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Litter Bag Study of Lantana Shrub Decomposition in Alluvial Soils of North India

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Abstract: A decomposition study of in alluvial soils was studied by nylon mesh bag technique. Carbon and nitrogen mineralization in lantana shrub during decomposition was measured. The kinetics of lantanas shrub was studied by first order model that showed the best fit for lantanas shrub decomposition in this study (R^2=0.98). The decay rate constant (k for the lantanas shrub as calculated fro the first order equation was 0.053 week^{-1}. Three distinct phases were noticed in entire study. In this first phase (0-4 weeks), 30 % of the lantana shrub was decomposed and in the second phase (5-8 weeks) 25 % of shrub were decomposed. Only 13 % of shrub decomposition was observed in third phase (9-12weeks) of the decomposition study. Decomposition of shrub was faster in initial weeks but became slower in later ones. The C: N ratio of lantana narrowed from 56.7 to 7.60. Nitrogen mineralization process increased because C: N ratio of soil became narrow.

Key words: Lantana shrub decomposition % First order model % C and N mineralization

INTRODUCTION

Reversal of soil fertility depletion is required to increase per capita agricultural production and may be achieves through use of inorganic and organic outputs. Use of organic fertilizer by resource poor farmer is constrained by inadequate supply, unstable prices of agricultural produce, scare financial resource and lack of access to credit. Organic inputs are commonly used in maintenance of soil productivity. Often however naturally plant are in sufficient abundance around farmers field along path in hedge and in the fields under fallow to be significant resources for nutrient supply to near by cultivated areas. *Lantana camera* is erect, vigorous shrub with shoot recurved prickles. It grows to 1.2 - 2.4 meter; its root system is very strong and it gives out new flush of shoots even after repeated cutting. It is generally prevalent in waste lands and lands near to railway tracks.

Nutrient mineralization pattern during decomposition of organic materials are related to the chemical composition of the organic inputs, climatic conditions, soil physico-chemical environment and nature of soil organisms. Knowledge of nutrient content and mineralization pattern of lantana shrub in alluvial soils is important to planning their use in fertility management.

The objective of this study was to determine kinetics of lantanas shrub decomposition and carbon and nitrogen mineralization pattern in alluvial soil.

MATERIALS AND METHODS

Lantana shrubs were collected and oven dried at 70°C and chaffed to 5-10 mm in size. The decomposition study was conducted during winter season (January - March, 2006) at agricultural farm of T.D. College, Jaunpur, India. The soil is sandy loam in texture with 4.0 g Kg^{-1} organic carbon, 7.8 pH (1:1.5 soil water ratio). Available Nitrogen, phosphorus and potassium were 290, 11.0 and 120 Kg ha^{-1} in soil, respectively. The site was under wheat crop during this study. The decomposition and mineralization were measured using 30 x 15 cm nylon litter bag with a mesh size of 5 mm allowing access to soil meso and macro fauna. The litter bags containing 15 g of lantana shrub was randomly placed between rows of wheat in a field. Incorporated litter bags were buried in the surface soil at 15 cm depth. Four litter bags were retrieved after 1,2,3,4,5,6,7,8,,9.10,11,12,13 and 14 weeks. The retried samples were washed in flow of water and oven dried at 70°C till a constant weight. The oven dried samples were weighed and analyzed for N and carbon following standard methods [1].

The single exponential equation, $y = e^{-kt}$ was used to calculate the decomposition rate constant k where y is the percentage of initial weight of plant material, remaining after the time t in weeks [2].

