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Diversity of Arthropod Galls in Taiwan

Liang-Yu Pan[1], Jhen Liu[1], Man-Miao Yang[2], and Gene-Sheng Tung[1*]

[1] Botanical Garden Division, Taiwan Forestry Research Institute, COA. 67 Sanyuan St., Zhongzheng District, Taipei City 10079, Taiwan

[2] Department of Entomology, National Chung Hsing University. 145 Xingda Rd., South Dist., Taichung City 402, Taiwan

* Corresponding email: gall@tfri.gov.tw

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ABSTRACT

A synthesis of a long-term gall faunal study covering Taiwan Island, Kinmen Islands, Penghu Islands, Green Island, and Orchid Island, which was conducted between 1995 and 2018, is presented. A total of 4,328 of arthropod-induced galls were collected, with 96.0% of the gall-inducing arthropods being monophagous. Among the seven orders of gall-inducing arthropods in the region, **DIPTERA** (42.2%) and **HEMIPTERA** (22.8%) were the two dominant gall-inducing groups. The dominant host-plant families were **LAURACEAE** (17.6%) and **FAGACEAE** (16.2%). Enclosed types of galls (65.8%) were more abundant than the open types (32.2%). Most host species (44.7%) harbored two or more, occasionally up to 11, shapes of galls. Galls were mostly found on leaves (55.6%) compared with other parts of plants. Among all gall-inducing taxa, **CECIDOMYIIDAE** was the most diverse group in terms of abundance, richness, and host use.

Key words: Gall flora, biodiversity, gall shape, host plant, gall-inducing arthropods

Introduction

Taiwan is an island nation covering an area of 35,980 km^2 and is situated along the southeastern Pacific off mainland China between Japan and the Philippines. More than 73% of the landscape is hilly and covered by forest (2,186,002 ha, covering c. 61% of the total landscape). Because of the unique climate, humidity, and altitude, the forests in Taiwan are highly diverse and classified under tropical, subtropical, temperate, and alpine forests (Su, 1984 a, b; Li *et al*., 2013). Approximately 6,000 species of vascular plants reportedly occur in Taiwan (Taiwan Biodiversity Information Facility, 2018).

Gall-inducing organisms interact intimately with plants. The rich and diverse flora has supported the evolution and diversity of a range of gall-inducing arthropods. Attempts to understand the arthropod-induced gall flora and the inducing faunal elements in Taiwan were first made by Yang and Tung (1998). Subsequent guidebooks were prepared by Yang *et al*. (2000) and Tung *et al*. (2018). Tung *et al*. (2006) analyzed the patterns that manifest in the

interacting plants and gall-inducing insects. The work listed 331 species of plants that were susceptible to gall-inducing arthropods out of a documented 4,698 species of known plants. **CECIDOMYIIDAE** (**DIPTERA**) (36.5%) and **PSYLLOIDEA** (**HEMIPTERA**) (33.9%) were the dominant groups, while **LAURACEAE** and **FAGACEAE** were the plant families harboring galls. Other works on galls in Taiwan have focused on specific gall-inducing taxa (Huang, 2003; Huang, 2007; Yang and Raman, 2007; Tung *et al*., 2008; Yeh, 2009; Yang *et al*., 2009, 2013; Aoki *et al*., 2013; Tang, 2015; Liao *et al*., 2016; Lin *et al*., 2018a) or galls living on specific host plants (Su, 2002; Yang *et al*., 2002; Tang, 2008; Tokuda *et al*., 2008; Melika *et al*., 2010; Chiang, 2011; Lin, 2011; Tsai, 2012; Su, 2013; Pan *et al*., 2015a, b; Yang *et al*., 2014; Lin *et al.*, 2018b, c).

The present study aimed to update the results of long-term research on gall fauna in Taiwan as of 2018. We inventoried the diversity of gall-inducing arthropod and host-plant species richness. Key characteristics of galls in Taiwan and patterns of host specificity were also analyzed.

