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LEACHING METABOLITES IN THE VEGETATION OF NORTHERN TAIWAN

I. Release of Cations in Some Vegetations of Northern Taiwan[1,2]

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Abstract

The comparative study of cation release from fresh leaves, litter and the associated soil of 23 selected species in northern Taiwan was performed. The cation contents of leaf leachates and aqueous extracts of each sample were determined by means of atomic absorption spectrophotometry. Among seven cations, the quantity of Ca, K, and Na was very high in the leaf leachates but low in the soil extracts, while that of Fe, Mn, Zn, and Cu was low in both plant leachates and soil extracts. The amount of cation released from plant materials and soils was affected by seasons. However, no correlation was found between cation release and environmental parameters of rainfall and temperature.

Introduction

The ecosystem study has received a great deal of attention since last decade, and many works concerning the nutrient release from leaves, branch, and litter have been reported (Bormann and Likens, 1969; Bormann *et al.*, 1970; Gosz *et al.*, 1972, 1973). Bormann and his coworkers studied the ecosystem of nutrient cycling in Hubbard Brook Forest, New Hampshire, and determined the nutrient budget by using a small water shed (Bormann and Likens, 1969; Linkens *et al.*, 1967; Siccama *et al.*, 1970). In addition, Tukey (1970, 1971) reported the leaching substances of plants and concluded that many substances as amino acids, carbohydrates, phenolics, alkaloids, and mineral nutrients were released. He demonstrated that the leachability of cations was affected by environmental parameters and the physiological characteristics of a plant.

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Most of the research was done in the northern America, however, this study has rarely been investigated in the subtropical zone of Taiwan.

In Taiwan the lururiant growth of vegetation and heavy rainfall preserve good conditions for ecosystem study. Chou (1975a and 1975b) reported the ecological function of leaching metabolites in *Miscanthus floridulus*, a dominant grass in Taiwan, but this work still lacks some information about the dynamics of ecosystem. Therefore, this study was focused on the comparison of cation release from 23 selected species in northern Taiwan, particularly in Taipei and Keelung counties.

Materials and Methods

Materials

Fresh leaves and fallen leaf litter of 23 species listed later were collected at ramdon from many sites in Taipei and Keelung counties of northern Taiwan. The samples, collected in the summer and winter of 1973–1974, were brought into the laboratory of Academia Sinica and air dried at room temperatures. The leaves were chopped into small pieces about 2.5 cm long.

Soil samples were collected from the top 10 cm layer of the earth in the areas beneath the plant growth. Each soil was air dried, screended with 2 mm sieve, and carefully examined to remove all visible plant fragments from the soils.

Climate

The study areas receive northwestern monsoon in winter and southeastern monsoon in summer; thus the annual precipitation is above 2800 mm. The average of annual temperature ranges from 15 to 23°C (Li, 1963). According to the climatic classification of Taiwan (Kuo, 1975), Keelung belongs to autumn-winter rain zone with high annual precipitation, while Taipei belongs to summer-autumn rain zone with varied annual rainfall. The weather record of 1973–1974 were obtained from the Taiwan Central Weather Bureau. The mean temperature and rainfall of 1973–1974 are given in Fig. 1. The samples for this study were collected from May to July of 1973 and from December 1973 to February 1974.

Preparation of leaf leachates and soil extracts

In an one-litter container, 50 g of chopped leaves of each species was mixed with 500 ml of distilled water, and left to stand for 12 hr of soaking. After soaking, the aqueous leachates were obtained by suction filter and further centrifuged.

