Non-Additive Effects of Mixing Rice Straw and Groundnut Stover Alter Decomposition

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Introduction

- Rice straw (RS) is a residue remained in high quantity in agricultural systems.
- Farmers use RS to improve soil fertility. But RS alone does not result in soil organic carbon (SOC) accumulation (Puttaso et al., 2011).
- Mixing of RS with other organic residues differing in chemical composition is likely to change the pattern of decomposition and may lead to SOC accumulation (Fig. 1).
- "Non-additive effects frequently present in decomposition of plant residue mixture. It describes decomposition of the mixture (observed values) which can be faster (synergistic) or slower (antagonistic) than the average sum of decomposition rates of its single component residue decomposing in isolation (calculated or predicted values) (Cuchietti et al, 2014)."
- ➢ To compare decomposition of mixture of RS (low quality) with a different chemical composition organic residue, groundnut stover (GN) (high quality) to that of these residues applied singly.

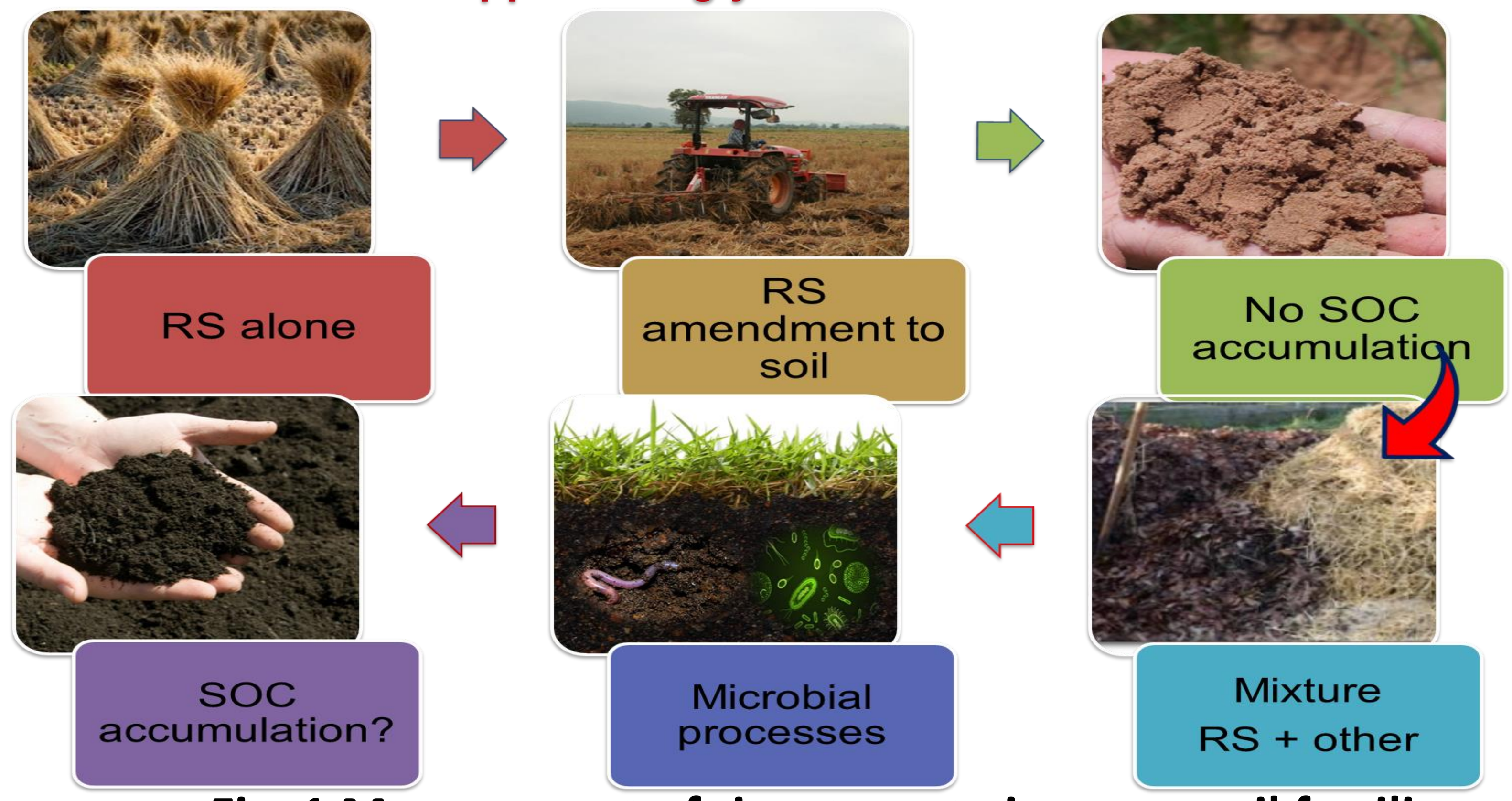

Fig. 1 Management of rice straw to improve soil fertility

Materials and Methods

- A microcosm experiment and the litter bag technique was employed and decomposition was investigated at 3, 7, 14, 28 and 56 days after incorporation.
- 4 treatments: 1) Unamended soil, 2) RS only (RS), 3) GN only (GN), 4) Mixture RS:GN @ 1:1 (w/w)(RS+GN) (Fig. 2)

