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Tree Fresh Leaf- and Twig-Leached Dissolved Organic Matter Quantity and Biodegradability in Subtropical Plantations in China

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Abstract: Extreme weather events often cause the input of fresh plant tissues into soils in forests. However, the interspecific patterns of tree fresh plant tissue-leached dissolved organic matter (DOM) characteristics are poorly understood. In this study, we collected fresh leaves and twigs of two broadleaf trees (*Liquidambar formosana* and *Schima superba*) and two coniferous trees (*Pinus massoniana* and *Pinus elliottii*) in subtropical plantations in China, and measured tree fresh tissue-leached DOM quantity and biodegradability. The interspecific patterns of fresh plant tissue-leached DOM production varied with organ types. Broadleaf tree leaves leached greater amounts of dissolved organic carbon (DOC), dissolved total nitrogen (DTN), and dissolved total phosphorus (DTP) than coniferous tree leaves, but an opposite pattern of DOC and DTN productions was observed between broadleaf and coniferous tree twigs. Regardless of tree species, leaves often leached greater quantities of DOC, DTN, and DTP than twigs. For both leaves and twigs, broadleaf tree tissue-leached DOM had greater aromaticity and lower biodegradability than coniferous tree tissue-leached DOM. Moreover, leaf-leached DOM had greater aromaticity and lower biodegradability than twig-leached DOM. In addition, DOM biodegradability negatively correlated with the initial aromaticity and DOC:DTN ratio, despite no relationship between DOM biodegradability and DOC:DTP ratio. These findings highlight the pivotal roles of leaf habit and organ type in regulating fresh tree tissue-leached DOM production and biodegradability and reveal that the substantial variations of fresh tissue-leached DOM biodegradability are co-driven by DOM aromaticity and N availability in subtropical plantations in China.

Keywords: decomposition; extreme weather event; leaching; plant growth form; stoichiometry

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1. Introduction

Dissolved organic matter (DOM), a small but labile fraction of soil organic matter, plays a crucial role in regulating key ecological processes in forests [1,2]. For example, DOM provides the main sources of energy and nutrients for heterotrophic microbes [3–6], and thus drives greenhouse gas emissions and soil organic matter formation in forests [7–9]. Moreover, DOM is an important vector controlling the transport of carbon (C) and other elements from terrestrial to aquatic systems [1,10,11]. Therefore, knowledge about DOM characteristics is necessary to fully understand forest ecosystem structure and function.

In forests, the leaching of soluble organic matter from plant litter, especially in the early stage of decomposition, is considered the primary source of DOM in soils [12,13]. It is well acknowledged that litter-leached DOM amounts are controlled by a variety of physical and chemical traits such as water holding capacity [14], soluble carbohydrates [15], and lignin concentration [16]. Likewise, litter-leached DOM biodegradability is co-regulated by C quality [3,17] and stoichiometric ratios between C and nutrients [18–21]. However, these previous studies have concentrated on senesced litter [4,16,22], and little is known about the production and biodegradability of DOM leached from fallen fresh plant tissues. In forests, extreme weather events such as hurricanes and storms often destroy the trees, increasing the input of fresh plant tissues into soils [23–25]. For example, typhoon-induced fine litterfall ranges from 2.21 to 5.12 Mg ha^{-1} year^{-1} in subtropical pine plantations [24]. Due to the substantial differences in physical and chemical properties between fresh and senesced plant tissues, the controls on amounts and biodegradability of fresh organ-leached DOM are unclear in these ecosystems. These knowledge gaps will limit our understanding of plant-mediated C and nutrient cycles in forests.

Here, we sampled the fresh leaves and twigs of four common afforestation species (broadleaf trees: *Liquidambar formosana* and *Schima superba*; coniferous trees: *Pinus massoniana* and *Pinus elliottii*) from subtropical plantations in southern China, and then conducted a 48 h leaching experiment to investigate the amounts of fresh tissue-leached dissolved organic carbon (DOC), dissolved total nitrogen (DTN), and dissolved total phosphorus (DTP). In this study, we used the amount of DOC in the leachates to indicate DOM production and assessed DOM aromaticity by measuring the specific ultraviolet absorbances at 254 nm ($SUVA_{254}$) and 350 nm ($SUVA_{350}$) [26,27]. Subsequently, we measured DOM biodegradability using a 28-day standard incubation experiment [17]. The main objectives of this study were to: (1) determine the effects of tree species and organ type on fresh tissue-leached DOM production and biodegradability, and (2) uncover the factors determining the variations of fresh tissue-leached DOM quantity and biodegradability in subtropical plantations.

