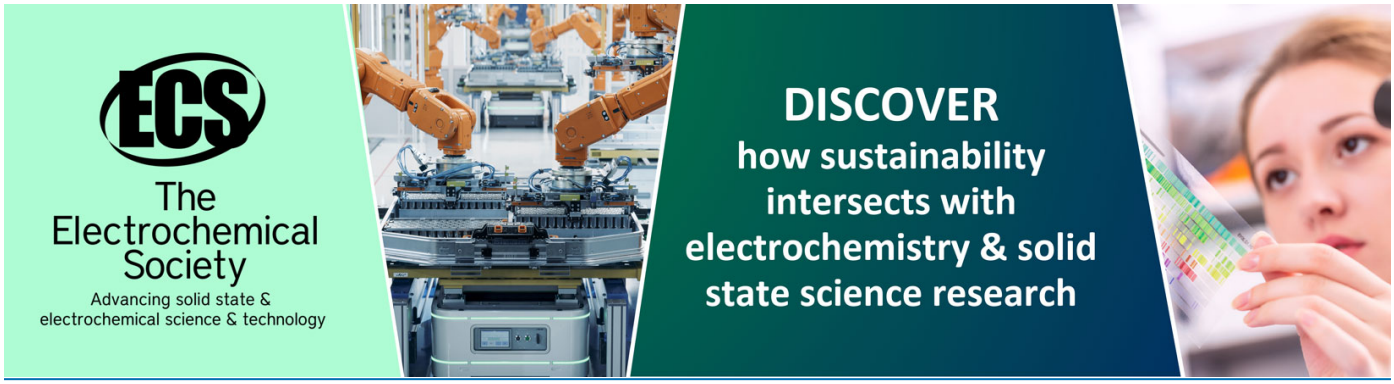
Characteristics of the Stem Sap Flow of Mixed Forest of *Maple camphor* Mixed Forest in Mountain Area of West Hunan Province



Characteristics of the Stem Sap Flow of Mixed Forest of *Maple camphor* Mixed Forest in Mountain Area of West Hunan Province

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Abstract. The stem sap flow characteristics of mixed forest of Maple camphor mixed forest in mountain area of West Hunan Province were studied. The results showed that during the observation period, the rainfall in the study area was 1971.84 mm and the number of rainfalls was 83 times. The stem flow of the mixed forest increased with the increase of rainfall, and there was a significant linear relationship between the stem flow and rainfall. The fitting equation of Maple camphor mixed forest was y = 0.0218x-0.0356, R^2= 0.6376.

Keywords: *Maple camphor* mixed forest, stem sap flow, mountain area of West Hunan Province.

Stem flow is the part of rainwater flowing through branches and leaves along the trunk to the ground [1]. Although it accounts for a small proportion of the total precipitation and is often neglected in the study, it is of great significance in ecology, hydrology and soil and water conservation. There has been a large number of studies on rainfall redistribution in forest canopy at home and abroad [2-5]. However, studies on stem sap flow characteristics of Maple camphor mixed forest in mountainous area of West Hunan Province are rarely reported [6-10].

Therefore, the study on the stem flow characteristics of Maple camphor mixed forest could provide data basis for further study on the hydrological effects of forest vegetation in this area, and play an important role in the scientific evaluation of the hydro-ecological function of the mountain forest ecosystem in Western Hunan.

1. Survey of research area

The experimental site is located in the small watershed of Never Zhai (E111 degree 12', 42.836, N29 degree 25', 27.582) in Wuling Mountains, which is located in Liangxi Village, Zengyang Town, Cili County, Zhangjiajie City, Hunan Province, about 7 km northwest of Cili County.

The watershed is relatively well sealed and belongs to the second-class small tributary of Li River, which is generally north-south. It is a low mountain area of Wuling Mountains. The total area of the watershed is 3.15 km2, the lowest elevation (outlet of the main channel) is 210 m, the highest elevation is 917.4 m, the length of the main channel is about 1.2 km, and the longitudinal ratio of the main channel

is about 28.4. In addition, the transverse and gully density are about 2.6 km/km2, and the main ditch longitudinal gradient is about 28.4 per thousand, which has severe soil erosion.

The forest coverage rate in this area is over 80%, and the vegetation types are mainly returning farmland to forest and secondary forest, which is a concentrated area of returning farmland to forest. The soil parent rock in this area is mainly sand shale, and the soil is mainly yellow red soil and acid soil. The main vegetation types are Pinus massoniana forest, Eucommia ulmoides forest, Citrus reticulata and miscellaneous shrub forest. The experimental plots were located at the national positioning observation and research station of the forest ecosystem in Cili, Hunan.