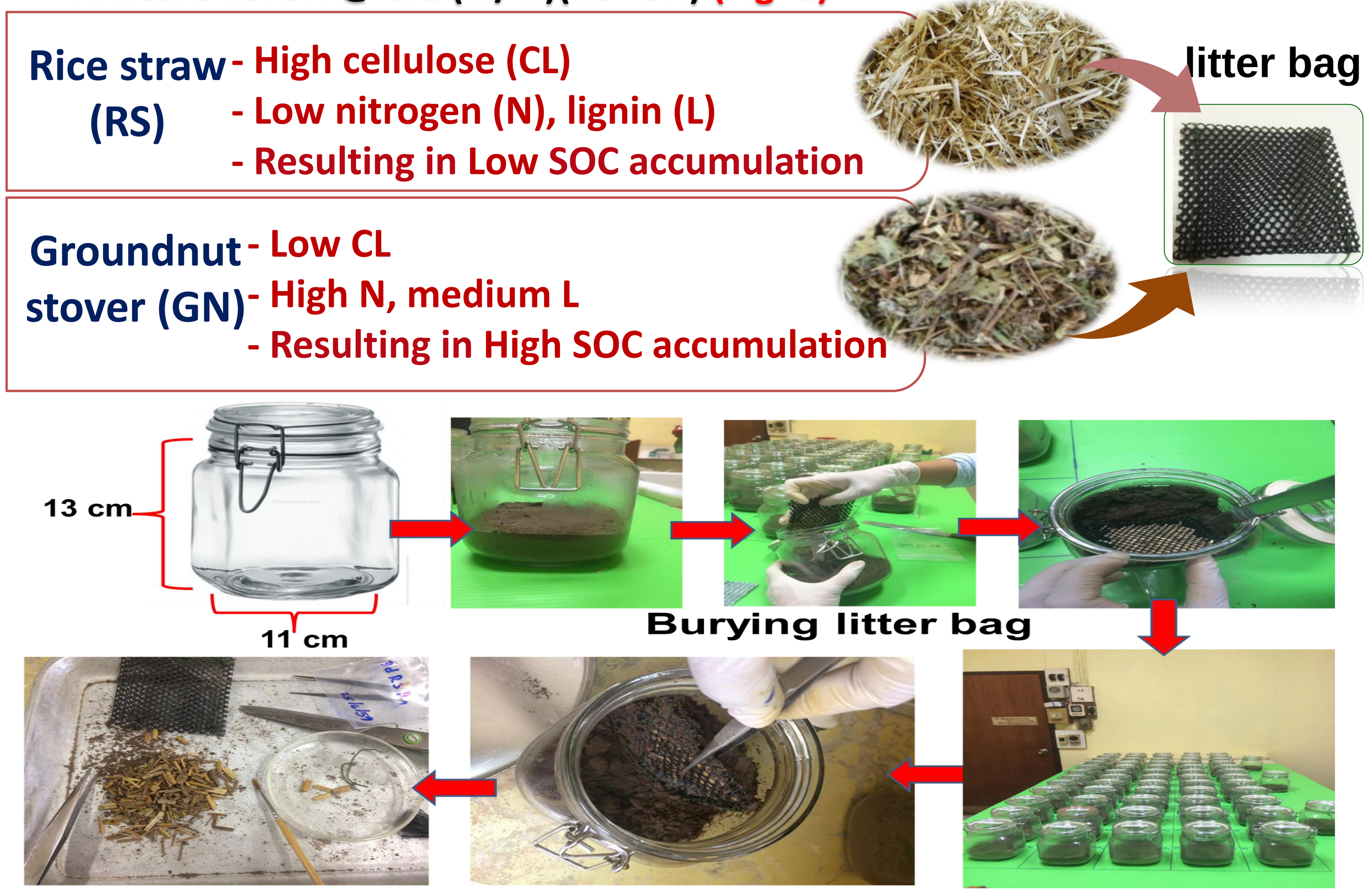

Fig. 2 Quality of residues, incubation experiment and soil and litter sampling

Results

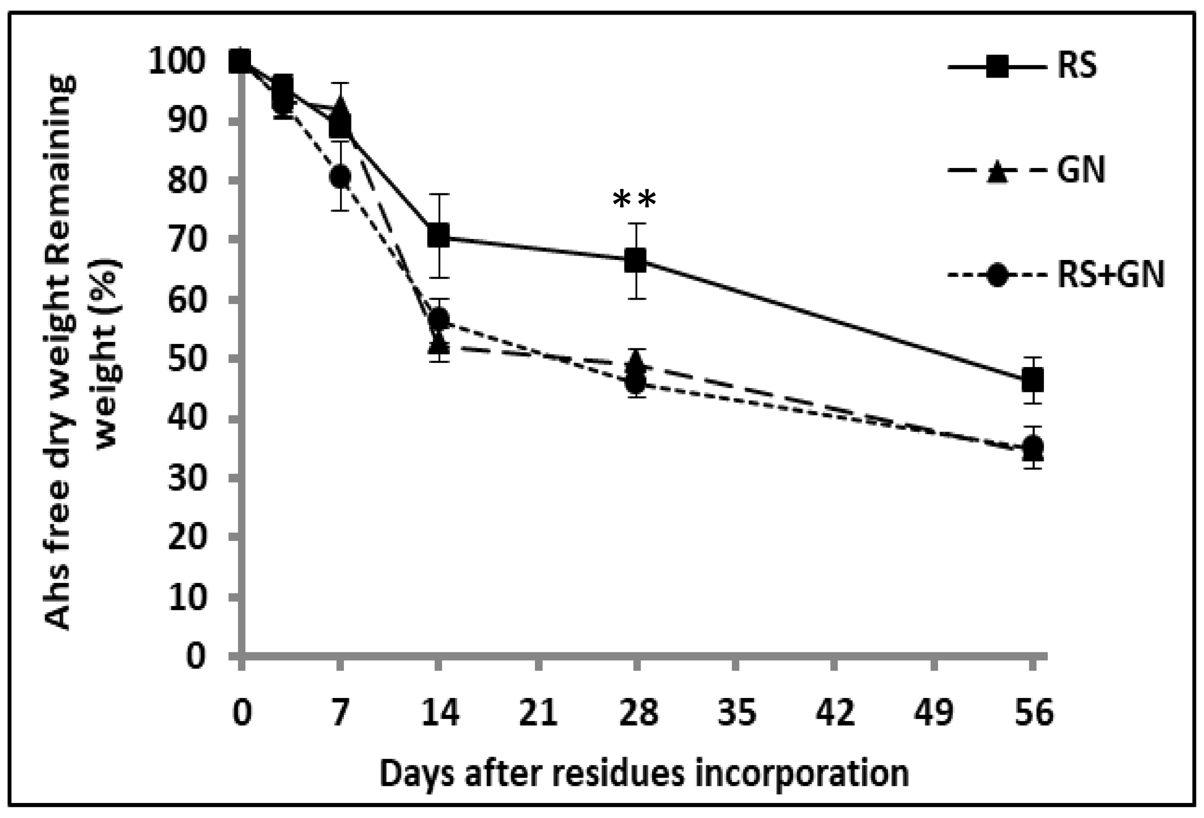

Fig. 3 Pattern of ash free dry weight remaining (% of original) of residues in litter bag after incorporation in soil. Vertical bars represent SEM, *= p ≤ 0.05, **= p ≤ 0.01, *** p ≤ 0.001 and not significantly different p > 0.05.