The aqueous extracts of soils were prepared by mixing 100 g of soil with

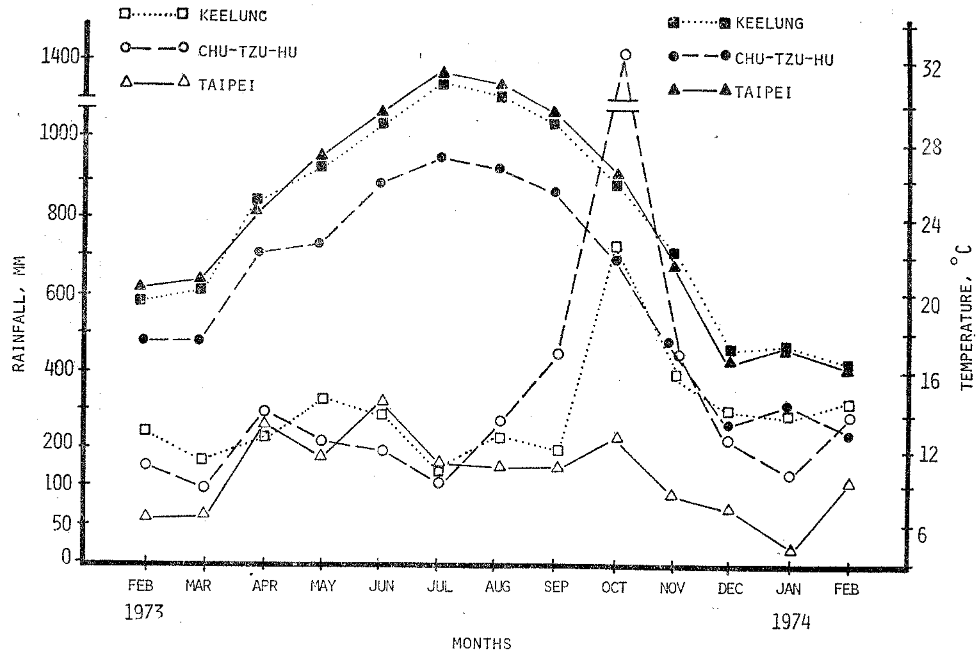

Fig. 1. Records of monthly rainfall and average monthly temperature in three locations of Taiwan from February 1973 to February 1974. The data were obtained from Taiwan Central Weather Bureau.

200 ml of distilled water and saken for 2 hr. The filtrate was obtained by centrifugation at 6000 rpm.

Determination of cation content in the leachates and extracts

The cation content of each solution was determined by an atomic absorption spectrophotometer (Perkin-Elmer, model 300) (called AAS), followed the techniques described in "Analytical methods for atomic absorption spectrophotometry" (Perkin-Elmer, 1971).

The data of analysis were analyzed statistically by means of analysis of variance.

Results

Cation content in the leaf leachates and soil extracts

Results of cation analysis of fresh leaves collected in summer showed that the amount of cation varied with species and cations (Table 1). Among the cations, the quantity of Zn, Fe, and Mn is as low as 50 ppm, and that of Na, Ca, and K varied with 2800–60000 ppm.

The cation contents in the leachates of litter from 21 species collected in summer are given in Table 2. The amount of Ca, K, and Na is very high as

Table 1. *Cation content in the leaf leachates of 23 selected species from four locations*

Fresh leaves were collected in summer of 1973.

Location	Species	Content, ppm					
		Ca	Fe	K	Mn	Na	Zn
Taipei	*Daphniphyllum teijsmannii*	7,100	2.50	3,200	10.3	10,500	1.00
	Melaleuca leucadendron	9,000	5.50	5,500	5.5	13,000	0.90
Nankang	*Acacia confusa*	7,000	4.50	7,300	12.0	10,200	0.90
	Bauhinia purpurea	5,700	4.50	8,000	2.0	50,500	1.80
	Boehmeria densiflora	4,000	5.00	6,000	0.3	9,600	0.30
	Dicraopteris dichotoma	7,000	18.00	6,200	32.5	9,300	9.60
	Eucalyptus robusta	6,000	9.50	2,700	20.0	11,300	9.30
	Ficus gibbosa	7,000	9.50	11,500	7.0	10,800	1.40
	Ficus retusa	7,000	3.00	5,500	0.3	8,800	1.00
	Ficus vasculosa	10,000	12.00	14,300	0.5	9,300	4.90
	Glochidion fortunei	60,000	3.20	8,800	50.2	50,500	0.40
	Sinocalamus latiflorus	7,000	5.00	9,300	22.5	8,300	1.10
Keelung	*Bridelia balansae*	6,000	3.00	6,600	1.2	9,200	0.20
	Ficus wrightiana	7,000	6.00	7,200	12.2	9,400	1.80
	Machilus thunbergii	9,000	4.50	4,600	25.4	16,500	0.80
	Mallotus japonicus	8,000	2.60	6,500	8.2	1,100	4.30
	Phyllostachys makinoi	7,000	4.50	4,000	2.2	11,700	0.30
	Psidium guayava	7,000	4.80	9,000	2.0	9,500	2.30
	Sinocalamus oldhamii	7,000	8.00	7,000	13.4	9,500	2.20
Chu-Tzu-Hu	*Euryra japonica*	8,000	4.80	6,300	29.5	47,800	1.50
	Itea parviflora	4,500	3.00	2,800	3.0	8,700	0.20
	Myrica rubra	6,000	3.00	3,500	8.0	9,000	0.50
	Sinobambusa kunishii	8,000	5.20	5.800	0.3	11.500	0.30