Materials and Methods

From 1995 to 2018, galls were collected from Taiwan Island, Kinmen Islands, Pescadores Islands, Green Island, and Orchid Island. The plant organs with galls were cut, stored in polyethylene bags, and transported to Taiwan Forestry Research Institute (Council of Agriculture, Taipei) and the Department of Entomology, National Chung Hsing University (Taichung). The samples were either dissected immediately or refrigerated at 5°C for later handling in order to determine the inducing agents and their developmental stages. The gall-inducing agent, host plant, locations, and gall shapes were recorded. Host plants were identified according to the Editorial Committee of the Flora of Taiwan, Second Edition (1993~2000) and APG IV (Chase *et al.*, 2016). Insects were identified according to Möhn (1955), Yukawa (1971), McAlpine (1981), Yang (1984), Mamaev and Krivosheina (1993), Gagné (1994), Melika and Abrahamson (2002), Tokuda (2004), Tokuda *et al*. (2008), Yeh (2009), Yang *et al*. (2009, 2013), Melika (2006), Melika *et al*. (2010), Tang *et al*. (2011), Melika *et al*. (2013), and Tang *et al*. (2016). For the gall-inducing species that were yet to be described, our use of "species" was closer to the idea of "morphospecies", in which we combined information on the morphology of gall inducers, host-plant species, plant part attacked, and morphology of galls. Gall-bearing plant organs and gall shapes were recorded. Different galls were divided into 10 types as curling, folding, pit, blister, swollen, filz, pouch, rosette, covering, and mark galls according to Küster (1911), Mani (1964), and Dreger-Jauffret and Shorthouse (1992). We recorded the gall-inducing species as "monophagous" when they induced galls on a single plant species only, and as "oligophagous" when they induced galls on closely related plant taxa.

We used the Pearson's Chi-square test and Cramer's V coefficient in R version 3.4.0 (R Core Team, 2017) to analyze the correlations among gall-inducer orders, host-plant classes, host-plant groups, gall-bearing organs, gall shapes, and gall types. To investigate gall inducer and plant richness, we determined gall-inducing species per total plant species and per host-plant species according to the method of Espírito-Santo and Fernandes (2007).

Results

A total of 4,328 galls were collected between 1995 and 2018. Among them, 157 Acarina-induced and 975 insect-induced galls were found on 526 plant species belonging to 91 families. Among the plants, 125 species were endemic.

Gall-inducing arthropods

DIPTERA (42.2%) and **HEMIPTERA** (22.8%) were the major gall-inducing groups (Table 1). A majority of the gall-inducing arthropods (96.0%) were monophagous and thus induced galls on a single host (Table 2). Within the monophagous group, 55.7%, 20.1%, 13.0%, 4.1%, 3.3%, 3.0%, and 0.2% of the galling organs were on leaves, stems, buds, petioles, fruits, flowers, and roots, respectively. By contrast, only 4% of the gall-inducing arthropods were

Table 1. Number of gall-inducing species in Taiwan

	Acari	Coleoptera	Diptera	Hemiptera	Hymenoptera	Lepidoptera	Thysanoptera	Total
Described species	21	0	9	48	37	0	0	115
Morphological species	136	19	469	210	121	40	22	1017
Total	157	19	478	258	158	40	22	1132
	13.9%	1.7%	42.2%	22.8%	14.0%	3.5%	1.9%	

Table 2. Specificity of gall-inducing species in Taiwan

	Acari	Coleoptera	Diptera	Hemiptera	Hymenoptera	Lepidoptera	Thysanoptera	Total
Monophagous	155	19	458	248	145	40	22	96.0%
Oligophaogus	2	0	20	10	13	0	0	4.0%
Total	157	19	478	258	158	40	22	1132

Table 3. Species richness of host species, gall-inducer species, and gall shapes

Host species number within each plant family	Number of Host families	Name of host families	Number of host species within the host family	Number of gall-inducing species within the host family	Number of gall shapes within the host family
above 20	4	Fagaceae	51	183	37
		Lauraceae	47	199	30
		Compositae	23	38	16
		Rosaceae	22	42	21
15-20	7	Theaceae	20	29	14
		Euphorbiaceae	19	38	13
		Moraceae	17	37	15
		Myrtaceae	17	28	11
		Fabaceae	17	26	12
		Rubiaceae	15	24	10
		Verbenaceae	15	28	11
10-14	4	Symplocaceae	13	29	13
		Aquifoliaceae	12	20	10
		Urticaceae	11	15	8
		Caprifoliaceae	10	14	8
5-9	15				
bellow 5	61				