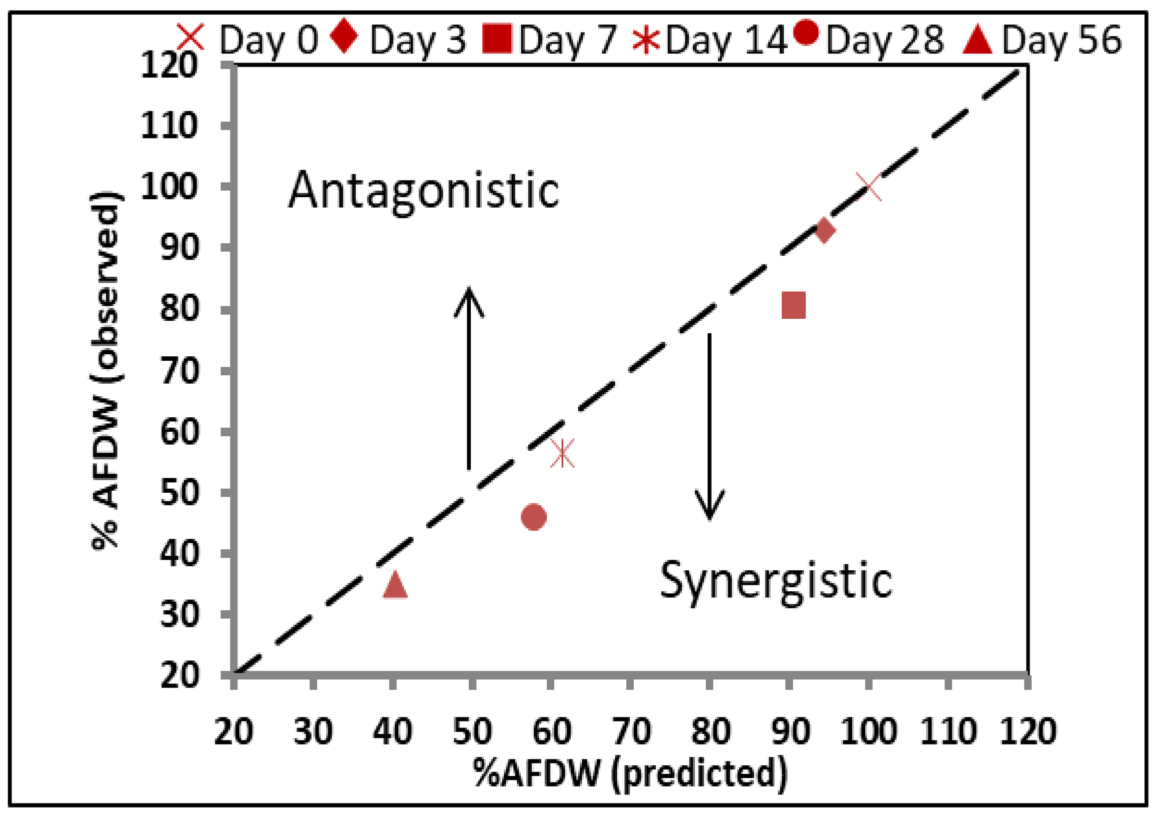

Fig. 6 Relationship between predicted and observed weight remaining (% of original) of the 1:1 mixture.

- ❖ Mixture of RS + GN accelerated decomposition over RS alone as indicated by lower ash free dry weight (AFDW) in the mixture than RS alone (Fig. 3).
- ❖ Microbial biomass N (MBN) under mixture peaked later than GN alone at early stage (day 3-14). The MBN under mixture significantly declined below that of GN alone at later stage (day 28-56) (Fig. 4).
- ❖ Soil mineral N (minN) in GN was highest until the end of incubation experiment. The mixture and GN alone treatments peaked at day 14 later on declined at day 28 (Fig. 5).

