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Research Article

RATE OF LITTERFALL AND DECOMPOSITION IN *Prosopis cineraria* AND *Ailanthus excelsa* BLOCK PLANTATION IN ARID CONDITION OF HARYANA

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Abstract: The study was carried out in Balsamand Research Farm, Hisar, for rate of litter fall and its decomposition rate in *Prosopis cineraria* (Khejri) and *Ailanthus excelsa* (Mahaneem) block plantation. The leaf-litter was collected at monthly interval from August, 2012 to September, 2013. Distribution indicated that litter production was much higher in December-February period and decreased in June-August. Maximum litter production was recorded in *Prosopis cineraria* block plantation than *Ailanthus excelsa* block plantation. Decomposition of leaf litter was studied using nylon bag technique. Decomposition of biomass varied with time in both the plantations. Highest decomposition was recorded *Prosopis cineraria* than *Ailanthus excelsa* block plantation. The practical implication of the study is that profuse litter under *Prosopis cineraria* increases more microbial activity which ultimately improves soil health.

Keywords: *Prosopis cineraria, Ailanthus excelsa*, Block plantation, Litterfall and Decomposition

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Introduction

Energy flow and nutrient cycling are essential for the proper functioning of an ecosystem. Litter fall is a fundamental process in nutrient cycling and it is mainly responsible for the transfer of organic matter and mineral elements from vegetation to the soil surface. The analysis of litter quality and quantity and its rate of decomposition are highly important for the understanding of energy flow, primary productivity and nutrient cycling in forest ecosystems. Litter fall is a major source of organic matter in forest ecosystem into soil subsystem [1]. Litter fall has also been described as a major pathway for the return of organic matter and nutrients from aerial parts of the plant community to the soil surface [2]. The advantages of litter fall in deciduous tree lies in the resulting reduced rate of transpiration while at the same time the return of leaf and other materials and their breakdown on the surface litter releases the mineral nutrients to the soil which are available for recycling. Uptake of nutrients by plants for their growth and development and some amount of the nutrients are accumulated in plant. Through litter fall large amount of nutrients are released to the soils which play an important role in biochemical cycling of nutrients [3]. It also improves the soil physico-chemical properties by adding the organic matter and nutrients to the soil [4]. Plant leaf is the main source of adding organic matter and nutrient to the soil compared to the other plant parts [5]. Nutrients are added to the soil by microbial oxidation of refractory components and the addition of nutrient to the soil by the decomposition varies from species to species and also depend upon the climatic condition (6). Considering the above facts, this study deals with the amount of litter production and its decomposition rate under arid condition.

Material and methods

The study was carried out in Balsamand Research Farm, Hisar, it is about 27 km away from CCS Haryana Agricultural University. The study area has an undulating topography characterized by high wind velocity and sand dune. The experimental area has an arid climate with mean annual rainfall of 220 mm, 80 percent of which is received in July to September.

The minimum and maximum temperatures are 1.0°C and 45.5°C in the month of January and June receptively. Litter fall was collected at monthly intervals from September, 2012 to August, 2013, in 21 years old *Prosopis cineraria* and block plantation of *Ailanthus excelsa*. For the collection of litter 20 replicates of 1×1m wooden frames (10 cm in height) were placed inside the *Prosopis cineraria* and *Ailanthus excelsa* block plantation. The above ground litter *i.e*., leaves, pods, fruit, branches etc from within the wooden frames were collected at monthly intervals. Litters from each plantation were oven dried at 60°C, until a constant weight was reached before taking the final reading. Litter decomposition studies were carried out by using the litterbag technique in the *Prosopis cineraria* and *Ailanthus excels* block plantation. After drying, 25 g of leaf litter for individual species were taken as an individual sample. Oven dried litter was placed in nylon litterbags of size 20×20 cm with a mesh size of 1 mm to permit only the movement of micro-arthropods and other microbial. To prevent the leaves from folding and clumping these were laid flatly inside the nylon bags. Total 360 bags filled with litter for each species were placed in *Prosopis cineraria* and *Ailanthus excelsa* block plantation. Ten bags for each species were collected at the end of every month. The collected samples were then gently washed to remove sediments and dirt particles by using a soft brush under slowly running tap water. Each sample was then oven-dried at 70°C to constant weight to calculate the rate of losses of weight by litters.

Results and discussion

Litter production

Monthly litter fall from shelterbelt and block plantations recorded during study period is shown in [Fig-1]. Significant differences in rate of litter fall production were recorded among the studied plantations. The quantity of litter fall was not uniformly recorded throughout the year. The highest litter fall production was in the month of January, 2013 and the lowest was in August, 2013. The variations in the litter fall production among the plantation were due to differential litter production capacity for different tree species and its growth habits, similarly, [7] also reported