oligophagous (Table 2, Appendix 1). The oligophagous species induced galls on different plants. For example, *Asphondylia* sp.4 were found living on the fruits of *Solanum americanum* and *S. nigrum* (**SOLANACEAE**), *Pitydiplosis puerariae* on the leaves of *Pueraria lobata* and *P. montana* (**FABACEAE**), and *Lasioptera* sp.1 on the petioles of *Zehneria mucronata* (**CUCURBITACEAE**) and the stems of *Achyranthes aspera* var. *rubro-fusca* (**AMARANTHACEAE**) and *Z. mucronata*. Among the oligophagous gall-inducing arthropods, 48.0% were found on leaves, 19.2% on petioles, 12.3% on stems, 12.3% on buds, 5.5% on flowers, and 2.7% on fruits.

A total of 199 species of gall-inducing taxa (the highest number of gall-inducing taxa in the region) occurred on 183 species of **LAURACEAE** and **FAGACEAE** (Table 3, Appendix 2). **CECIDOMYIIDAE** constituted 42.2% of the

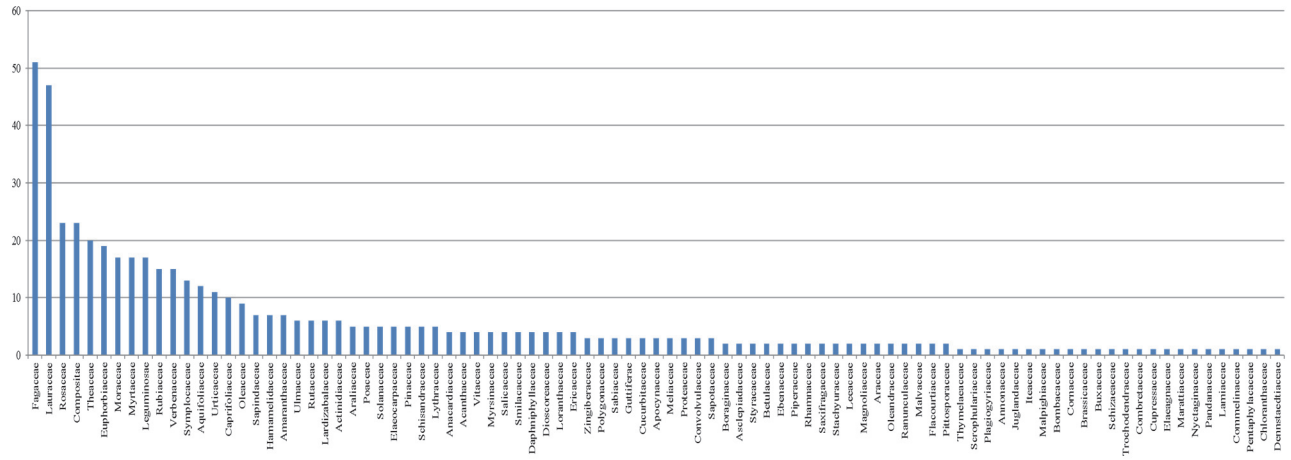

Fig. 1. Distribution of gall-inducing arthropod species among host families arranged from high to low.

gall flora. In addition, 18 species of gall-inducing **ACARI**, 107 of **DIPTERA**, 65 of **HEMIPTERA**, and four of **THYSANOPTERA** were associated with the species of **LAURACEAE**, while 123 species of the Hymenoptera-induced galls were found on **FAGACEAE**. Ten species of **COLEOPTERA** occurred on the species of **MYRTACEAE** and **LYTHRACEAE** (five each). Moreover, 15% of the galls induced by six species of **LEPIDOPTERA** occurred on **EUPHORBIACEAE**.