compared with that of Fe, Mn, and Zn. In some species, such as *Boehmeria densiflora, Ficus wrightiana, Machilus thunbergii, Mallotus japonicus* and *Psidium guayava* revealed exceedingly high amount of Ca from 47000 to 61000 ppm; however, Fe, Mn, and Zn were very low (Table 2). The Cu content in leaf leachates and litter was less than 1 ppm (Chou, unpublished data).

Cation content in the aqueous soil extracts

The results of cation analysis of 23 associated soils are shown in Table 3. The soil extract of *Ficus wrightiana* exhibited the highest amount of Ca of 152 ppm, but the cation content of *Melaleuca leucadendron, Ficus retusa, Ficus*

Table 2. *Cation content in the leachates of litter of 21 species from four locations*

Leaf litter was collected in summer of 1973.

Location	Species	Content, ppm					
		Ca	Fe	K	Mn	Na	Zn
Taipei	*Daphniphyllum teijsmannii*	7,000	9.5	300	4.6	8,000	25.0
	Melaleuca leucadendron	60,000	7.0	5,000	17.0	52,900	2.9
Nankang	*Acacia confusa*	5,000	5.8	400	6.3	8,100	2.2
	Bauhinia purpurea	7,000	0.8	1,600	1.0	8,500	0.9
	Boehmeria densiflora	61,000	4.0	6,700	3.0	50,500	1.2
	Dicraopteris dichotoma	7,000	19.0	700	96.0	8,400	0.8
	Eucalyptus robusta	7,000	15.0	800	150.0	9,400	1.5
	Ficus gibbosa	7,000	15.0	5,000	12.5	9,100	2.0
	Ficus retusa	7,000	9.0	6,800	0.3	9,000	0.8
	Ficus vasculosa	9,000	19.1	6,000	3.5	8,900	1.3
	Glochidion fortunei	8,000	5.0	2,200	19.2	8,600	1.0
	Sinocalamus latiflorus	6,000	8.8	300	33.0	8,200	9.5
Keelung	*Bridelia balansae*	6,000	8.5	1,800	62.9	8,300	2.0
	Ficus wrightiana	47,000	10.0	62,000	3.4	41,000	0.8
	Machilus thunbergii	57,000	5.0	9,100	48.6	49,900	2.8
	Mallotus japonicus	57,000	7.5	8,000	64.0	50,500	9.5
	Phyllostachys makinoi	3,000	5.0	800	14.6	1,200	3.2
	Psidium guayava	58,000	7.5	10,000	1.4	50,200	0.7
	Sinocalamus oldhamii	6,000	5.6	300	18.0	8,200	1.1
Chu-Tzu-Hu	*Myrica rubra*	6,000	5.5	500	7.7	7,900	0.8
	Sinobambusa kunishii	6,000	5.5	300	0.8	8,500	1.9

vasculosa, Glochidion fortunei, Phyllostachys makinoi, Psidium guayava and *Sinocalamus oldhamii* revealed in low concentration as 0.06 ppm. Furthermore, the amount of cation in soil is lower than that in plant leachates (Table 1 and 2).

Effect of season on cation leaching

Inasmuch as different climatic conditions, the amount of cation leaching varied with seasons. Thus the data obtained from two seasons were computed by ratio, which was calculated from the amount of cation in the leachate of summer sample over that of winter sample. Thus, when the ratio is above 1, the amount of cation in the summer sample is greater than that in the winter sample. In most species, the quantity of cation leached from

Table 3. *Cation content in the soil extracts from the area of 23 associated species*

Soils were collected in summer of 1973.

