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Decomposition Pattern in *Pinus longifolia* Leaf Litter in Chandak Forest in the Presence of Cow Dung and Urea

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A B S T R A C T

The aim of present study was to determine the effect of cow dung and urea on the mass loss and decomposition percentage of *Pinus longifolia* leaf litter in the Chandak forest of Pithoragarh. Litter bags technique was used to determine their mass loss in the forest floor for one year at monthly intervals. Litter bags were collected from untreated controlled samples and treated with 1:1 cow dung treated litter and 05% urea treated samples are taken to the laboratory and then analyzed for their weight loss and decomposition percentage. The decomposition percent was found maximum in the month of September (10.29 %) in 1:1 cow dung , whereas the decomposition percentages was found 6.42 % in 05% urea and 5.47 % in control condition respectively in the month of August and September. The favorable climatic conditions enhanced the decomposition percentages.

Introduction

Pinus roxburghii Sarg. (syn. *Pinus longifolia* Roxb.) (Pinaceae), commonly known as chir pine, is a tall tree with a spreading crown found in the Himalayan from Kashmir to Bhutan, Afghanistan and in southern Indian hills (Shuaib *et al.*, 2013). It starts its growth in dense tufts at the end of pine boughs. It is attached to its bough by a sheath or cap (Das and Ramakrishnan, 1985). Litter fall and litter decomposition are key processes in nutrient cycling of forest ecosystems.

The process "plant litter decomposition" is necessary for the recirculation of nutrients and a continued buildup of plant biomass as well as for the maintenance of food webs through the energy released by the degradation of organic compounds. The main process of decomposition is extremely complex and can be subdivided into a multitude of sub processes. Meentemeyer (1978) and later Berg *et al.* (1993) demonstrated a large-scale effect of climate on decomposition rate of newly shed plant

litter. However, such an effect is not general to all litter species (Berg, *et al*., 2000) and not to all decomposition stages (Johansson, *et al*., 1995), but the changed substrate composition may dominate decomposition rates at least for some foliar litter species.

Most studies of litter decomposition have been performed in different forest ecosystems; little information is available on decay responses forests (Cleveland *et al*., 2006; McGroddy *et al.*, 2004; Micks *et al*., 2004; Vitousek, 1998), especially in the forests of Himalaya (Mo *et al*., 2007). This relationship was observed by (Fogel and Cromack, 1977) and later developed (Johansson *et al*., 1995) to different climate situations. The objective of this study is to evaluate the litter decomposition in natural forests of *Pinus roxburghii* in Pithoragarh district of the eastern Uttarakhand. The emphasis will be put on the relationship between the processes of litter decomposition and atmospheric temperature including litter treatment with cow dung and urea.

Materials and Methods

Study Area

The study was conducted in pure Pine forest of Chandak at Pithoragarh District of Kumaon Himalayas at an altitude of 1600. This area is situated between Lat. 29º27´ N. and 30º49´N. and Long. 79 º 50´ E. and 81 º 3 E. Chandak forest regions is present on 6000 ft (1.830m) altitude surrounded by 283 Hectare of pine forest (Fig-1).

Litter Collection and Litter Treatment

The pine litter (only fresh fallen leaf litter) was collected in the summer season (from April to June) and brought to the laboratory carefully on polythene bags. The collected needle were weighted and sampled for litter decomposition treatments. A total number of 108 bags filled with leaf litter (100 g each) in nylon mash (2mm). Out of 108 bags, 36 bags of leaf litter were mixed with 05% urea solution and another 36 bags mixed with 1:1 cow dung with litter and 36 bags used as a control. All 108 bags placed on the Pine forest floor for one year. In regular monthly interval 3 bags from each treated and controlled litter samples taken out and brought to the laboratory in the pollythene bags and washed carefully, oven dried at 80 ^{o} C and weighted finally. The decomposition percentage was calculated by weight loss. The mean monthly temperature ranges from 4.2^{o} C in January to 28. 4^{o} C. the climatic data are shown in Fig-2.