2. Materials and Methods

2.1. Study Site

Fresh tree tissues were collected from plantations in the long-term Forest Restoration Experimental Station of Jiangxi Agricultural University (26°55′16′′ N, 114°48′14′′ E) located in the Luoxi Town, Taihe County, Jiangxi Province, southern China. The study site has a humid subtropical monsoon climate. Mean annual temperature is 18.6 °C, and mean annual precipitation is 1726 mm. These plantations have been established in 1991 and the main afforestation species are *L. formosana*, *S. superba*, *P. massoniana*, and *P. elliottii*. These selected four tree species have been widely planted for restoring degraded lands and maintaining ecosystem services in subtropical regions of China. For example, the area of *P. massoniana* plantations has reached 1.00×10^7 hm^2 according to the eighth National Forest Resource Survey in China. Mean tree height in the *L. formosana*, *S. superba*, *P. massoniana*, and *P. elliottii* plantations was 10.7 m, 9.8 m, 8.7 m, and 11.6 m, respectively, and mean diameter at breath height (DBH) in the *L. formosana*, *S. superba*, *P. massoniana*, and *P. elliottii* plantations was 16.2 cm, 20.3 cm, 17.9 cm, and 26.4 cm, respectively. The detailed description of the study site is shown in Xu et al. [28].

2.2. Plant Sampling and Measurement

In the study site, we randomly established six plots (10 m × 10 m) in the *L. formosana*, *S. superba*, *P. massoniana*, and *P. elliottii* plantations in June 2019. In each plot, we selected three individuals with similar tree height and DBH and then harvested thirty fully expanded and healthy leaves and ten twigs from the canopy of each targeted individual. For each organ type, plant materials collected from the same plot were mixed and divided into two subsamples. The first subsample was oven-dried at 65 °C to determine the initial moisture content and then ground to pass through 0.15 mm sieves for chemical analyses, and the second subsample was used for the leaching experiment. Plant organic C and total N concentrations were measured on a FlashSmart CHNS/O Elemental Analyzer (Thermo Fisher Scientific, Bremen, Germany), total P concentration was colorimetrically determined on an autoanalyzer (AA3, Seal Analytical, Germany) after acid digestion, total polyphenols were measured with the Folin–Ciocalteau method [29], soluble sugars and starch were measured by the anthrone colorimetry method [30], and tissue density was assessed by the procedures of Pérez-Harguindeguy et al. [31]. The initial chemical properties of tree tissues are shown in Table 1.

Tree tissue-leached DOM was extracted with a short-term leaching experiment [32]. For each tree organ, 3 g of fresh plant material was placed in 500 mL glass jars and soaked in 200 mL of deionized water in the dark at room temperature (about 20 °C) for 48 h. Subsequently, the leachates were filtered through 0.7 μm Whatman ™ GF/F glass microfiber filters (Little Chalfont, Buckinghamshire, UK) and used to measure DOM parameters. In the leachates, DOC and DTN concentrations were measured on a TOC analyzer (multi N/C 2100S, Analytik Jena, Jena, Germany), DTP concentration was colorimetrically measured on an autoanalyzer after peroxodisulfate oxidation [33], and the ultraviolet absorbances of DOM at 254 nm and 350 nm was measured with an ultraviolet-visible spectrophotometer (UV600SC, Jinghua Instruments, Shanghai, China). Plant-leached DOC, DTN, and DTP productions were obtained from the total amounts of DOC, DTN, and DTP in the leachates and the dry mass of fresh tree tissues. The specific ultraviolet absorbance at 254 nm ($SUVA_{254}$) and 350 nm ($SUVA_{350}$) were calculated by dividing the ultraviolet absorbance at 254 nm and 350 nm by the DOC concentration, respectively [26,27].