Host plants

FAGACEAE topped the list of host plants, hosting 51 species of gall-inducing arthropods, followed by **LAURACEAE** and **ASTERACEA**, which hosted 47 and 23 species, respectively (Fig. 1, Table 3). We observed that most of the host plants (71.7%) had gall-inducing inhabitants that belonged to the same order (Table 4). One hundred and forty-nine plant species out of the total 526 host plants hosted more than one order of gall-inducing arthropod. *Cinnamomum subavenium* (**LAURACEAE**) hosted six gall-inducing orders, including three **HEMIPTERA** species, three **DIPTERA** species, two **THYSANOPTERA** species, one **ACARI** species, one **COLEOPTERA** species, and one **LEPIDOPTERA** species (Table 4, Appendix 3).

A majority of gall-inducing arthropods (95.3%) were associated with dicotyledons. Less than 3% of the gall-inducing arthropods were found on monocotyledons, 1.3% were found on gymnosperms, and 0.7% were found on pteridophytes. Among the different gall-inducing orders, **DIPTERA** was the major order, making use of 41.4% of the recorded dicotyledonous hosts, 62.5% monocotyledonous hosts, and 73.3% of gymnosperms in contrast to the host use of other insect orders. The ratio of galled plant species to the total flora of Taiwan was 0.09, while the average number of gall-inducing species per plant species was 0.19. For the correlation analysis, gall-inducing arthropod orders were both highly and poorly correlated with host-plant families ($p < 0.001$, Cramer's V = 0.53), host-plant groups ($p < 0.001$, Cramer's V = 0.21), and host-plant class ($p < 0.001$, Cramer's V = 0.12). Among the host-plant classes, gall-inducing **DIPTERA** and **ACARI** arthropods had wider host ranges in **PTERIDOPHYTA, GYMNOSPERMAE**, dicotyledons, and monocotyledons, in contrast to other gall-inducing agents on the plant taxa (Table 5). There were only few records of galls on **PTERIDOPHYTA** induced by **ACARI** and **DIPTERA**, including three species of **ERIOPHYIDAE** on *Nephrolepis biserrata* (**OLEANDRACEAE**), **ERIOPHYIDAE** sp.16 on *Lygodium japonicum* (Schizaeaceae), **ERIOPHYIDAE** sp.90 on *Angiopteris lygodiifolia* (**MARATTIACEAE**), **ERIOPHYIDAE** sp.105 on *N. auriculata*, **CECIDOMYIIDAE** sp. 124 on *Plagiogyria falcate* (**PLAGIOGYRIACEAE**), and **CECIDOMYIIDAE** sp. 370 on *Pteridium revolutum* (**DENNSTAEDTIACEAE**).

Rosids and asterids were the two major correlated host-plant groups (Table 5). Gall-

Table 4. Gall-inducing order richness in each host species

Number of gall-inducer Order within each host species	Number of host species	Example taxa	%
6	1	*Cinnamomum subavenium*	0.2
5	1	*Cyclobalanopsis glauca*	0.2
4	7	*Cinnamomum osmophloeum* etc.	1.3
3	28	*Bischofia javanica* etc.	5.3
2	112	*Actinidia latifolia* etc.	21.3
1	377	*Acer kawakamii* etc.	71.7

Table 5. Number of gall-inducing species on host-plant classes and host-plant groups in Taiwan

	Gall-inducing species on host-plant classes				Gall-inducing species on host-plant groups					
	Pteridophyta	Gymnospermae	Dicotyledons	Monocotyledons	Magnoliids	Asterids	Rosids	Monocots	Commelinids	NA
Acari	6	1	147	3	19	41	77	2	1	17
Coleoptera	0	0	18	1	1	3	13	0	1	1
Diptera	2	11	447	20	115	137	150	3	16	66
Hemiptera	0	3	254	1	65	82	81	0	1	29
Hymenoptera	0	0	155	3	1	7	146	1	0	3
Lepidoptera	0	0	39	1	3	10	19	0	1	7
Thysanoptera	0	0	19	3	7	7	4	0	0	4
Total	8	15	1079	32	211	287	490	6	20	127

Table 6. Richness of gall-inducing species and host plants of different orders in Taiwan

	Acari	Coleoptera	Diptera	Hemiptera	Hymenoptera	Lepidoptera	Thysanoptera	Total
Number of host family	49	10	56	48	20	20	13	91
Number of host species	136	16	262	183	73	34	20	526
Gall-inducing species/ host species	1.15	1.19	1.82	1.41	2.16	1.18	1.10	2.15

inducing arthropod orders, including **ACARI** (77 species), **COLEOPTERA** (13 species), **DIPTERA** (150 species), **HYMENOPTERA** (146 species), and **LEPIDOPTERA** (19 species) induced galls on different rosid species. Similarly, 7 **THYSANOPTERA** species and 82 **HEMIPTERA** species induced galls on different asterid species.