Results and Discussion

The maximum decomposition or minimum remaining litter biomass was found in cow dung treated litter 45.95 g, whereas the decomposed litter was found remaining 60.75g in urea treated litter and 67.53 g in control condition (Table 1).Though mixing of the cow dung and the urea solution increased the decomposition and the remaining litter biomass was observed significant (significant ($p<0.05$) in different treatments, none of the treatment revealed full litter decomposition . Continuous decrease in litter biomass in every month revealed that the environmental conditions were in support of litter decomposition and the mixing of cow dung was much supported than other conditions.

The average decomposition percent was found 6.25 % in the treatment with cow dung treated litter, whereas the decomposition percentages was found 4.05 % in urea treated and 3.21% in control condition . The decomposition percent was found maximum in the month of September

10.29 % in cow dung treated , whereas the decomposition percentages was found 6.42 % in urea treated and 5.47 % in control condition respectively in the month of August and September (Table -1). The overall decomposition rate was higher in the months of rainy season as compared to other seasons. The decomposition percent was found minimum in the month of December 2.10 % in control i.e., natural condition, whereas the decomposition percent were 2.24 % in urea treated and 2.32 % in cow dung solutions, respectively in the month of December and June. The overall decomposition rate decreased in the autumn and summer seasons as compared to rainy seasons. The correlation between monthly decay percent and different treatments revealed that application of the urea and the cow dung solutions may increase the decomposition rates up to 65% and 66 % respectively than the normal natural conditions 38%.(Fig-4,5,6)

Table.1 Monthly Remaining Biomass and Decomposition Percentage in Different Treatments

Month	Elapsed day	Weight loss of leaf litter			Decomposition % of leaf litter		
		Control	Urea	Cow dung	Control	Urea	Cow dung
July	30	95.85	93.71	91.35	4.15	6.29	8.65
August	60	91.75	87.70	82.87	4.27	6.42	9.28
September	90	86.74	82.28	74.34	5.47	6.17	10.29
October	120	83.08	77.18	68.15	4.21	6.20	8.32
November	150	81.06	73.85	63.87	2.43	4.31	6.28
December	180	79.36	72.20	60.47	2.10	2.24	5.32
January	210	77.56	70.50	57.68	2.27	2.35	4.61
February	240	75.71	68.85	55.77	2.38	2.34	3.33
March	270	73.93	66.49	53.05	2.35	3.43	4.87
April	300	71.46	64.30	50.21	3.34	3.28	5.35
May	330	69.11	62.19	47.04	3.29	3.28	6.32
June	360	67.53	60.75	45.95	2.29	2.32	2.32