Plant-leached DOM biodegradability was assessed with a 28-day standard laboratory incubation experiment [17]. Prior to incubation, DOC concentration in the leachates was diluted to about 20 mg L^{-1} to avoid excessive microbial growth. Meanwhile, microbial inoculums were obtained by placing 5 g of fresh forest soils in 1000 mL of deionized water. Subsequently, 100 mL of diluted leachates per treatment was placed in a 500 mL glass jar, and 5 mL of microbial inoculums was added to the jar. In addition, six glass jars with 100 mL of deionized water and 5 mL of microbial inoculums was established as blanks. All glass jars were sealed and aerobically incubated in the dark at 20 °C for 28 days. By the end of incubation, DOC concentration in the leachates was determined on a TOC analyzer. Plant-leached DOM biodegradability was calculated from the difference between the initial and final DOC amounts and was expressed as the proportion of the initial DOC amount (%).

2.3. Statistical Analyses

All statistical analyses were performed with R version 4.1.1 [34], and the accepted significant level was set at $\alpha = 0.05$. Linear mixed models were used to assess the effects of tree species, organ type, and their interaction on DOM parameters with the 'nlme' package. For each tree species, paired *t*-test was used to examine the differences in DOM parameters between leaves and twigs. For each plant organ, one-way ANOVA with Tukey's HSD comparison was applied to determine the differences in DOM parameters among the tree species with the 'agricolae' package. Spearman's correlation analysis was used to examine the relationships between DOM parameters and initial properties of plant materials with the 'survey' package. A linear regression analysis was used to determine the relationships between DOM biodegradability and initial DOM properties with the 'abline' function.

Table 1. Initial properties of tree leaf and twig in subtropical plantations in southern China.

Species	Organ Type	Organic C	Total N	Total P	C:N Ratio	C:P Ratio	Polyphenols	Soluble Sugars	Starch	Tissue Density
		mg g^{-1}	mg g^{-1}	μg g^{-1}			mg g^{-1}	mg g^{-1}	mg g^{-1}	g cm^{-3}
L. formosana	Leaf	465 (3) B	15.7 (0.29) A	1338 (28) A	29.7 (0.4) C	348 (7) C	128.2 (1.9) A	66.5 (1.1) A	29.9 (1.1) A	0.782 (0.01) A
	Twig	551 (4) a	5.84 (0.07) a	704 (11) b	94.4 (1.6) b	784 (11) b	40.5 (0.7) b	37.5 (1.1) a	22.0 (0.9) a	0.567 (0.01) a
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.020	<0.001
S. superba	Leaf	482 (4) A	14.2 (0.17) B	1142 (25) B	34.1 (0.6) B	424 (12) B	120.1 (1.6) B	60.1 (1.6) B	26.7 (0.6) A	0.468 (0.01) C
	Twig	460 (4) d	4.12 (0.06) c	676 (7) b	111.8(2.0)a	681 (6) c	76.8 (0.7) a	34.9 (0.7) a	19.8 (1.1) ab	0.605 (0.02) a
	p-value	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
P. massoniana	Leaf	475 (3) AB	13.5 (0.17) B	1377 (18) A	35.4 (0.6) B	345 (6) C	61.6 (1.0) D	52.1 (1.3) C	21.0 (0.7) B	0.693 (0.002) B
	Twig	516 (4) b	5.77 (0.06) a	583 (8) c	89.4 (0.9) b	885 (11) a	23.2 (0.5) c	29.1 (1.1) b	18.1 (0.8) b	0.456 (0.001) b
	p-value	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.016	<0.001
P. elliottii	Leaf	484 (3) A	8.8 (0.15) C	918 (22) C	55.3 (1.2) A	528 (13) A	84.7 (0.9) C	49.4 (1.4) C	20.0 (0.8) B	0.676 (0.002) B
	Twig	498 (5) c	5.27 (0.07) b	745 (9) a	94.7 (1.4) b	669 (10) c	21.3 (0.7) c	29.5 (1.1) b	16.4 (0.8) b	0.471 (0.001) b
	p-value	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.042	<0.001

The data in the parentheses are the standard errors of the means ($n = 6$). In the same column, the different uppercase letters indicate the significant differences among the tree leaf treatments ($p < 0.05$), and the lowercase letters indicate the significant differences among the tree twig treatments ($p < 0.05$). For the same tree species, p-value < 0.05 indicate the significant differences between leaf and twig.