Among the 91 host-plant families, **DIPTERA** (56), **ACARI** (49), and **HEMIPTERA** (48) were recorded on more than 50% of the host plants (Table 6). There were 269 species of host plants (51.1%) supporting only single species of gall inducers (Table 7). However, *Cyclobalanopsis glauca* (**FAGACEAE**) hosted galls induced by 14 species of **CYNIPIDAE** (e.g., *Cyclocynips*, *Cycloneuroterus*, *Dryocosmus,* and *Plagiotrochus*), three species of **CECIDOMYIIDAE**, one species of **ERIOPHYIDAE**, one species of **CURCULIONIDAE**, and one species of **PSYLLOIDEA** (Appendix 3).

Position of galls on plant organs

Galls induced on leaves (55.6%) were more frequent than those on other plant organs (Fig. 2, Table 8). Within each category of gall-inducing taxa, **ACARI** (88.5%, 139/157 species), **DIPTERA** (45.2%, 216/478), **HEMIPTERA** (77.9%, 201/258), **HYMENOPTERA** (47.5%, 75 /158), and **THYSANOPTERA** (90.9%, 20/22) occurred on leaves. **COLEOPTERA** (63.2%, 12/19) and **LEPIDOPTERA** (55.0%, 22/40)

Table 7. Distribution of gall-inducing species per host-plant species in Taiwan

Number of gall-inducing species per Host-plant species	Number of Host-plant species	%
20	1	0.2
14	1	0.2
13	1	0.2
12	2	0.4
11	4	0.8
10	1	0.2
9	3	0.6
8	5	1.0
7	4	0.8
6	17	3.2
5	14	2.7
4	31	5.9
3	54	10.3
2	119	22.6
1	269	51.1

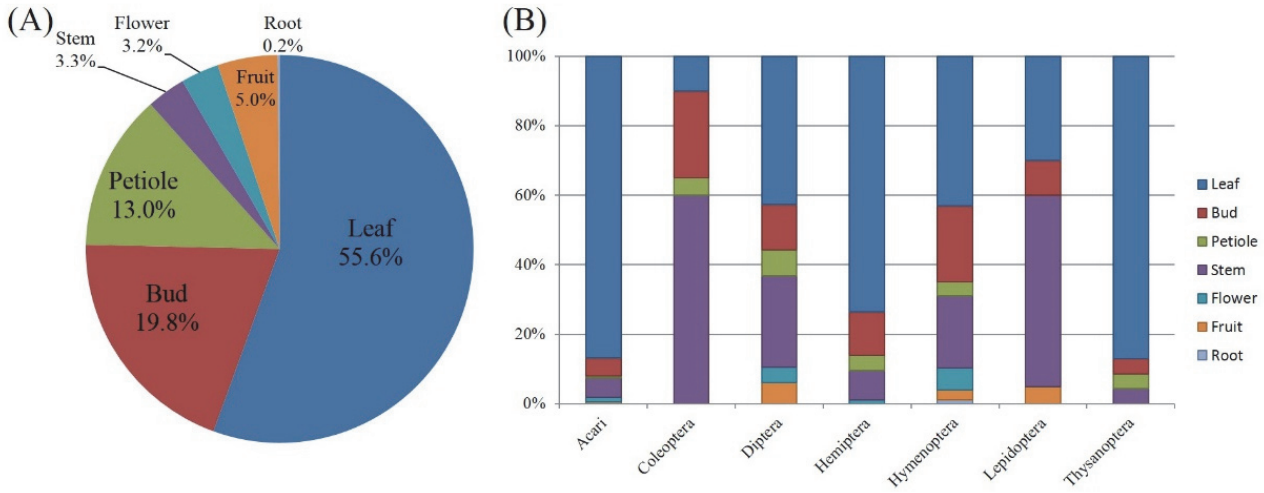

Fig. 2. Positions of galls on plant organs. (A) Positions of galls for all gall inducers. Galls were more frequently found on leaves than on other parts. (B) Positions of galls induced by different orders of gall-inducing arthropods.

induced galls more often on stems.

