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An Assessment of Leaf Litter Contribution in Soil Fertility of *Salix* Stands under Natural Conditions

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Abstract

An experiment was conducted at the forest nursery at Wadura, Sopore, Kashmir during 2006-07 to study the contribution of litter in soil fertility of *Salix* stands under natural conditions. Nutrient status of the soil under *Salix* stands of both the species viz. *Salix alba* and *Salix fragilis* was determined before and after the litter fall. Concentrations of all the nutrients (organic carbon, N, P, K, Ca and Mg) was found to be higher after the litter fall as compared to before litter fall and control. *Salix fragilis* stands recorded maximum soil organic carbon, N, P, K, Ca and Mg content before as well as after the litter fall as compared to *Salix alba* and control.
Key words : Leaf litter, *Salix alba, Salix fragilis*, Soil, Nutrients.

Salix alba and *Salix fragilis* are considered as most important tree species in temperate agro/farm forestry systems. In India they are extensively cultivated in western Himalayas upto 2,400 m, mostly in Kashmir and Kullu valleys along river streams, canal banks, Nalla sides and around lakes. They are fast growing multipurpose tree species and of late, these species have assumed a lot of importance in extensive planting programmes both in homesteads and as avenue. The light wood of these species are commercially used in the cricket bat industry for the manufacture of cricket bats (1). Since Kashmir willow has been internationally acknowledged for cricket bat production, large number of willows are planted every year. The trees being deciduous in nature are a source of substantial quantity of organic matter by way of litter fall. Litter production, decomposition and untrient return in natural forests and in plantations are important aspects of nutrient cycling, since a considerable amount of nutrients are returned through litter fall in the form of leaves, twigs, branches, flowers and are available for reabsorption. The sequential process of litter fall, its decomposition and subsequent mineralization are essential in sustaining a dynamic forest ecosystem (2). Through experience, the incorporation of tree leaf biomass into the soil has received wider recognition primarily in view of their capacity to retain long term fertility and stability of the soil (3). Keeping in view the potential litter production of both the species viz. *Salix alba* and *Salix fragilis*, the present investigation was undertaken to study the contribution of litter in soil fertility of *Salix* stands.

Methods

The present investigation were undertaken at the Forest Nursery of Department of Forestry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Wadura, Sopore during 2006-07. The materials used, experimental procedures followed and methods adopted during the investigation are described as below.

Analysis of Soil Chemical Characteristics

The soil samples were collected from the *Salix* stands before and after the litter fall to assess the contribution of leaf litter in soil fertility of *Salix* stands. The following procedures were followed in the soil analysis.

Preparation of Soil Samples

The soil samples were air dried, crushed with

Table 1. Available soil nutrient status of *Salix* and non-*Salix* stand before and after litter fall.

Chemical constituents	Organic carbon (%)		Available N (kg/ha)		Available P (kg/ha)		Available K (kg/ha)		Exchangeable Ca (kg/ha)		Exchangeable Mg (kg/ha)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Salix alba	1.2	1.5	294	432	22.3	43.2	241	341	218	312	187	231
Salix fragilis	1.3	1.6	298	446	27.1	49.2	267	353	243	319	198	244
Control 1st (non-*Salix* stand)	0.9	0.92	215	412	14.3	32.1	219	223	204	297	156	197
Blue pine stand (control 2nd)	1.9	2.1	318	513	34.1	51.2	281	367	267	347	203	286

wooden mortar and pestle and sieved through 2 mm sieve. The sieved samples were labelled and stored in polythene bags for subsequent chemical analysis. Standard procedures were followed for the estimation of organic carbon, available nitrogen, phosphorus, potassium, calcium and magnesium.

Results and Discussion

Available Organic Carbon Content

Table 1 shows that the soil organic carbon content of both the *Salix* species viz. *Salix alba* and *Salix fragilis* was more after litter fall. However, maximum soil organic carbon content (10—25%) was reported under *Salix fragilis* stand after litter fall as compared to *Salix alba* and control. A significant increase in soil organic carbon content of both the species was recorded when compared to first control. However, the values obtained were less as compared to second control. The significant increase in soil organic carbon content in both the species after litter fall could be due to the addition from decomposing leaf litter. The increase in organic matter was more or less proportional to the amount of leaf litter (4). However, the increase in soil organic carbon content under *Salix fragilis* could be attributed to addition of good quantity of leaf litter into the soil (5). Moreover, a significant increase in soil organic carbon content under natural ecosystem, comprising grasses and blue pine (control second) could be due to the tangible enrichment of soil with respect to organic matter in the form of leaf litter under natural ecosystem (grass + blue pine). Our findings are in agreement with the findings of various researchers (6—8).