3. Results

Tree species, organ type, and their interaction significantly affected DOC production, DTN production, DTP production, DOC:DTN ratio, and DOC:DTP ratio (Table 2). For each tree species, leaves leached greater amounts of DOC, DTN, and DTP than twigs (Table 3). Broadleaf tree (*L. formosana* and *S. superba*) leaves had greater DOC, DTN, and DTP productions than coniferous tree (*P. massoniana* and *P. elliottii*) leaves, whereas broadleaf tree twigs had lower DOC production than coniferous tree twigs (Table 3). Plant-leached DOC, DTN, and DTP productions showed a negative relationship with the initial tissue C:N and C:P ratios, but exhibited a positive relationship with polyphenols, soluble sugars, and starch (Table A1). In the leachates, tree leaves often had higher DOC:DTN and DOC:DTP ratios than tree twigs (Table 3). In addition, broadleaf tree leaves had greater DOC:DTN ratio in the leachates than coniferous tree leaves, although there was no significant difference between broadleaf and coniferous tree twigs (Table 3).

Table 2. Results (*F*-values) of linear mixed models on the effects of tree species (S), organ type (O), and their interaction on tree tissue-leached DOM properties and biodegradability in subtropical plantations in southern China.

Sources of Variation	DOC Production	DTN Production	DTP Production	DOC:DTN Ratio	DOC:DTP Ratio	$SUVA_{254}$	$SUVA_{350}$	DOM Biodegradability
S	527 ***	158 ***	426 ***	85 ***	120 ***	53 ***	87 ***	41 ***
O	2697 ***	1450 ***	1783 ***	481 ***	89 ***	60 ***	119 ***	27 ***
S × O	707 ***	417 ***	329 ***	67 ***	85 ***	0.35	10 ***	0.31

DOC, dissolved organic carbon; DTN, dissolved total nitrogen; DTP, dissolved total phosphorus; DOM, dissolved organic matter. ***, $p < 0.001$.

Table 3. Dissolved organic C (DOC), dissolved total N (DTN), and dissolved total P (DTP) productions, and stoichiometric ratios of tree tissue leachates in subtropical plantations in southern China.

Species	Organ Type	DOC Production	DTN Production	DTP Production	DOC:DTN Ratio	DOC:DTP Ratio
		mg g^{-1}	μg g^{-1}	μg g^{-1}		
L. formosana	Leaf	60.9 (1.4) A	323 (4) A	61.2 (1.5) A	188 (5) A	997 (29) B
	Twig	7.7 (0.4) b	80 (4) c	17.1 (0.6) a	97 (5) a	449 (7) c
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001
S. superba	Leaf	35.7 (0.3) B	212 (4) B	46.4 (0.8) B	169 (3) B	770 (12) C
	Twig	8.3 (0.4) b	107 (4) b	11.5 (0.7) c	77 (3) b	726 (15) b
	p-value	<0.001	0.001	<0.001	<0.001	0.055
P. massoniana	Leaf	19.2 (0.3) C	161 (4) C	17.3 (0.6) C	120 (2) C	1114 (34) A
	Twig	14.0 (0.6) a	138 (6) a	14.0 (0.5) b	102 (3) a	998 (25) a
	p-value	0.001	<0.001	0.005	0.006	0.003
P. elliottii	Leaf	13.1 (0.3) D	134 (5) D	21.1 (0.8) C	98 (4) D	626 (22) D
	Twig	8.8 (0.6) b	114 (4) b	11.8 (0.6) c	77 (3) b	749 (18) b
	p-value	0.002	0.003	0.001	0.014	0.010

DOC, dissolved organic carbon; DTN, dissolved total nitrogen; DTP, dissolved total phosphorus. The data in the parentheses are the standard errors of the means ($n = 6$). In the same column, the different uppercase letters indicate the significant differences among the tree leaf treatments ($p < 0.05$), and the lowercase letters indicate the significant differences among the tree twig treatments ($p < 0.05$).

Tree species, organ type, and their interaction produced significant effects on $SUVA_{254}$ and $SUVA_{350}$ values (Table 2). Irrespective of tree species, leaves had higher $SUVA_{254}$ and $SUVA_{350}$ values in the leachates than twigs (Figure 1). For both leaves and twigs, broadleaf trees had greater $SUVA_{254}$ and $SUVA_{350}$ values in the leachates than coniferous trees (Figure 1).

