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Snowfall Acidity in Fir Forest

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Abstract

Firs managed in uneven-aged systems are regarded as significant evergreen species in the Black Sea Region. According to their ecology, firs grow optimally in cool and wet site conditions (Çepel, 1985; Kantarcı, 2005). Firs form storied and irregular stands due to their shade tolerance. The interception arising from crown cover and vertical stratification has an effect on rainfall reaching the forest floor and hence affects the process of creating water resources.

Water is an indispensable element for living organisms. Forests play an important role because of storage, reform and regulation water resources.

The aim of this study is to compare the snowfall in open areas and in fir forests in terms of acidity values. The plot was established at an altitude of 1,580 m in Bolu-Aladağ Mountains where fir grows optimally. Eight snow samplers were placed into the forest and one sampler in the open area. Measured snowfall amounts were evaluated as mm. Correlation and variance analysis were used for statistical evaluation. The acidity of snow samples was compared with the pH values. The values found range from 3.5 pH to 7.0 pH. In terms of volume, the open area has shown higher values than the forest area.

Under the global climate change situation, part of the world's agenda in recent years, the importance of available fresh water resources of the countries will obviously increase in the future. Therefore, when determining the existing situation and renewability of water resources, it is necessary to know what amount of snow has fallen in the forests, which are the main water producing areas and how the canopy cover can affect these quantities. Particularly, snowfall is very important for nutrients of water resources. Through the snowfall information, the process of water resource formation in the forests will be set forth more clearly. This will also be useful in terms of planning and decision of functions of forest resources in the context of sustainable forest management.

Keywords: Ecosystem Monitoring, ICP, Air Pollution, Sustainable management of natural resources, Precipitation, Acid Rains

Introductıon

European countries' long-range trans-boundary air pollution agreement was signed in 1979 for the monitoring of negative effects of air pollution on forests and the elimination of losses. Turkey has also signed this agreement. In the context of sustainable management of natural resources, the "Monitoring and Evaluation of the Effects of Air Pollution International Cooperative Programme on Forests" (***ICP Forests)*** was established under the test areas for the first time in Europe in 1985, with the purpose of monitoring forest ecosystems.

For the development of sustainable forest management information system in Turkey, the PPA 05/TR/7/7 joint Turkey-Netherlands project was launched in January 2006. The international co-operation program for the Assessment and Monitoring of Air Pollution Effects on Forests and the protection of forests against atmospheric pollution has started with level I and level II plots in forest areas.

In October 2007, the first Turkish level II plot in Şerif Yüksel research forest was established for fir (*Abies bormülleriana* Mattf). For observations on snow depositions, 8 through-fall snow samplers (collectors) were placed within this plot. For reasons of comparison, one snow collector was placed in the open area very close to the observation area.

The laboratory of Black Sea Forest Research Institute is suitable for measuring pH values of snow samples. The values obtained from snow have showed that the snowfall has acid properties owing to various reasons such as gases from heating plants in northern counties of Turkey and polluted airs of European countries „arriving" by long-range atmospheric movements.

Forests have major influences on the factors such as interception, body flow, dropping its crown hill, forest rainfall, surface storage, run-off, infiltration, evapo-transpiration. They represent the most important components of the hydrological chain and are collectively defined

as the disposition of precipitation (Zengin, 1997).

The deposition is one of the key factors in the causal chain. Detection of the amount and properties of atmospheric deposition is needed for this reason (Deposition Manual, 2011)

Snow sampling had started at the end of 2008. The value of 5.5 is considered to be a neutral pH value. If the pH value is lower than 5.0 the snow has acid properties. However, the measurements in the fir stand have not finished yet. In order to assess the exact pH values of snow in this plot, long term measurements and observations have to be performed continuously.