that peak litter fall periods were coincided with the dry periods with no or little rainfall and could be associated with the natural senescence of leaf from trees in response to the stress included by water shortage. Litter fall among the plantations consist of leaf, branches, pods, flower etc but the maximum quantity of litter fall was leaf litter. Likewise [8] also recorded the leaf litter 63 to 97% of the total litter production which is varies with species, size, age and site specific. The results are in accordance with the findings of [9] who reported significant differences in rate of litter production among the tree species. Among the plantations highest litter fall were recorded in *Prosopis cineraria* than *Ailanthus excelsa* block plantations. Multiple species combination in the forest gardens yield a substantial amount of litter which varies in quantity of different tree species [10]. Overall it was observed that the pattern of litter fall from each plantation exhibited a similar pattern and the highest production of litter fall was recorded from December to February in the Prosopis cineraria and *Ailanthus excelsa* block plantations. This may be due to water or temperature stress which activates the synthesis of abscisic acid in the foliage. The quantity and pattern of litter production varies with tree species, growth pattern, age, density and canopy characteristics [11] and also the environmental conditions like temperature, water and mineral nutrient availability which limit litter production [12]. Similarly, reported that climatic conditions and rainfall directly influence the litter production dynamics [13].

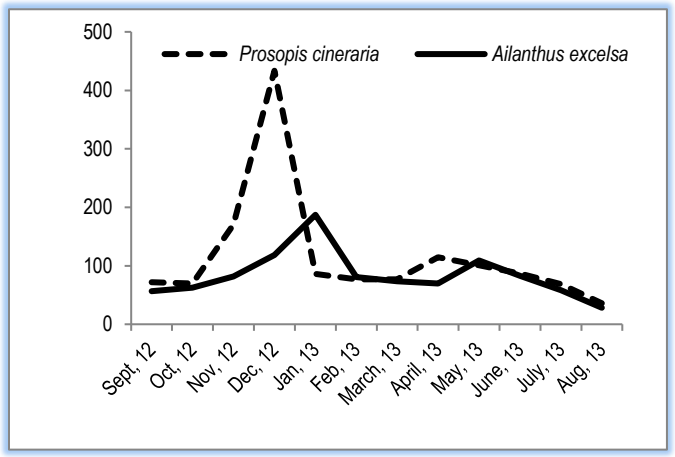

Fig-1 Rate of litter fall (g) under different plantations during different months

Litter decomposition

Litter decomposition of different plantations showed significant variation among different tree species and the loss of litter under different plantations were recorded the following pattern*: Prosopis cineraria* > *Ailanthus excelsa* [Fig-2]. It may be due to the quality of litter, amount of water soluble phenolic compounds, tannin, flavonoids, physico-chemical properties of litter and the presence of waxy cuticle [14]. Leaf litter decreased gradually during dry and wet season due to decomposition [15]. Decomposition was reported higher during the initial period and thereafter a gradual loss was observed in advanced stage [16]. In the initial stage of experiment decomposition of litter varied with time interval and among the plantations under study. Maximum litter decomposition was recorded in earlier stage then it subsequently decreased and after 360 days most of the litter was decomposed in different plantations. The decomposition rate was higher in Prosopis cineraria block plantation as compared to *Ailanthus excelsa* block plantation. At the end of year 0 percent litter in Prosopis cineraria and 7.64 percent litter in *Ailanthus excelsa* block plantation were remained undecomposed in begs. Relative large decrease in litter mass was observed due to non-lignified carbohydrate and leaching of readily soluble substances [17]. As the decomposition proceeds, the organisms help in decomposition utilizing the soluble components and components which degradable easily like sugars, starches and proteins. In later stage, decomposition was occurred at slower rate due to the presence of recalcitrant *i.e*., lignin, cellulose, tannins and hemicelluloses [18]. Decomposition of tree litter based on its physical and chemical composition and environmental factors may play the important role in determining the productivity of natural agro-ecosystems [19]. In rainy season litter mass loss was rapid may be due to the favorable conditions for fast decomposing litter and soil moisture contents and high biological activity [20]. During the dry period the decomposition rate was subsequently decline, it may be due to the lowering of soil moisture and temperature which can decrease the activity of decomposer organisms [21]. Variations of decay rate among the different plantation were also observed, it may be due to substrate quality, and climatic conditions quantity and quality of decomposer organisms are the primary determinants of leaf litter decay rate.

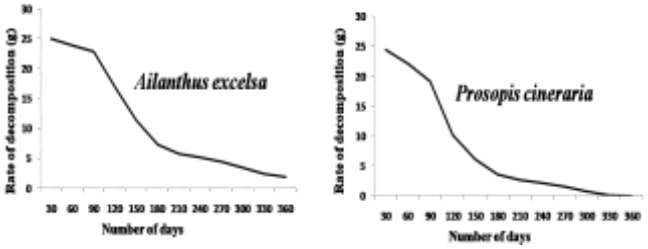

Fig-2 Rate of litter decomposition under different plantations

Conclusion

Litter productions of both the plantations were much higher in December-February period and decreased in June-August. Maximum litter production was recorded in Prosopis cineraria plantation as compared to *Ailanthus excelsa* block plantation. Time for decomposition of litter varied with time. In early stage the litter decomposition was higher than lateral stage. Highest litter decomposition was recorded in *Prosopis cineraria* block plantation than in *Ailanthus excelsa* block plantation but the trend of decomposition was same in both the plantations.

Application of research: Leaf-litter fall under trees and its further decomposition results in the improvement of soil health

Research Category: Forestry

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Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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