Location	Species	Content, ppm (ug/g soil)					
		Ca	Fe	K	Mn	Na	Zn
Taipei	*Daphniphyllum teijsmannii*	26.0	3.00	13.0	0.52	60.0	0.36
	Melaleuca leucadendron	9.6	1.00	16.6	0.08	18.0	0.06
Nankang	*Acacia confusa*	20.2	0.40	19.6	3.98	24.8	0.14
	Bauhinia purpurea	14.0	1.20	15.2	0.18	20.0	0.10
	Boehmeria densiflora	62.0	1.10	17.4	0.08	29.4	0.06
	Dicraopteris dichotoma	14.0	10.80	14.4	0.44	31.6	0.59
	Eucalyptus robusta	16.0	1.04	14.2	2.38	6.40	0.60
	Ficus gibbosa	26.0	0.16	11.6	0.08	38.0	0.16
	Ficus retusa	48.0	2.00	17.0	0.08	50.0	0.06
	Ficus vasculosa	14.0	0.50	13.6	5.56	27.4	0.06
	Glochidion fortunei	9.4	0.56	14.4	0.06	13.6	0.06
	Sinocalamus latiflorus	16.0	0.20	14 6	0.98	19.6	0.14
Keelung	*Bridelia balansae*	18.0	1.20	7.0	9.80	19.0	0.16
	Ficus wrightiana	152.0	0.90	13.4	0.40	23.0	0.14
	Machilus thunbergii	40.0	1.16	29.6	0.18	38.0	0.06
	Mallotus japonicus	20.0	0.60	21.0	2.76	16.0	0.14
	Phyllostachys makinoi	14.0	1.00	15.6	7.54	32.0	0.06
	Psidium guayava	14.0	2.40	28.6	0.16	3.0	0.06
	Sinocalamus oldhamii	24.0	5.00	12.8	0.16	24.2	0.06
Chu-Tzu-Hu	*Euryra japonica*	52.0	0.50	16.6	0.08	28.6	0.26
	Itea parviflora	14.0	0.40	11.2	0.38	19.0	0.10
	Myrica rubra	28.0	1.84	25.2	1.50	34.4	0.26
	Sinobambusa kunishii	16.0	2.40	29.9	2.00	21.6	0.54

fresh leaves is greater in summer than in winter. One fourth of the plant species showed higher quantity of cation leaching in winter. This indicated that the leachaing of cation was significantly affected by season (Table 4).

Data of leaf litter analysis showed that the cations leached from leaf litter collected in summer were significantly greater than those collected in winter (Table 5).

Results of calculation as expressed by ratio of cations leached from the soils showed that the cation content was generally higher in the extract of summer sample than in the winter sample (Table 6).

It is therefore concluded that the quantity of mineral leached out was higher in summer, and varied with species and cations themselves.

Table 4. *Seasonal variation of cation leaching from fresh leaves of 23 species from four location*

Data were expressed as the ratio of amount of cation content in summer over that in winter.

Location	Species	Ratio (summer/winter)					
		Ca	Fe	K	Mn	Na	Zn
Taipei	*Daphniphyllum teijsmannii*	1.06	1.25	0.92	1.03	1.03	1.43
	Meleleuca leucadendron	1.06	0.81	0.92	0.79	1.18	0.90
Nankang	*Acacia confusa*	1.08	1.13	1.04	1.14	1.02	1.44
	Bauhinia purpurea	1.04	1.02	0.94	1.67	1.15	1.22
	Boehmeria densiflora	0.98	0.77	1.09	3.00	0.91	3.00
	Dicraopteris dichotoma	0.88	0.97	1.02	1.08	1.03	1.13
	Eucalyptus robusta	0.92	1.06	0.98	1.33	1.93	0.98
	Ficus gibbosa	0.82	1.19	1.08	1.30	1.14	1.56
	Ficus retusa	1.03	1.15	1.02	3.00	1.11	1.25
	Ficus vasculosa	1.05	1.09	1.02	0.83	1.03	1.40
	Glochidion fortunei	1.03	0.91	1.04	1.12	1.17	4.00
	Sinocalamus latiflorus	1.00	1.16	1.03	1.02	1.11	1.22
Keelung	*Bridelia balansae*	1.03	1.14	1.03	1.50	0.97	2.00
	Ficus wrightiana	1.17	0.80	1.20	1.11	0.78	1.20
	Machilus thunbergii	1.02	1.29	1.02	1.05	1.27	4.00
	Mallotus japonicus	1.14	1.30	1.00	1.37	1.10	1.23
	Phyllostachys makinoi	0.93	1.15	0.95	1.47	0.98	3.00
	Psidium guayava	1.00	1.60	1.13	4.00	1.10	1.53
	Sinocalamus oldhamii	1.07	1.11	1.05	0.60	1.15	3.00
Chu-Tzu-Hu	*Euryra japonica*	0.84	1.14	0.95	1.05	1.21	1.67
	Itea parviflora	0.82	1.15	0.97	1.50	1.01	2.60
	Myrica rubra	1.03	1.25	0.83	1.11	1.10	0.56
	Sinobambusa kunishii	1.07	1.11	1.05	0.60	1.15	3.00