Shapes of Galls

A total of 66 morphologically varied shapes of galls were recorded (Appendix 1, Appendix 4). Some of the gall shapes were more abundant on specific plant organs. For example, pouch galls were common on leaves (142 species of gall inducers), and spindle-shaped galls were common on stems (87 species). The swollen galls, which only had swollen tissues with no special shapes were common on buds (32 species), flowers (8 species), and petioles (16 species). With regard to fruit galls, 14 species of gall inducers induced galls of the same fruit shape and were difficult to record. Only spindle-shaped and swollen galls were observed on roots.

Some host plants bore several galls of diverse shapes; these galls were induced by different insects. For example, *Machilus pseudolongifolia* (**LAURACEAE**) had at least 11 morphologically varied shapes in the covering

Table 8. Number of gall-inducing species on different host-plant organs

Fauna of gall-inducer	Leaf	Bud	Petiole	Stem	Flower	Fruit	Root
Acari	139	9	8	1	2	1	0
Coleoptera	2	12	5	0	0	1	0
Diptera	216	134	66	31	22	38	0
Hemiptera	201	23	34	0	3	12	0
Hymenoptera	75	36	38	5	11	7	2
Lepidoptera	12	22	4	2	0	0	0
Thysanoptera	20	1	1	0	0	1	0
Total	665	237	156	39	38	60	2

and mark galls induced by seven species of **CECIDOMYIIDAE**, three species of **PSYLLOIDEA** (pouch and covering galls), one species of **ACARI** (blister gall), and one species of **THYSANOPTERA** (leaf roll). *Machilus zuihoensis* had 11 different types of blister and mark galls induced by 11 species of **CECIDOMYIIDAE** and two species of **PSYLLOIDEA** (pouch and pit galls). The occurrence frequencies of different gall shapes, from the most to the least, were mark gall (40.3%), covering gall (21.6%), pouch gall (14.9%), curling (5.9%), pit gall (4.9%), blister gall (3.6%), folding (3.5%), swollen (2.7%), filz gall (1.4%), and rosette gall (1.4%).

Types of Galls

Among the 10 gall types, mark and covering galls represent the two dominant gall types in the present study. Gall types were moderately correlated with the order of gall inducers ($p < 0.001$, Cramer's V = 0.44). There were more enclosed types of galls (65.8%) than open types (32.2%). Within each gall-inducing group, the major gall types induced by **ACARI** (58.6%, 92/157 species) and **HEMIPTERA** (29.8%, 77/258) were pouch galls, whereas those induced by **COLEOPTERA** (100%, 19/19), **HYMENOPTERA** (91.1%, 144/158), **DIPTERA** (57.5%, 275/478), and **LEPIDOPTERA** (45.0%, 18/40) were mark galls. **THYSANOPTERA** (54.5%, 12/22) typically induced leaf curls.

Galls induced on leaves and buds were highly correlated with pouch galls (17.8%, 161/902 species of gall inducers), covering galls (23.1%, 208/902), and mark galls (33.4%, 301/902) ($p < 0.001$, Cramer's V = 0.51). The major gall type that was induced on stems (79.3%, 188/237), fruits (89.7%, 35/39), flowers (76.3%, 29/38), and roots (100%, 2/2) was mark gall. Galls on petioles were typically covering galls (63.3%, 38/60). In addition, gall types were highly correlated with the plant clades ($p < 0.001$, Cramer's V = 0.14). We recorded 85 gall inducer species inducing mark galls on 63 species of asterids, 13 on 7 species of commelinids, 98 on 34 species of magnoliids, and 213 on 103 species of rosids.