Table 1. Basic characteristics of the plant in plots

Stand type	Altitude/m	Slope/°	Slope direction	Parent material	Soil types	Origin	Density /(plant·hm^{-2})	Average height/m	Average DBH/cm	Canopy density	Main plants of shrub grass
Maple camphor mixed forest	333	18	Northwest	Plate shale	Yellow soil	secondary forest	3507	7.0	7.8	0.85	*Gynostemma pentaphyllum*, *Mallotus philippensis*, *Pteridium aquilinum*, etc

2. Research methods

2.1. Determination of precipitation outside forest

From June 10, 2015 to September 9, 2016, HOBO U30 automatic weather station was used to continuously observe precipitation and precipitation process, and a siphon self-gauge and a standard rainfall tube were used to measure precipitation and precipitation process outside the forest.

2.2. Measurement of stem sap flow

According to tree diameter class and canopy standard, 15 trees were selected in each plot. The 2.0 cm diameter polyethylene plastic hose was planted along the middle crack and wrapped around the trunk in a snake shape from 2 m height. The plastic pipe and the horizontal angle were 30 degrees. The hose was placed in the gap between the glass rubber hose and the trunk, and sealed plastic containers. Measure water volume after each rain, and convert the area projected by canopy into the stem flow of individual tree and stand.

Trunk stream is calculated according to the following formula [10].

$$S = \sum_{i=1}^{N} \frac{S_N \cdot M_N}{A \cdot 10^3}$$

Where S is the stem flow (mm), MN is the number of tree samples per diameter order, SN is the stem flow (ml) of tree samples per diameter order, A is the sample area (m2).

2.3. Data process

Excel and SPSS17.0 statistical analysis software was used for data processing and plotting.

3. Results and analysis

3.1. Precipitation variation characteristics

During the observation period, the precipitation of the study area reached 1971.84 mm, the number of rainfalls were 83 times (Fig. 1), the average rainfalls were 5 times per month, and the average rainfall was 131.46 mm per month. Referring to the optimal segmentation method proposed by Huang Yan [11], this study divided the rainy season into the following stages: spring rainy season (March-April), main rainy season (May-August), autumn rainy season (September-October), the rest of the month (1, 2, 11, December) is dry season.

During the observation period, the precipitation of the spring rainy season, the main rainy season and the autumn rainy season accounted for 88.48% of the precipitation of the observation period, which indicated that the dry and wet season of the Wuling Mountains in Western Hunan changed obviously and the season was distinct, and the precipitation of the whole year came from the rainy season more. In addition, the rainy season was the growing season of the main vegetation types in the study area. Plenty of water is a good condition for vegetation growth.

Figure 1 showed that of the 83 precipitations in the study area from June 10, 2015 to September 9, 2016, 48 occurred in 2016 and 35 in 2015. Moreover, the precipitation was totally 1971.84 mm, which were 1412.61 mm in 2016 and 559.23 mm in 2015.