Tree species and organ type independently produced a significant effect on DOM biodegradability (Table 2). Regardless of tree species, twig-leached DOM had greater biodegradability than leaf-derived DOM (Figure 1). For both leaves and twigs, broadleaf trees had lower DOM biodegradability than coniferous trees (Figure 1). In addition, tissue-leached DOM biodegradability was negatively related to the initial $SUVA_{254}$ value, $SUVA_{350}$ value, and DOC:DTN ratio, but exhibited no significant relationship with DOC:DTP ratio (Figure 2).

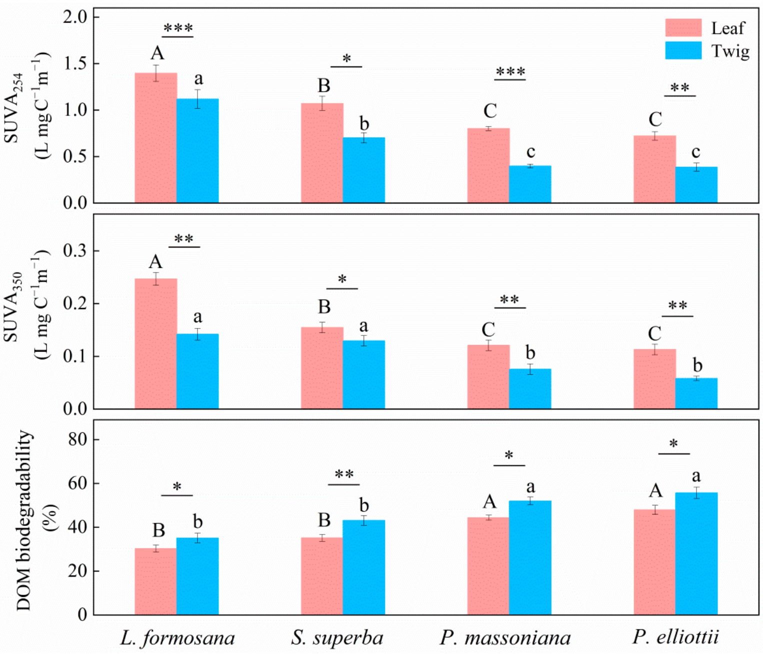

Figure 1. Optical properties and biodegradability of tree litter-derived dissolved organic matter (DOM) in subtropical plantations in southern China. The error bars are the standard error of the means ($n = 6$). Different uppercase letters indicate the significant differences among the tree leaf treatments ($p < 0.05$), and different lowercase letters indicate the significant differences among the tree twig treatments ($p < 0.05$). For each tree species, *, **, and *** indicate the significant differences between leaf and twig at the levels of $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively.

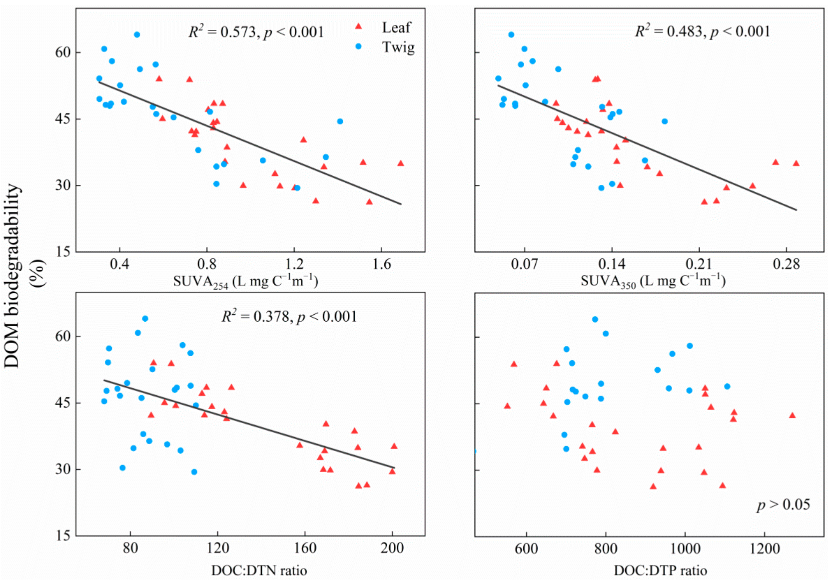

Figure 2. Relationships between plant-leached dissolved organic matter (DOM) biodegradability and the initial properties in subtropical plantations in southern China.