Material and Method

Serif Yuksel Research Forest, Forest Enterprise forests is divided into Aladag in 1965. There are 1575 hectares of land area where has characterized as moderately rugged terrain. Research Forest land that is in Aladag mountains where are northern part of the mass Koroglu Mountain range dominant tree species in Uludag Fir (*Abies bormülleriana*) and Scots pine (*Pinus sylvestris),* respectively. Climatic data are as follows:

Mean annual rainfall : 882.6 mm
Mean annual temperature : 5.7 ^{0}C
Minimum temperature : -28.7 ^{0}C, in February (11/02/1975)
Maximum temperature : +38.6 ^{0}C, in August (08/12/1994) and September (09.18.1994)
Mean annual water shortage : 52.9 mm
Plot elevation : 1,590 m.

For fir (*Abies bormülleriana* Mattf) forest, the application of the first Turkish level II plot in Şerif Yüksel research forest has been completed at the end of the 2007. Observations of snow precipitation have been carried out using 8 through fall snow samplers (collector); two snow samplers were placed in each cardinal direction inside the plot. For reasons of comparison, one snow collector was placed in the open area very close to the observation area. Between 12/09/2008 and 03/15/2011 (a period of two years), every 15 days, snow samples were collected. Volume values and acid ratios (ph) of the samples were measured in the Soil laboratory of Western Black Sea Forestry Research Institute. There were eight snow collectors under the trees inside the plot and one snow collector in the open area, making possible the comparison between the through fall and the open area. Snow samples were taken, dissolved at room temperature then the liquid volume and pH were measured.

Findings

Between 12.09.2008 and 03.15.2011, every 15 days, 19 measurements were carried out by determining the time snowfall. The pH values ranged from 3.5 to 7.5. The snow acidity depending on time was analyzed using One-Way Analysis of Variance ANOVA. The results are shown in table 1.

Table 1: One-Way Analysis of Variance of pH values depending on the time (ANOVA)

		Sum of squares	df	Mean square	F	Sig.
Ph	Between groups	26,004	18	1,445	6,440	,000
	Within groups	17,048	76	,224		
	Total	43,052	94			

P <0.000 was found and it has been shown that it is different at higher level of significance on pH value measurement date. Examining the relationship between date and pH measurements, (r = 0.066 ns) (p = 0.523) values were found, so there is no correlation between them. According to Table 2 there is no significant correlation between the measurement date and the pH.

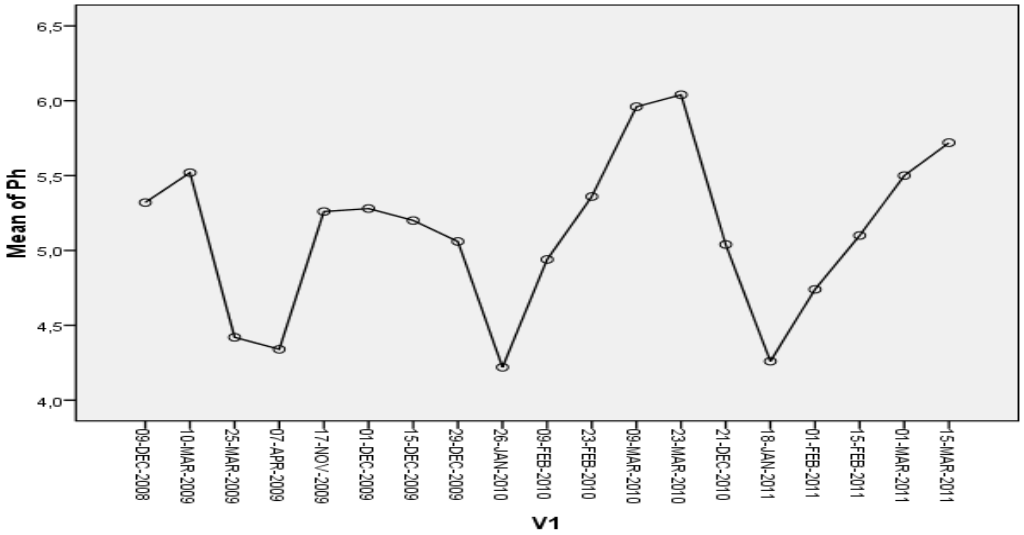

Figure 1 : Variation of pH values depending on period of measurement

Table 2: Correlation Analysis

		Date	Sampler No	Precipitation snow/rain equivalent	pH
Date	Pearson correlation	1	,000	-,045	**,066**
	Sig. (2-tailed)		1,000	,666	**,523**
	N	95	95	95	95
Sampler No	Pearson correlation		1	,032	,001
	Sig. (2-tailed)			,758	,992
	N		95	95	95
Precipitation Snow/Water Equivalent	Pearson correlation			1	-,035
	Sig. (2-tailed)				,733
	N			95	95
Ph	Pearson correlation				1
	Sig. (2-tailed)				
	N				95

