutrient supply. N content of soil show a distinct decrease as soil texture become coarser (Miller, 2004). Therefore proper N management is important for sandy regosol.

Manures behave differently as sources of available nitrogen due to differences in the amounts and forms of nitrogen in the manure (Qian and Schoenau, 2001). Availability of nitrogen from organic sources is mainly influenced by the rate of mineralization. Nitrogen mineralization is a microbiological process in which C:N ratio is an important factor affecting the rate of mineralization (Mueller *et al.*, 1998).

Among the crop residues paddy straw is the most available organic material in Sri Lanka and the nutrient content of soil can be increased by its application to the soil (Amarasiri and Wickramasinghe, 1988). Due to its high C:N ratio and slow decomposition rate, paddy straw needs more attention to increase their efficient use in Agriculture. Enrichment of paddy straw with other materials which enhance the decomposition of paddy straw may be a useful practice in their efficient soil management. Ariyaretne (2008) also repported that the incorporation of plant residue like paddy straw with high C: N ratio into the soil takes long duration for decomposition; therefore N is not available to the plants temporarily. Thus suitable enrichment of paddy straw for quick decomposition of straw is important.

Effective microorganisms (EM) is a liquid microbial inoculant that contains assorted culture of beneficial fertilizer without fermentative microorganism such as lactic acid bacteria (*Lactobacillus Spp*), yeast (*Saccharomyces spp*), photosynthetic bacteria (*Rhodopseudo monas spp*), actinomycetes and fermenting fungi (Takashi Kyan *et al.*, 1999). Application EM has been reported to result in rapid proliferation of its constituent beneficial microorganism. The beneficial organisms have also been ascribed with the ability to encourage the mineralization of soil organic matter, which is the main mechanism through which EM could some benefit soil health and plant nutrition (Piyadasa, 1995). Plants with lower C:N ratio is usually considered to decompose quickly than those with higher C:N ratio (Parr and Papendick, 1978). Gliricidia could be attributed to the improvement of the rhizosphere by the added organic matter, especially those with a lower C: N ratio (Graves *et al.*, 2004). The present study was undertaken to ascertain the effect of paddy straw enrichments with *Gliricidia* and EM on N availability in sandy regosol.

Materials and Methods

The laboratory experiment was conducted at Eastern University, Sri Lanka which is located in the low country, dry zone of Sri Lanka. The soil used in this study was sandy regosol (pH 6.9, C 0.47%, N 0.0356%). Three organic materials used: paddy straw (C:N ratio 63:1, N 0.672%) , EM treated paddy straw (N 0.88%) and *Gliricidia* (N 4.1%).

EM treated paddy straw

EM extended solution was prepared by mixing five litres of EM stock solution and five litres of molasses in 100 litres of water. This mixture was kept in a closed container for 10 days. After that, this extended EM solution was added to the paddy straw and mixed thoroughly. EM treated paddy straw was kept in an airtight bag. It was ready to use when it had sweet fermented smell and white filamentous fungi on the surface.

Ten Kg of air dried and sieved (2mm mesh sieve) soil was filled in black polythene bag which had the dimension of 30cm x 40cm. The treatments were sole application of paddy straw (51.64 g paddy straw/10 kg soil), enrichment of paddy straw with effective microorganisms (EM) (39.43 g EM treated paddy straw/ 10 kg soil) and enrichment of paddy straw with *Gliricidia* (4.18 g *Gliricidia* / 25.82 g paddy straw/10 kg soil) all on equal nitrogen basis at the rate of 0.347g N/ 10kg soil. Four treatments included control (no nitrogen source) were replicated five times in a completely randomized design.

The treatments were incubated for 10 weeks and kept moist during the incubation. The soil analysis was carried out to measure soil available N by kjeldhal method (Jackson, 1973) at 2 weeks intervals. Data were analyzed using SAS statistical package and treatments means were separated in Duncan's multiple range test.

Results and Discussion

Available nitrogen content in soil

Table 1: Effect of nitrogen sources on nitrogen availability of soil

Nitrogen sources	Available nitrogen (mg/Kg of soil)		
	2nd week	*6th week*	*10th week*
Paddy straw	20.0a	23.0d	52.0a
EM treated paddy straw	46.1b	64.0a	100.0b
Paddy straw + *Gliricidia*	45.0b	62.3a	81.3c
Control	48.0b	49.0e	49.6a

Means followed by the same letter within the column are not significantly different according to the Duncan multiple range test at 5% level.