4. Discussion

The interspecific patterns of leaf- and twig-leached DOM production differed between broadleaf and coniferous trees. Specifically, broadleaf trees produced greater amounts of DOC and soluble nutrients in the leaf leachates but had lower DOC quantity in the twig leachates than coniferous trees (Table 3). Previous studies also observed greater amounts of DOM for broadleaf tree leaf litter than for coniferous tree leaf litter in temperate and subtropical forests [16,19,35]. In general, plant-leached DOM production is controlled by litter physical and chemical traits such as non-structural carbohydrates and lignin concentration [15,16,28,36]. Thus, these inconsistent results would be explained by the differences in interspecific patterns of leaf and twig traits between broadleaf and coniferous trees. These findings suggest that the interspecific patterns of fresh plant tissue-leached DOM production between broadleaf and coniferous trees is largely dependent on organ type in subtropical plantations.

In this study, the greater DOM production of broadleaf trees relative to coniferous trees would be explained by the following mechanisms. First, broadleaf trees have higher soluble sugars, starch, and polyphenols concentrations in fresh leaves than coniferous trees (Table 1). Second, compared with coniferous trees, broadleaf trees had greater specific leaf area and water holding capacity [37], which would enhance leaching of soluble compounds from fresh leaves. However, coniferous tree twigs had lower tissue density than broadleaf tree twigs (Table 1), which would favor the entry of waters into plant tissues [14]. Accordingly, DOC production was greater for coniferous tree twigs than for broadleaf tree twigs.

During leaching, broadleaf tree leaves had greater DTN and DTP productions than coniferous tree leaves, despite no significant difference between broadleaf and coniferous tree twigs (Table 3). These inconsistent interspecific patterns would be explained by the differences in nutrient concentrations in fresh tissues between broadleaf and coniferous trees. In forest soils, the soluble nutrient leached from plant litter is the primary nutrient source for microbial growth and activity [3,4,38]. Accordingly, the interspecific difference of fresh tissue-leached DTN and DTP productions would partly help explain the spatial variations of soil microbial-mediated ecological processes between broadleaf and coniferous tree plantations in subtropical regions.

Tree fresh tissue-leached DOC, DTN, and DTP productions negatively correlated with both C:N ratio and C:P ratio (Table A1). This result was contrary to the previous studies which did not observe any significant relationship between litter-leached DOM production and C:N:P stoichiometry [35,39]. These inconsistent findings indicate the contrasting roles of C:N:P stoichiometric ratios in regulating DOM production between fresh and senesced tree tissues. In plant tissues, the higher C:N and C:P ratios represent the lower metabolic activities and associated smaller amounts of non-structural compounds and nutrients [40,41]. In this study, plant tissues with higher C:N and C:P ratios were observed to have lower soluble sugars and starch (Table 1). Thus, fresh tree tissue-leached DOM production increased with decreasing C:N and C:P ratios.

For both leaves and twigs, broadleaf trees had greater $SUVA_{254}$ and $SUVA_{350}$ values in the leachates than coniferous trees (Figure 1), indicating that broadleaf tree tissue-leached DOM had greater amounts of aromatic compounds than coniferous tree tissue-leached DOM [26,27]. Moreover, both $SUVA_{254}$ and $SUVA_{350}$ values correlated negatively with C:N and C:P ratios, but correlated positively with soluble sugars, starch, and polyphenols (Table A1). Hagedorn and Machwitz [15] also found that the molar UV absorptivity at 285 nm of litter-derived DOM exhibited negative relationship with C:N and lignin:N ratios. In this study, broadleaf trees had higher soluble organic compounds in the leaves and twigs than coniferous trees (Table 1), and thus produced DOM with greater aromaticity in subtropical plantations.