According to the measurement date for the distribution of pH values in the Duncan test of homogeneity, the values are represented in 8 groups. As can be seen in Table 3, the highest values were measured in March.

Depending on samplers, pH values were analyzed by ANOVA One-Way Analysis of Variance. As shown in Table 4, p = 0.149. When examining the relationship between samplers and pH (r = 0.001, ns) (p = 0.992), no correlation between the variables was found. According to Table 2, there is no significant relationship between the pH and samplers.

Table 3: Duncan homogeneity test for measured pH values depending on the date

		Subset for alpha = 0.05							
V1	N	1	2	3	4	5	6	7	8
26-Jan-2010	5	4,220							
18- Jan -2011	5	4,260							
07-Apr-2009	5	4,340	4,340						
25-Mar-2009	5	4,420	4,420	4,420					
01-Feb-2011	5	4,740	4,740	4,740	4,740				
09-Feb-2010	5		4,940	4,940	4,940	4,940			
21-Dec-2010	5			5,040	5,040	5,040	5,040		
29-Dec-2009	5			5,060	5,060	5,060	5,060		
15-Feb-2011	5				5,100	5,100	5,100		
15-Dec-2009	5				5,200	5,200	5,200		
17-Nov-2009	5				5,260	5,260	5,260		
01-Dec-2009	5				5,280	5,280	5,280	5,280	
09-Dec-2008	5				5,320	5,320	5,320	5,320	
23-Feb-2010	5				5,360	5,360	5,360	5,360	
01-Mar-2011	5					5,500	5,500	5,500	5,500
10-Mar-2009	5					5,520	5,520	5,520	5,520
15-Mar-2011	5						5,720	5,720	5,720
09-Mar-2010	5							5,960	5,960
23-Mar-2010	5								6,040
Sig.		,127	,070	,059	,086	,111	,061	,052	,113

Means for groups in homogeneous subsets are displayed. a. Uses Harmonic Mean Sample Size = 5,000.

Table 4: Variation of pH values based on samplers ANOVA

	Sum of squares	df	Mean square	F	Sig.
Ph	Between groups	3,081	4	,770	1,735 ,149
	Within groups	39,971	90	,444	
	Total	43,052	94		

Conclusion

Using 15-day cycles, 19 snowfall measurements were made. pH values has ranged between 3.5 to 7.5 pH. In Table 1, acidity of snowfall was shown in relation to time, and analyzed using one-way ANOVA analysis of variance. P <0.000 was found meaning that at the measurement of pH value it is different at the higher level than $\alpha = 0.01$ level of significance.

In Table 2, examining the relationship between time and pH measurement, (r = 0.066 ns) (p = 0.523) were found meaning no correlation between. In other words, there is no significant correlation between the pH measurement dates. Referring to figure 1, it is shown that the highest pH values were measured in March. In the context of long-range air movements, it is believed that it could be caused by desert dust transported to our country.

According to the measurement date for the distribution of pH values in the Duncan test of homogeneity, the values are represented in 8 groups. In the table 3, it is shown that the highest values were measured in March.

In table 4, the change in pH values depending on samplers was analyzed with one-way ANOVA analysis of variance and $p = 0.149$ was found. At $\alpha = 0.05$ significance level, there was no significant difference between samplers. The relation between samplers and pH values ($r = 0.001$ ns) ($p = 0.992$) was found. It means that the lack of correlation between them has emerged. In other words, there is no significant correlation between the pH and the samplers.

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