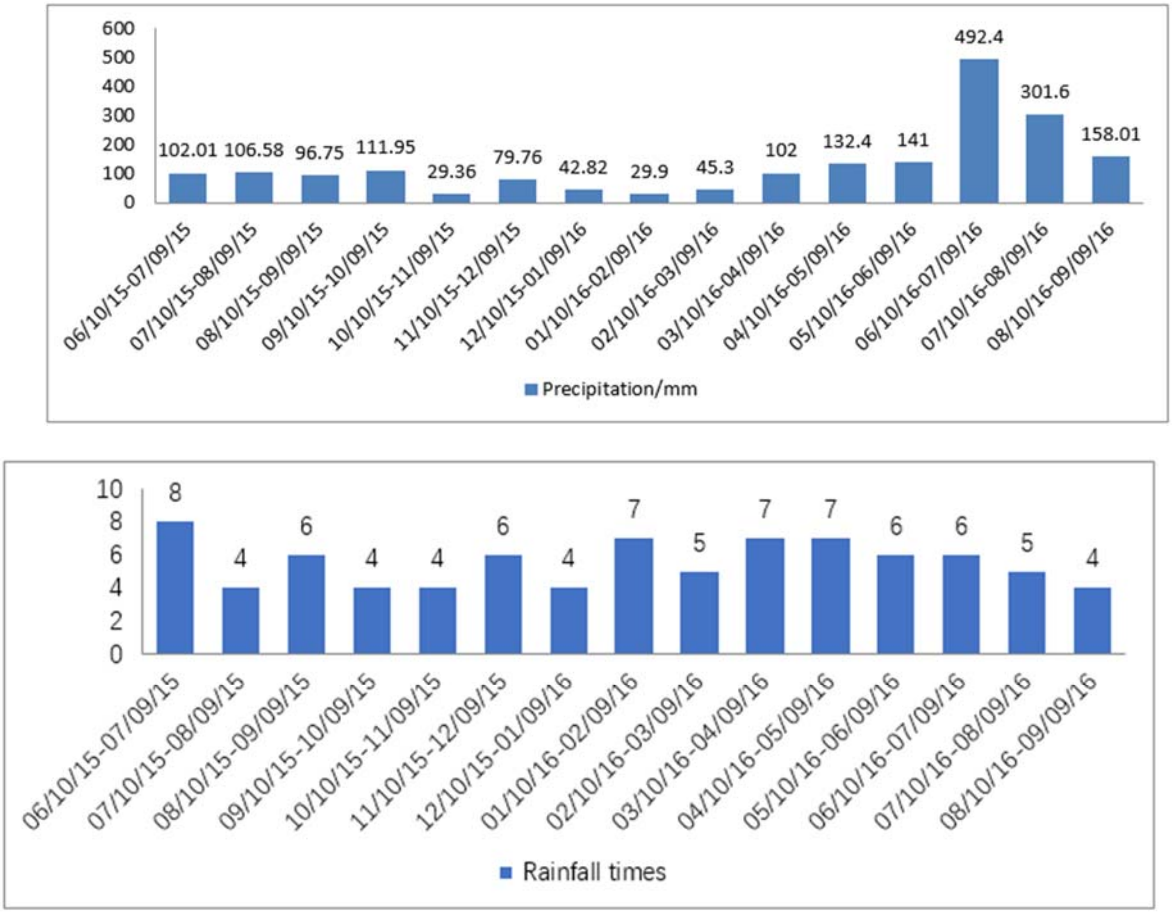

Fig. 1 Rainfall during the observation period

3.2. Characteristics of stem sap flow

Figure 2 showed the relationship between stem flow and rainfall in the mixed forest. In 83 rainfall periods, 78 stem flow and 39.98 mm stem flow occurred in the mixed forest. There was a significant linear relationship between stem flow and rainfall in Maple camphor mixed forest. The fitting equation of Maple camphor mixed forest was y=0.0218x-0.0356 and R2=0.6376, where y represented the stem flow and x represents rainfall. Theoretically, when y = 0, there was no stem flow, and when the rainfall reached 1.63 mm, the stem flow could be produced.

The results showed that the stem flow of Maple camphor mixed forest increased with the increase of rainfall. When the maximum rainfall was 206 mm, the stem flow of the mixed forest was 8.21 mm. The results showed that the stemflow was positively correlated with the rainfall in the Maple camphor mixed forest. The reason was that a large amount of rainfall forms penetrating rain, and part of the penetrating rain fell to the ground through the canopy, part of the rainfall could flow through the trunk to the ground,

forming a trunk stem flow. Furthermore, the greater the rainfall was, more than the carrying capacity of the trunk, the greater the trunk stem flow could be.

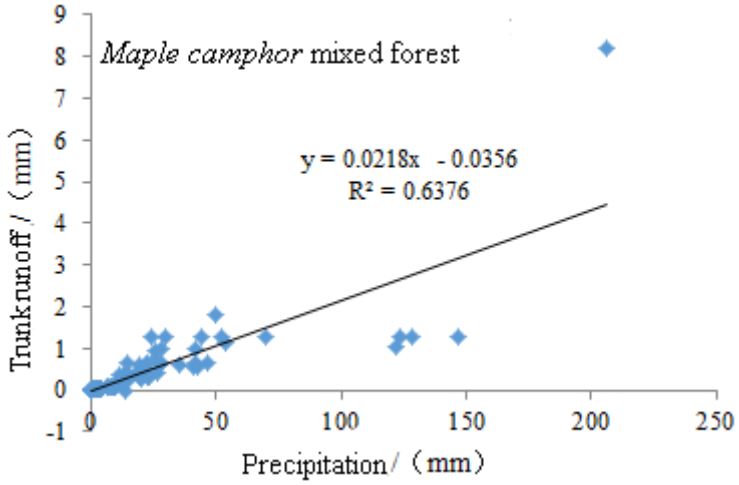

Fig. 2 Relationship between trunk runoff and rainfall of Maple camphor mixed forest.

4. Conclusion

The characteristics of stem sap flow of mixed forest of Maple camphor mixed forest in mountain area of West Hunan Province were studied. The results showed that during the observation period, the rainfall in the study area was 1971.84 mm and the number of rainfalls was 83 times. The stem flow of the mixed forest increased with the increase of rainfall, and there was a significant linear relationship between the stem flow and rainfall. The fitting equation of mixed forest of Maple camphor mixed forest was $y = 0.0218x - 0.0356$, $R^2 = 0.6376$.

Acknowledgements

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