Comparison of cations release from leaves and litter in two seasons

To compare the leachability of cation in leaf and litter, the cation ratio was obtained from the content of cation in fresh leaf over that in litter. Results of calculations in two seasons are given in Table 7. It was found that the amount of some cations was higher in leaf than in litter, but that of Fe, Mn and Zn was lower in leaf. This suggested that the leachability of cation in leaf is greater than that in leaf litter. Comparing the seasonal effect on leaf/litter ratio, the effect was greater in winter than in summer.

Table 5. *Seasonal variation on cation leaching from leaf litter of 21 species from four locations*

Data are expressed as the ratio of amount of cation content in summer over that in winter.

Location	Species	Ratio (summer/winter)					
		Ca	Fe	K	Mn	Na	Zn
Taipei	*Daphniphyllum teijsmannii*	1.35	1.19	1.50	1.15	1.03	1.25
	Melaleuca leucadendron	0.92	1.40	1.19	1.42	1.05	0.91
Nankang	*Acacia confusa*	1.56	0.94	1.33	1.05	1.16	1.47
	Bauhinia purpurea	1.11	1.33	1.33	1.25	1.08	1.00
	Boehmeria densiflora	1.05	1.25	0.96	1.00	0.83	1.20
	Dicraopteris dichotoma	1.09	1.03	0.78	1.13	1.02	1.00
	Eucalyptus robusta	1.17	1.50	0.76	1.53	1.11	1.25
	Ficus gibbosa	1.13	0.91	1.19	1.25	1.02	1.67
	Ficus retusa	1.13	1.01	1.08	3.00	1.06	1.25
	Ficus vasculosa	1.11	1.09	1.20	0.78	1.13	2.60
	Glochidion fortunei	1.11	1.25	1.22	1.60	1.05	0.67
	Sinocalamus latiflorus	1.30	1.40	0.75	1.09	1.04	1.38
Keelung	*Bridelia balansae*	1.33	1.15	1.50	0.86	1.04	1.67
	Ficus wrightiana	1.22	1.05	1.07	0.97	1.06	0.89
	Machilus thunbergii	1.09	2.50	1.02	1.36	1.03	0.93
	Mallotus japonicus	1.10	0.94	1.10	2.56	1.05	1.17
	Phyllostachys makinoi	0.94	1.11	1.60	1.17	1.20	1.10
	Psidium guayava	1.05	2.50	1.04	0.70	1.02	0.70
	Sinocalamus oldhamii	1.30	1.40	0.75	1.09	1.04	1.38
Chu-Tzu-Hu	*Myrica rubra*	1.18	1.38	1.67	1.03	1.18	0.89
	S nobambusa kunishii	1.33	1.83	1.50	2.00	1.21	1.46

Discussion

In this study we found that the quantity of leaching cations varied with species and minerals. Some elements of Ca, K, and Na released in great amount, while Zn and Cu were sometimes lower than 1 ppm which indicated that those areas were not polluted by heavy metals. The released cations was generally greater in summer than in winter, indicating that the metabolic cations of Ca, Na, and K might be accumulated in the plant during dry season, and those cations were continuously leached out in the wet season of autumn-winter period. Tukey (1971) indicated that the leachability of minerals from plants was regulated by both internal and external factors. The internal factor included the type and nature of plant leaf, physiological age of leaf,

Table 6. *Seasonal variation of cations leaching from the soils of 23 associated species from 4 locations*

Data are expressed as a ratio of amount of cation content in summer over that in winter.