Notably, broadleaf trees had lower fresh leaf- and twig-leached DOM biodegradability than coniferous trees during 28-day incubation (Figure 1). This interspecific pattern of fresh tissue-leached DOM biodegradability was contrary to the previous studies reporting greater senesced leaf-leached DOM biodegradability for broadleaf trees than for coniferous trees in forests [18,19,42]. These inconsistent results indicate that the interspecific variations of plant-leached DOM biodegradability differ between fresh and senesced tissues in forests. In general, DOM biodegradability is influenced by DOM aromaticity and C:N:P stoichiometry because microbial activity is limited by the availability of energy and nutrients [17,19,28,43]. The initial $SUVA_{254}$ value, $SUVA_{350}$ value, and DOC:DTN ratio were also observed to correlate negatively with DOM biodegradability in this study (Figure 2). In these forests, coniferous tree tissues often had lower aromatic C content and DOC:DTN ratio in the leachates than broadleaf tree tissues (Figure 1). Therefore, coniferous trees had higher fresh tissue-leached DOM biodegradability than broadleaf trees. These results imply that the interspecific variation of fresh tissue-leached DOM biodegradability is co-regulated by C quality and N availability in subtropical plantations.

Tree fresh leaves had greater DOC, DTN, and DTP productions and DOM aromaticity, but had lower DOM biodegradability than tree fresh twigs (Table 3 and Figure 1). Kammer and Hagedorn [44] also found that senescent leaves produced greater quantity of DOC with higher refractory components than senesced twigs in a temperate forest. In these forests, tree fresh leaves had higher soluble sugars and starch contents and lower tissue density than tree fresh twigs (Table 1). In contrast, tree leaves could allocate a greater amount of defensive compounds (i.e., condensed tannins and polyphenols) to resist herbivores than tree twigs due to the relatively higher nutrient concentrations [45]. In this study, higher polyphenol concentration was also observed for tree leaves than tree twigs (Table 1). Therefore, tree fresh leaves produced higher amounts of DOM containing greater aromatic compounds than tree fresh twigs in subtropical plantations. Due to the lower DOM aromaticity and DOC:DTN ratio, fresh tissue-leached DOM biodegradability was higher for tree twigs than for tree leaves in these plantations.

In forests, litter-leached DOM strongly influences soil organic matter formation and stabilization [1,9]. In these plantations, tree fresh leaves produced much greater amounts of DOM with higher biodegradability than tree senesced leaves [19]. These observations imply that tree fresh leaf-leached DOM would promote the accumulation of mineral-associated C fractions via the microbial pathway [9,38]. Considering that the intensity and frequency of extreme weather events exhibit an increasing trend as a result of global climate change [46], our findings highlight the crucial role of plant fresh tissue in regulating C budget in subtropical forest ecosystems.

5. Conclusions

In summary, tree fresh tissue-leached DOM production and biodegradability varied with leaf habit and organ type. During leaching, broadleaf tree fresh leaves produced greater amounts of DOM with higher aromaticity than coniferous tree fresh leaves, whereas broadleaf tree fresh twigs produced lower amounts of DOM with greater aromaticity than coniferous tree fresh twigs. Irrespective of organ type, broadleaf trees had higher tissue-leached DOM biodegradability than coniferous trees due to the lower DOC:DTN ratio and aromatic C content. Given the elevating incidences of extreme weather events such as hurricanes and storms and subsequent increased input of fresh plant tissues in the context of global climate change [46], these findings will help understand and predict the biogeochemical cycles in subtropical plantations in southern China.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Spearman's correlation coefficients between tree tissue-leached DOM parameters and the initial chemical traits in subtropical plantations in southern China.

	C:N Ratio	C:P Ratio	Polyphenols	Soluble Sugars	Starch
DOC production	−0.891 ***	−0.701 ***	0.641 ***	0.746 ***	0.538 ***
DTN production	−0.870 ***	−0.716 ***	0.626 ***	0.709 ***	0.529 ***
DTP production	−0.845 ***	−0.627 ***	0.779 ***	0.870 ***	0.699 ***
$SUVA_{254}$ value	−0.543 ***	−0.475 **	0.705 ***	0.751 ***	0.758 ***
$SUVA_{350}$ value	−0.481 **	−0.483 **	0.781 ***	0.775 ***	0.849 ***

DOC, dissolved organic carbon; DTN, dissolved total nitrogen; DTP, dissolved total phosphorus; $SUVA_{254}$, the specific UV absorbance at 254 nm; $SUVA_{350}$, the specific UV absorbance at 350 nm. **, $p < 0.01$; ***, $p < 0.001$.

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