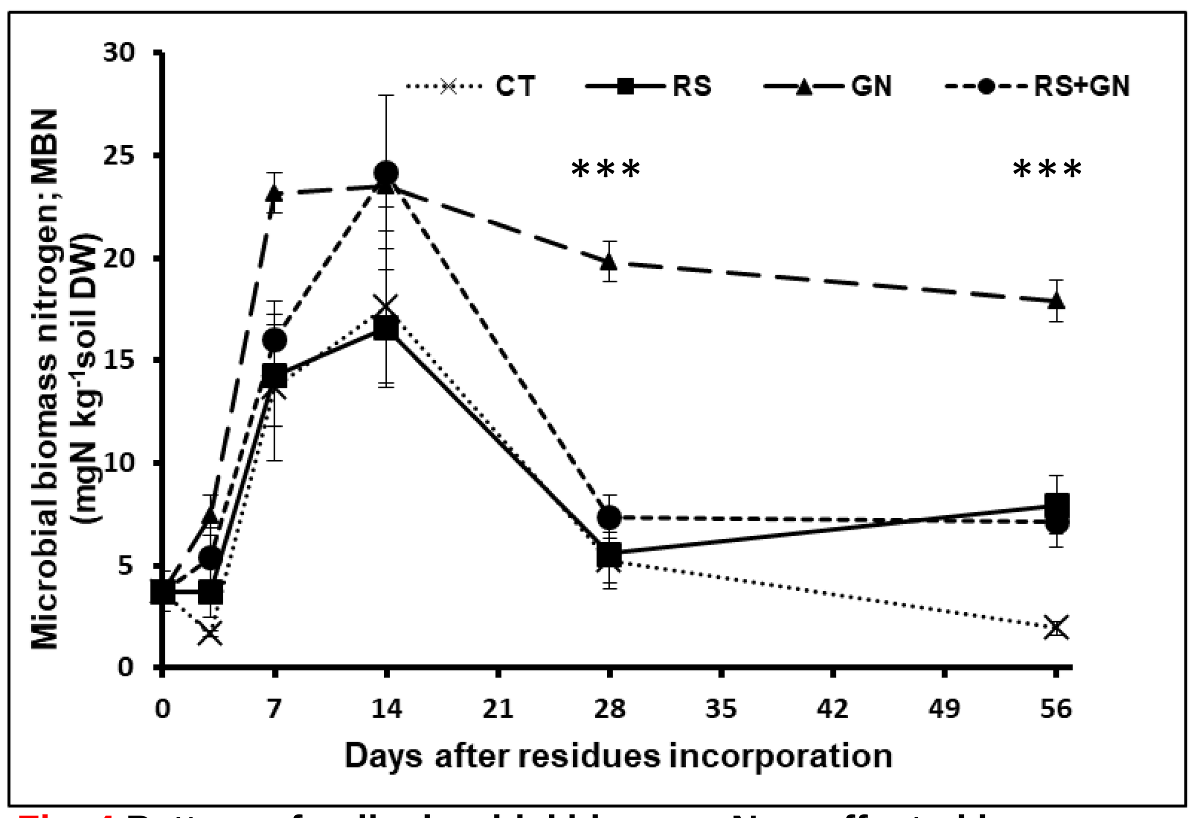

Fig. 4 Pattern of soil microbial biomass N as affected by different residue treatments. Vertical bars represent SEM, *= p ≤ 0.05, **= p ≤ 0.01, *** p ≤ 0.001 and not significantly different p > 0.05.