Location	Species	Ratio (summer/winter)					
		Ca	Fe	K	Mn	Na	Zn
Taipei	*Daphniphyllum teijsmannii*	0.92	0.37	0.58	1.30	1.60	1.00
	Melaleuca leucadendron	0.53	1.28	1.73	1.33	0.88	0.75
Nankang	*Acacia confusa*	2.01	1.05	1.09	1.33	0.89	2.33
	Bauhinia purpurea	1.35	2.00	1.09	1.13	1.25	1.00
	Boehmeria densiflora	1.46	0.87	1.18	1.00	1.44	1.00
	Dicraopteris dichotoma	3.89	0.48	1.00	1.10	1.07	1.40
	Eucalyptus robusta	2.42	1.68	1.01	1.19	0.35	1.15
	Ficus gibbosa	1.69	0.23	0.75	0.67	1.84	1.60
	Ficus retusa	1.24	1.33	1.31	1.33	1.22	0.75
	Ficus vasculosa	0.47	1.67	0.68	1.79	1.06	0.16
	Glochidion fortunei	0.42	1.40	1.00	0.60	1.45	1.00
	Sinocalamus latiflorus	2.76	0.25	1.20	2.45	4.00	0.29
Keelung	*Bridelia balansae*	1.88	1.00	1.00	4.90	3.28	1.14
	Ficus wrightiana	2.38	1.80	0.48	0.80	1.15	2.33
	Machilus thunbergii	1.01	1.21	1.41	2.25	1.36	0.75
	Mallotus japonicus	3.30	10.00	1.42	1.62	1.31	0.54
	Phyllostachys makinoi	1.75	0.33	0.68	1.83	1.26	0.60
	Psidium guayava	0.50	2.16	2.86	0.80	0.32	0.00
	Sinocalamus oldhamii	1.67	7.14	1.33	1.60	1.33	0.75
Chu-Tzu-Hu	*Euryra faponica*	1.44	1.00	0.55	1.33	2.38	0.87
	Itea parviflora	1.30	1.11	1.40	1.90	1.42	1.25
	Myrica rubra	1.47	1.15	1.37	1.25	0.95	1.13
	Sinobambusa kunishii	2.11	1.88	1.00	12.50	1.08	1.00

plant nutrient status, and physiological disorders, while the external factors involved temperature, light-darkness, the duration of leaching period and the intensity of rainfall. Chou (1975a) reported that the leachability of cation in *Miscanthus floridulus* was significantly affected by the duration of leaching. However, in the present study no significant difference in leachability of cation was found in the excided fresh leaves and litter during the period of soaking from 6–12 hr. The soaking process is of course different from the natural leaching. It is possible that the amount of cation leaching could be affected by duration of leaching in nature. Nevertheless, we were unable to perform a natural leaching process in this heavy rainfall area of northern

Table 7. *Comparison of cations release from leaf and litter in two seasons; S: summer, W: winter*

Data are expressed by the ratio of the amount of cation in leaf over that in litter.