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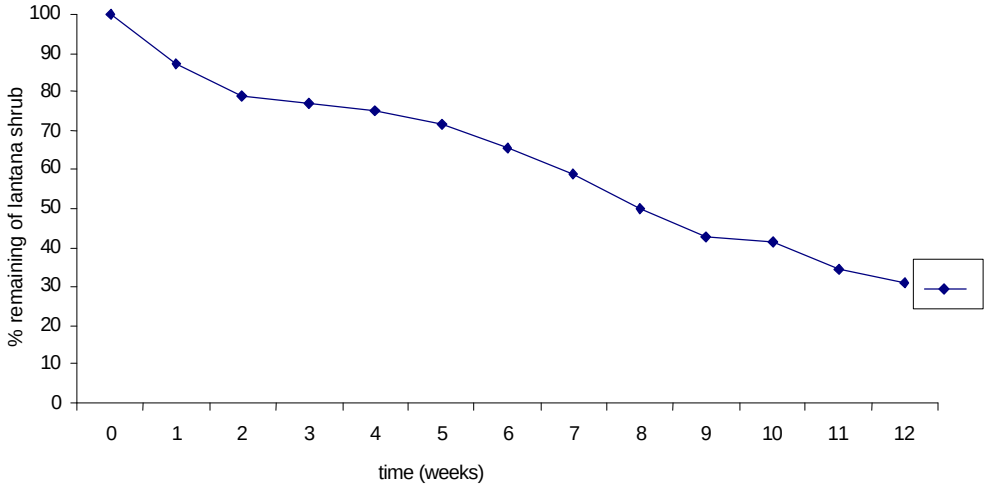

Fig. 1: % remaining during Lantana shrub decomposition in alluvial soil

RESULTS AND DISCUSSION

The nylon mesh bag containing 15 gm lantana shrub was placed in 15 cm depth of soil. It is observed that during first week 1.8 gm of lantana shrub decomposed but after 2nd and 4th week only it becomes only 1.29 and 0.36 gm, respectively. After 12 weeks, only 4.6 gm of lantana shrub remained. This means that 11.34 gm of shrub was decomposed in 72 days. Also, data showed that the decomposition was slower from 3rd to 6th week. About eight weeks was required for 50 % decomposition of lantana shrub in field condition. By the end of 9th week or about 57.2 % lantana shrub was decomposed in field condition while 65.9 % lantana shrub was decomposed after eleven weeks. After the completion of decomposition experiment, about 68 % of shrub was decomposed.

In the present study, the initial rapid decomposition of lantana shrub may be due to availability of early decomposable carbohydrates, proteins and other substances [3]. Relatively slow rate of decomposition during 3rd to 6th week may be attributed partially to the prevailing low air temperature which would bring down the soil temperature.

Percent Remaining of Lantana Shrub During Decomposition: One can notice that 50 % of shrub decomposed after 8 weeks (Fig. 1). Decomposition of shrub was faster in initial weeks but become slower in later ones. About 30 % of shrub was decomposed after 4th weeks of nylon mesh bag placement in soil. Three distinct phases were noticed in decomposition study. In the first phase (0-4 weeks) 30 % of shrub decomposed followed by second phase (5-8 weeks) 25 % of shrub decomposed and during third phase (9-12 weeks) only 13 % of shrub decomposition was observed.

Change in C:N Ratio of Lantana Shrub During Decomposition: It is observed that C: N ratio of lantana shrub at the initial period was 56.7 which decreased to 7.60 by the end of 12 weeks of the investigation. During the first phase of decomposition (0-4 weeks) C:N ratio decreased very fast but become slower in the second and third phase of decomposition. Rapid N mineralization in soil with lantana shrub was probably due to narrow C: N ratio accompanied by decrease in N mineralization in soil with lantana shrub, which attributed to wide C:N ratio of plant material and immobilization of N by microorganisms.

The C:N ratio of the microorganisms bodies is not only more constant but also much narrower between 4:1 and 9:1. Bacterial tissue in general is somewhat richer in protecting than fungi and consequently has narrow C: N ratio. As a result, C: N ratio value is wide and C: N ratio for plant material is in between those of higher first week than that of last week of incubation period.

Kinetics of Lantana Shrub Decomposition: The first order of kinetic model showed the best fit for the lantana shrub decomposition data in this study (R^2 = 0.99). The decomposition rates constant for the lantana shrub as calculated from the first order equation was 0.053 (k) week^{-1}, the half life ($t^{1/2}$) of the lantana shrub was worked out to be 57 days. Decomposition rates were not much affected by nutrient concentration, probably due to many factors affecting decomposition, mineralization and immobilization under field condition [4]. Several workers have demonstrated that the single exponential model describes reasonably well the decomposition rate of plant residue [5].

The rate of decomposition of lantana shrub measured under field condition in this appears to be

higher than that reported by [6] from an incubation study. This indicated the limitations of the incubation studies for extrapolation to field condition. The rates of decomposition were similar for all sample of lantana shrub and were accurately described by the single exponential function. The decomposition rates constant were in the range reported for materials of similar chemical composition [7].

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