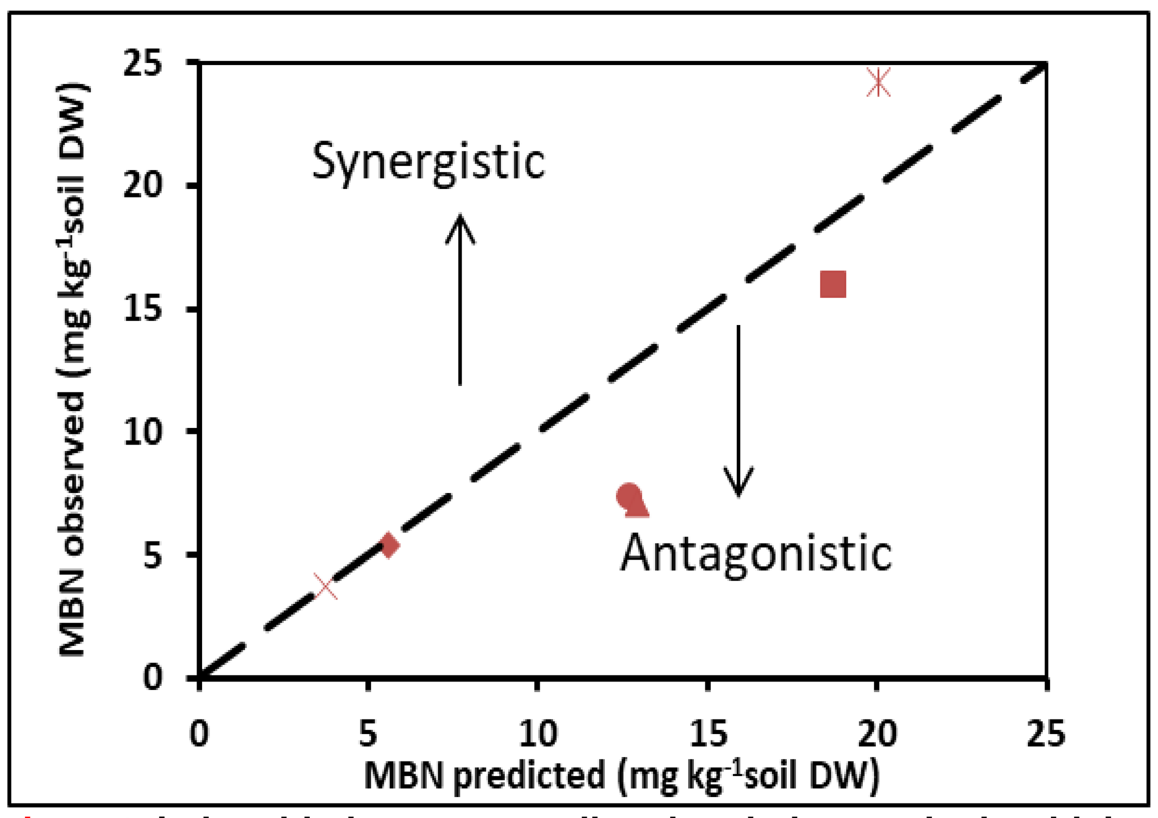

Fig. 7 Relationship between predicted and observed microbial biomass nitrogen of the 1:1 mixture.

❖ Non-additive effects of synergistic type, i.e., decomposition rate was higher under the mixt than residues alone, was found (Fig.3, 6).

MBN and minN showed antagonistic type of non-additive effects meaning the mixture was lower than those of the GN alone except for MBN at day 14.(Fig.4, 5, 7, 8).