Location	Species	Ratio (leaf/litter)											
		Ca		Fe		K		Mn		Na		Zn	
		S	W	S	W	S	W	S	W	S	W	S	W
Taipei	*Daphniphyllum teijsmannii*	1.00	1.27	0.25	0.25	10.70	16.50	2.24	2.50	1.31	1.31	0.04	0.04
	Melaleuca leucadendron	0.15	0.13	0.79	1.36	1.10	1.43	0.32	0.58	0.25	0.22	0.31	0.31
Nankang	*Acacia confusa*	1.40	2.03	2.76	0.65	18.30	23.3	1.90	1.75	1.25	1.43	0.59	0.60
	Bauhinia purpurea	8.14	8.73	5.63	7.33	5.00	7.08	2.00	1.50	5.94	5.57	2.44	2.00
	Boehmeria densiflora	0.07	0.08	1.25	2.03	0.90	0.79	0.10	0.03	0.19	0.17	0.25	0.10
	Dicraopteris dichotoma	1.00	1.31	0.95	0.95	8.86	6.78	0.34	0.35	1.11	1.09	12.00	10.50
	Eucalyptus robusta	0.86	1.08	0.63	0.90	3.38	2.62	0.13	0.15	1.20	1.29	6.20	7.92
	Ficus gibbosa	1.00	1.37	0.63	0.48	2.30	2.52	0.56	0.54	1.19	1.07	0.70	0.75
	Ficus retusa	1.00	1.10	0.33	0.29	0.81	0.85	0.33	0.33	0.98	0.93	1.00	1.00
	Ficus vasculosa	1.11	1.17	0.63	0.63	2.38	2.80	0.14	0.13	1.04	1.14	3.77	7.00
	Glochidion fortunei	7.50	8.05	0.64	0.88	4.00	4.72	2.60	3.75	5.87	5.24	0.40	0.07
	Sinocalamus latiflorus	1.17	1.37	0.57	0.52	46.00	45.00	0.68	0.69	1.01	0.94	0.11	0.09
Keelung	*Bridelia balansae*	1.00	1.29	0.59	0.59	3.67	5.33	0.02	0.01	1.11	1.19	0.10	0.08
	Ficus wrightiana	0.15	0.14	0.60	0.79	0.12	0.10	3.59	3.14	0.23	0.31	0.25	1.67
	Machilus thunbergi	0.16	0.17	0.90	1.75	0.51	0.51	0.52	0.68	0.33	0.27	0.29	0.07
	Mallotus japonica	0.14	0.13	0.35	0.25	0.81	0.90	0.13	0.24	0.02	0.02	0.46	0.44
	Phyllostachys makinoi	2.33	2.34	0.90	0.87	5.00	8.40	0.15	0.12	9.75	12.00	0.09	0.03
	Psidium guayava	0.12	0.13	0.64	1.00	0.90	0.92	1.43	0.25	0.19	0.18	3.29	1.50
	Sinocalamus oldhamii	1.17	1.48	1.43	1.88	23.30	16.30	0.74	0.88	1.16	1.09	2.00	2.50
Chu-Tzu-Hu	*Myrica rubra*	1.00	1.14	0.55	0.60	7.00	14.00	1.04	0.96	1.14	1.22	0.63	1.00
	Sinobambusa kunishii	1.33	1.67	0.95	1.57	19.00	27.50	0.38	1.25	1.35	1.43	0.16	0.08

Taiwan. Our data therefore only demonstrated the quantitative comparison of cation release from the 23 selected species, and showed the nutrient pool in the subtropical vegetation. Additionally, no correlation was found between the cation release and climatic factors of temperature and rainfall. Thus the analysis of data between the sampling areas of Nankang, Taipei, Chu-Tzu-Hu, and Keelung appeared not significantly.

The leaching metabolites constitute not only inorganic minerals but also organic compounds. Both substances always play an important role in determination of vegetation composition (Muller, 1966). In general, minerals and some organic compounds sometimes may favor plant growth, but sometimes are detrimental. The ecological significance of these substances depends on the amount and nature of substances leached out. For example, in the artificial raindrip of *Arctostaphylos glandulosa* var. *zacaensis*, several phenolics, such as hydroguinone, *p*-coumaric, *p*-hydroxybenzoic, vanillic, ferulic, syringic, chlorogenic, and gallic acids are the major phytotoxic substances in determining the process of dominance (Chou and Muller, 1972). Additionally, in the aqueous leachate of *Miscanthus* leaf leachate, most of aforementioned phytotoxins are present, which are responsible for the allelopathic influence (Chou and Chung, 1974). In this study, we found several species, such *Sinobambusa kunishii*, *Eucalyptus robusta*, and *Sinocalamus* spp. which exhibited strong allelopathic potential. Many toxic spots were found on the chromatograms of ether fraction of aqueous leachates of leaves and litter (Chou and Chen, unpublished data).

Nevertheless, in an ecosystem study of subtropical vegetation, the present information is still insufficient, and many experiments concerning the input and output of nutrient or energy flow thus need to be conducted.

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臺灣北部植物的淋溶代謝物研究

I. 臺灣北部植物的陽離子釋放

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二十三種臺灣北部地區的植物鮮葉、枯葉及這些植物底下的土壤分夏冬兩季採集。由鮮葉、枯葉及土壤所得的淋溶液或萃取液分別用原子吸收析光儀以測定其含量。分析陽離子含量結果顯示，在鮮葉中含量最高，枯葉次之，土壤中最少。其中 Ca, K, Na 的含量高達數千 ppm。而 Zn 及 Cu 則低至 1 ppm 以下。陽離子淋溶率與季節有關，在夏季採集的樣品其淋溶液中所含陽離子量較冬季採集的要高，但其含量和溫度與降雨量沒正相關係。