The results (Table: 1) pertaining to the available soil nitrogen content indicated that there was significant influence of nitrogen sources and incubation stages on available nitrogen content of soil as P value is less than 0.05. Results indicated that in all stages the available N was least in soil amended with paddy straw (63:1) than control and paddy straw enrichment. This may be due to the utilization of N by microorganisms to decompose the organic matter, especially with rice straw, which has a higher C: N ratio. Mubarak *et al.* (2001) similarly reported N-immobilization shortly after incorporating crop residue with high C:N ratio; when soil was incubated with straw alone, At 2nd week of incubation soil available nitrogen content was on par in paddy straw enrichments and in control treatment, but was significantly higher than sole paddy straw treatment. This may be due to soil nitrogen immobilization , the greater C availability in the organic system apparently supports a more active microbial biomass with greater N demand, thus promoting immobilization and mineralization of NO3 (Burger and Jackson, 2003). Addition of an organic material with a high C:N ratio induces the immobilization of inorganic N.

Results of experiment further indicated that in treatments of paddy straw enriched with EM and *Gliricidia* the available soil N content was significantly superior to its sole application. By mixing slow N release paddy straw with highly decomposable *Glyricidia* the mineralization pattern of soil altered. *Glyricidia* decomposes quickly and release soil inorganic N which can be utilized by microorganisms to meet its urgent N need for their activity. Paddy straw contributes organic matter to soil and hence increase the long term residual effect of *Glyricidia*. Application of EM to the paddy straw significantly increased its potential to provide more inorganic N than sole application of straw.

Hussain *et al.* (1991) reported that EM enhanced the decomposition and mineralization of organic materials resulting in higher N percentages compared with their respective controls.

They also stated that rice straw was the least decomposed which may have resulted from their inability to retain sufficient moisture to support active microbial decomposition.

Among these treatments, the available N content ranked first in treatment received paddy straw enriched with EM and was followed by the treatment received paddy straw along with *Gliricidia* at all stages incubation (Table1). This may be due to the impact of EM on the rate of decomposition as the microbial activity higher in EM treatment. In *Glyricidia* enriched treatment, initial N availability may be low due to temporary immobilization of available N for the decomposition of high C:N materials. Results also showed that the available soil N was significantly different between enriched paddy straw with *Gliricidia* and EM at 10th week of incubation only. This may be treated straw than the *Gliricidia* treated one during the period of incubation.

Periodical changes in available N (mg/Kg of soil)

The results indicated that the inorganic nitrogen content in soil amended with paddy straw was drastically decreased up to 2nd week of incubation due to its high ratio of carbon to nitrogen and was continued until 6th week of incubation and then increased. Yadvindar singh *et al.* (1988) indicated that the addition rice straw with high C:N ratio resulted in immobilization of N throughout the incubation. Ocio *et al.* (1991) reported that most of the microbial biomass N formed due to the incorporation of rice straw was derived from the organic N contained in the straw itself. These findings suggest the microbial populations are able to assimilate the organic N and inorganic N for the formation of their cells.

Due to this least available N was recorded in paddy straw amended soil throughout the incubation period. In the soil received straw with *Glyricidia* and straw with EM, the available N decreased slightly up to 2nd week of incubation and then increased. Addition of *Glyricidia* along with paddy straw reduced the N immobilization in soil due to its rapid decomposition (lower C:N ratio) and higher N content. Therefore input of easily decomposable organic N by *Glyricidia* can increase the microbial activity, causing increased rate of decomposition and associated nutrient release. It is suggested that mixed application of high and low quality resources can modulate N release, resulting in relatively higher synchronization which can help in minimizing N loss from agroecosystem, Sonu Singh *et al*. (2007).

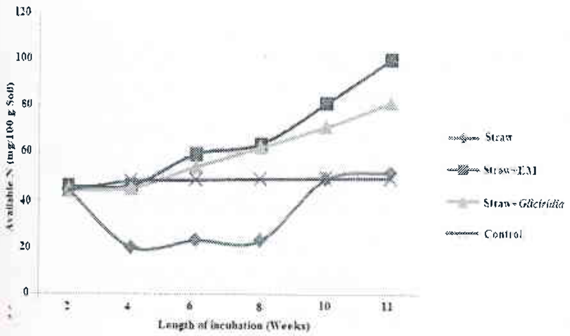

Figure 1. Effect of paddy straw enrichments on soil available N during incubation period

Soil received EM treated paddy straw also caused slight immobilization at initial stage of incubation. But 2 weeks after incubation there was an increase in soil nitrogen availability. This was slightly higher than the *Gliricidia* treatment. This indicates that addition of EM stimulates the easy decomposition and mineralization of nutrients from applied organic materials. Fatunbi and Ncube (2009) stated that the decomposition and mineralization of nutrients from added organic materials was positively influenced by the application of EM.

Conclusions

Results indicated that availability of soil N was influenced by incubation period and paddy straw enrichment. The available nitrogen content was higher in enriched paddy straw treatment than its sole application. Between the enrichment treatments nitrogen availability was higher in EM treatment then *Gliricidia* treatment. This finding concludes that the addition of an organic material with a high C:N ratio induces the immobilization of inorganic N.

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