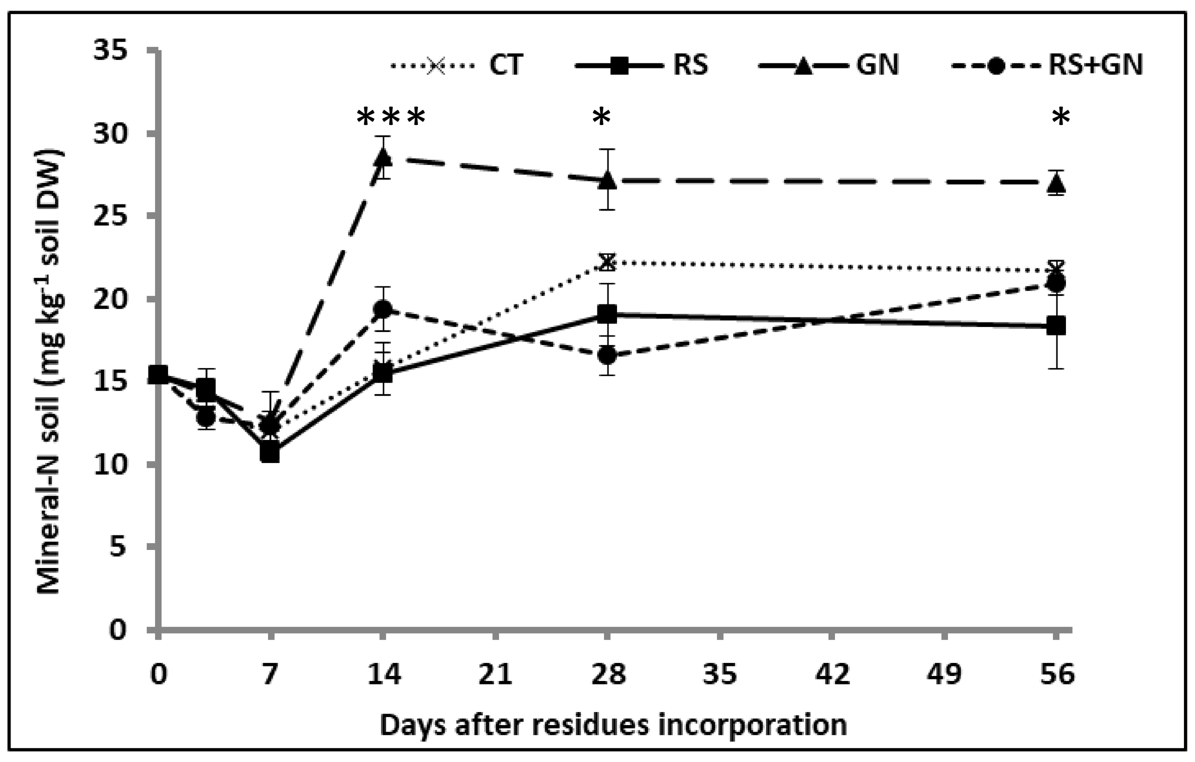

Fig. 5 Pattern of soil mineral N as affected by different residue treatments. Vertical bars represent SEM, *= p ≤ 0.05, **= p ≤ 0.01, *** p ≤ 0.001 and not significantly different p > 0.05.

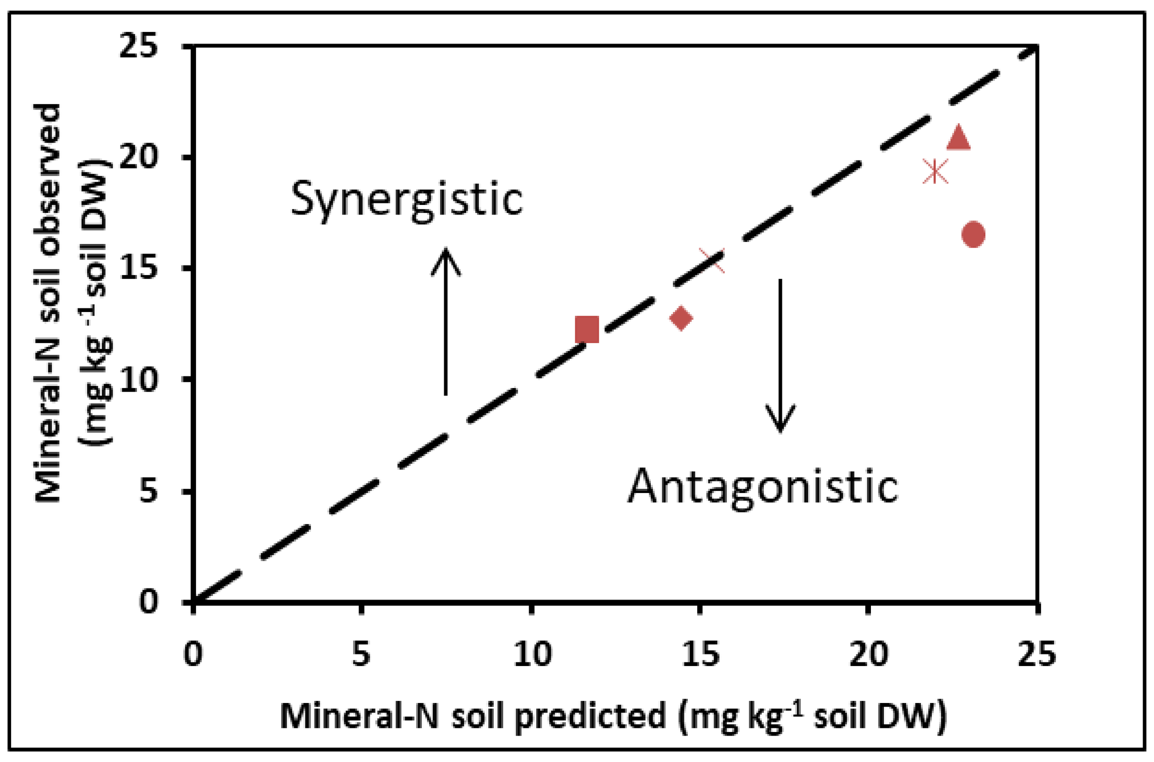

Fig. 8 Relationship between predicted and observed soil mineral N of the 1:1 mixture.

Conclusions

➢ The mixture treatment altered decomposition as indicated by non-additive effect of decomposition as well as microbial biomass N which was related to altered pattern of soil mineral N release.

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Reference;

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