Available Nitrogen Content

Table 1 shows a significantly higher soil nitrogen content of *Salix* stand after litter fall. Available N status was found to enhance by 46 to 91%. The values obtained for soil nitrogen content under *Salix* plantation were significantly higher than non-salix stands. Moreover, natural ecosystem comprising of grasses and blue pine, depicted highest soil nitrogen content. The significant increase in available soil nitrogen content may be due to addition of N rich litter of *Salix fragilis* and *Salix alba* into the soil (9). Moreover, the heavy increase in soil N content under natural ecosystem, comprising of grasses and blue pine may be due to the continuous and bulk additions of leaf litter into the soil. The litter additions provide a stable supply of carbon and energy for microorganisms and cause an increase in the microbial biomass pool, thereby increasing soil respiration rate which might help to enhance N availability in the soil (10). These results are in close agreement with the findings of Kumar et al. (11) who also reported higher available nitrogen under tree litters than control.

Available Phosphorus Content

The data on available phosphorus content revealed that there was a significant increase in phosphorus content under the stands of both the species after litter fall as compared to pre-litter fall (Table 1). Higher available soil phosphorus content (49.2 kg/ha) was reported under *Salix fragilis* stand. The increase in available phosphorus was by 31—93%. The natural ecosystem consisting of grasses and blue pine, showed highest soil phosphorus content. The increase in soil phosphorus content in both the species after litter fall could be attributed to the organic matter additions which produces organic acids during decomposition, thereby increasing the availability of P in soils (12). Further the increase may also be due to narrow C:P ratio of organic matter which are likely to increase the available soil phosphorus content compared to those with wider C:P ratio (13). Our findings are in agreement with the results of Prasad et al. (4) and Dass et al. (14).

Available Potassium Content

Higher available soil potassium content was recorded under *Salix* plantation after litter fall as compared to before litter fall (Table 1). Potassium content was more under *Salix fragilis* stand as compared to *Salix alba* stand. Moreover, the K content was more under *Salix* plantation than non-*Salix* stand. Natural ecosystem, comprising of grasses and blue pine revealed highest soil K content. The significant increase in soil K content under *Salix* plantation after litter fall may be due to the leaf litter additions into the soil and can also be attributed to the fact that potassium is not strongly bound in organic structures, unlike that of nitrogen and sulfur. Hence microbial action is not critical for K release as it is for the mineralization of organic bound elements. This could be one of the reasons for less immobilization as indicated by large release to the available pool (15). The increase in soil K content under *Salix* stands after litter fall could be attributed to the addition of large quantity of litter biomass into the soil (6). The heavy increase in soil K content under natural ecosystem comprising of grasses and blue pine is due to the reason that there is continuous and bulk addition of organic matter in the form of leaf litter into the soil which after decomposition enhances the soil K status by its release through leaching into the available pool (10). Our results are in conformity with the findings of Kumar et al. (11).

Exchangeable Calcium Content

Higher exchangeable calcium content of soil was observed after litter fall (Table 1) in both the species as compared to before litter fall. The values obtained for calcium content of soil under *Salix* plantation were significantly higher than control first. Natural ecosystem comprising grasses and blue pine depicted the highest calcium content. The higher exchangeable calcium content of soil after litter fall may be ascribed to organic matter addition into the soil, which is subsequently released into the soil ecosystem through decomposition processes by biotic activities than leaching (16). Further, the increase in soil calcium content under natural ecosystem, comprising of grasses and blue pine could be due to the continuous and bulk addition of calcium rich organic matter into the soil, which upon decomposition enhance the soil calcium status (10).

Exchangeable Magnesium Content

Exchangeable magnesium was significantly higher in soil of both the species after litter fall (Table 1). Among the two species, soil of *Salix fragilis* stand exhibited the maximum Mg content followed by *Salix alba* stand. Moreover, the values obtained for Mg content under *Salix* plantation were significantly higher than non-*Salix* stand. Further, the natural ecosystem revealed the highest Mg content. The significant increase in exchangeable Mg under *Salix* plantation after litter fall could be attributed to the addition of foliar rich Mg into the soil. It can also be due to biological mobilization of Mg into the soil (17).

Conclusion

Thus it could be concluded that nutrients like organic carbon, N, P, K, Ca and Mg were maximum in the soil of *Salix* stands after litter fall as compared to before litter fall and control and hence it makes *Salix* species a promising species for afforestation of poor soils, marginal lands and wastelands. Thus, it is advisable to conduct such similar studies in different ecoclimatic zones for evolving strategies for the management of various forestry species .

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