Fig.1 Location of the Study Area

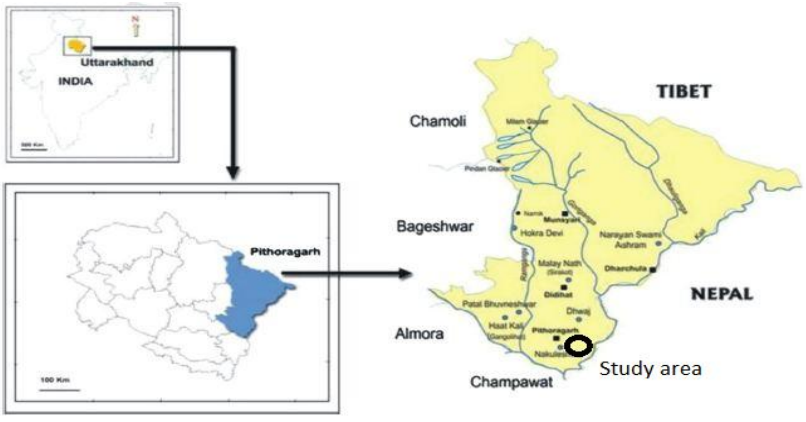


Fig.2 Average Annual Temperature, Humidity and Rainfall of the Study Area

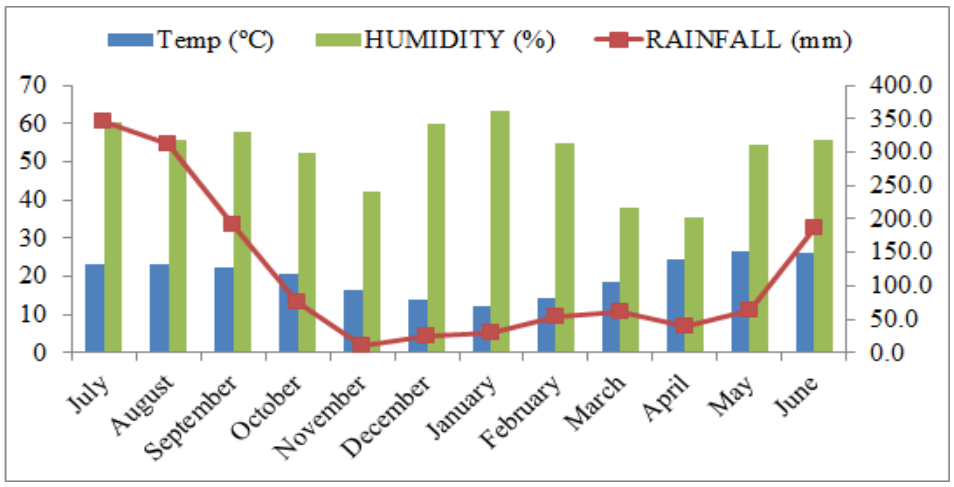


Fig.3 Litter Decomposition (%) in Different Treatments

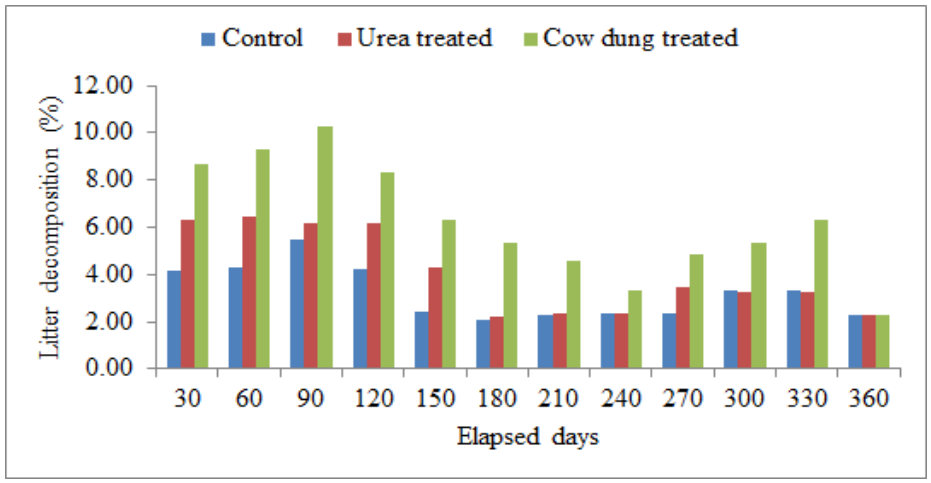


Fig.4 Litter Decomposition Percentage in Control Treatment

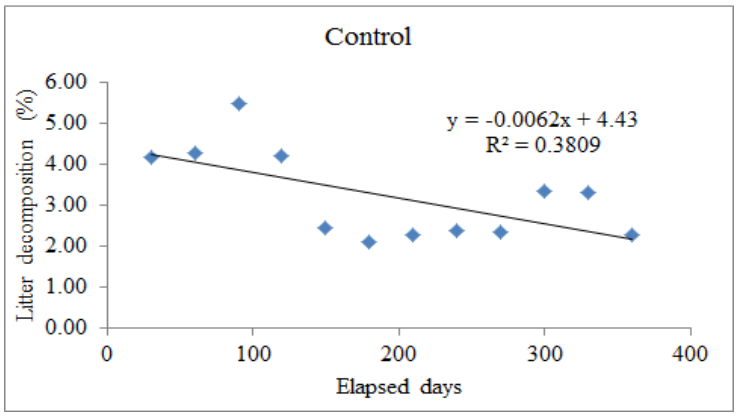


Fig.5 Litter Decomposition of Urea Treated Litter

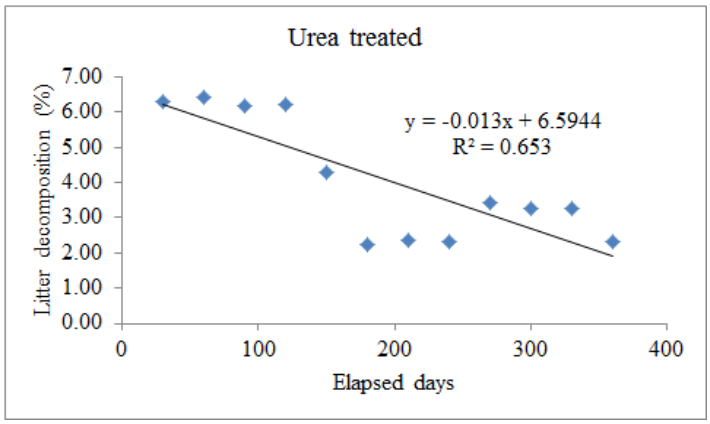
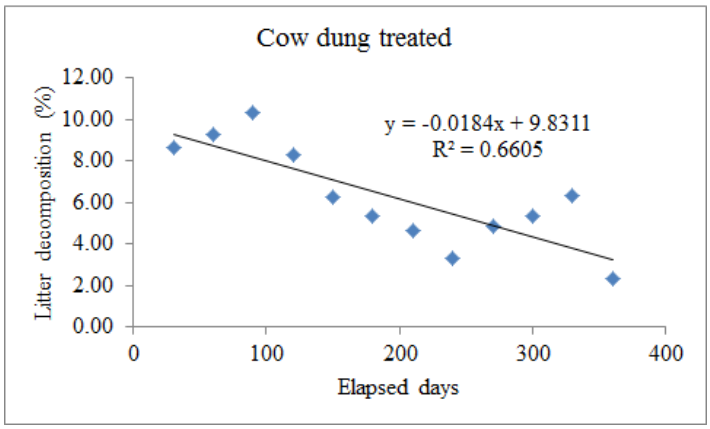


Fig.6 Litter Decomposition Cow Dung Treated Litter



Present results revealed application of 5% urea solution and the cow dung treatment increased the average decomposition percent whereas the decomposition percentages was lower in control condition. This indicates that cow dung gives suitable surface for the growth of microbes like fungus and insects, and they are responsible for the decomposition of litter. The earlier works done by Xiaoming and Suzuki (2004) revealed effects of urea treatment on litter decomposition and in urea-treated plots, the decomposition rate of leaves was greater than that of control. Bhattacharyya *et al.*, 2005 found that the treatments consisted of control, no input; cow manure, Urea and Fertilizer single dung and urea were integrated and compared to their single applications. Benitez *et al.* (1999) have reported that decomposition of organic materials by application of cow dung accelerates the mineralization process of the substrate.

Climatic conditions also play crucial role on the decomposition of the decomposing matter. Table-1 shows the effect of temperature and rainfall during different period of the year were different decomposition rate. High decomposing percentage shows high temperature, rainfall and high humidity which may also resulted into high microbial activity and vice versa. (Pandey and Singh, 1982; Bahuguna *et al.*,

1990). The decomposition percentage were maximum in the months of August and September , in the rainy seasons due to high humidity the microbial activity was highest due to the favorable effect of soil moisture on the activates of decomposer.

In conclusion, the application of Urea and cow dung increased the decomposition rate and percentage than control treatment whereas the decomposition rate and percentage was found maximum in cow dung treatment.

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