Discussion

The major host-plant families of gall-inducing arthropods are varied in different areas throughout the world. **FAGACEAE** has been observed to be the dominant host family in Europe and North America (Felt, 1940; Mani, 1964), while **FABACEAE** is the most dominant in Africa (Mani, 1964), India (Mani, 1964; Mani, 1973), and South America (Houard, 1933; Dreger-Jauffret and Shorthouse, 1992; Gonçalves-Alvim and Fernandes, 2001; Maia and Fernandes, 2004). In addition, **ROSACEAE** is more commonly attacked by **HEMIPTERA** in Japan (Yukawa and Masuda, 1996). In the descending order of abundance, **LAURACEAE** (17.6%), **FAGACEAE** (16.2%), and **ROSACEAE** (3.7%) are the principal gall-bearing families in Taiwan.

We recorded 347 species of arthropod gall inducers (30.7%) on 125 endemic host plants (23.8%), whereby **DIPTERA** represented the predominant gall-inducing order (Table 9). The

Table 9. Number of gall inducers found on endemic host plants

Fauna of gall-inducing arthropods	Endemic host-plant species		Gall-inducer species		Number of gall-inducer species in 2006
	species	percentage	species	percentage	
Acari	30	15.6%	34	9.2%	-
Coleoptera	2	1.0%	4	1.1%	1
Diptera	79	41.1%	179	48.2%	83
Hemiptera	57	29.7%	105	28.3%	51
Hymenoptera	12	6.3%	35	9.4%	13
Lepidoptera	7	3.6%	9	2.4%	7
Thysanoptera	5	2.6%	5	1.3%	2
Total	125		371		157

Table 10. Comparison of the gall-inducing faunas of Taiwan and Japan

	Acari	Coleoptera	Diptera	Hemiptera	Hymenoptera	Lepidoptera	Thysanoptera
Taiwan	157	19	478	258	158	40	22
Japan	171	20	647	292	222	58	10
Ratio	1.09	1.05	1.35	1.13	1.41	1.45	0.45

endemic host-plant species of *Machilus* sp. and *Cinnamomum* sp. hosted 55 (15.9%) and 38 species (11.0%) of gall-inducing arthropods, respectively (Appendix 3). The endemic *Machilus* spp. were most preferred by **DIPTERA**, and the endemic *Cinnamomum* spp. were most preferred by the **HEMIPTERA**. *Machilus* and *Cinnamomum* species are also dominant groups in low and intermediate altitude forests in Taiwan (Su, 1984a, b, 1985). The larger plant families were not expected to host more gall-inducing species in Taiwan (Tung *et al*., 2006), and the results did not support the plant family size hypothesis, which was suggested by Fernandes (1992). However, the influence of gall-inducing species richness was similar to the effect of presence of hosts such as *Qualea* spp. (*Vochysiaceae*) in Brazil (Araújo *et al*., 2013) and *Terminalia sericea* (*Combretaceae*) in South Africa (Veldtman and McGeoch, 2003). Such endemic host-plant taxa provide diverse local gall-inducing species and represent keystone resources in different localities.

In the Sino-Japanese region, the gall-inducing arthropod fauna is relatively well studied in Japan (Yukawa and Masuda, 1996). In general, Taiwan and Japan share 1,677 common plant species (Hsieh, 2002). Because gall-inducing arthropods are usually closely limited with regard to host plants, we contrasted host-plant flora and gall-inducing orders between Taiwan and Japan. **ASTERACEAE, CAPRIFOLIACEAE, FAGACEAE, LAURACEAE, FABACEAE**, and **ROSACEAE** are preferred by gall-inducing arthropods, which constitute a considerable proportion of **DIPTERA**, **HEMIPTERA**, and **HYMENOPTERA** (Table 10).

In many regions, **CECIDOMYIIDAE** is the predominant gall-inducing arthropod family (Mani, 1964; Price *et al*., 1998; Espírito-Santo and Fernandes, 2007). Hanson and Gómez-Laurito (2005) studied gall diversity in Costa Rica, which has a warm temperature, and reported that cecidomyiid species accounted for 70% of the gall inducers. Taiwan has 197 cecidomyiid species/1,000 km^2 and 1,676 plant species/1,000 km^2 (Table 11). We compared the proportions of cecidomyiid species to plant species among Costa Rica, Taiwan, and Japan, and approximately similar patterns were observed.

Table 11. Taxonomic distribution of gall inducers in Taiwan, Japan, and Costa Rica

	Gall-inducers in Costa Rica	Gall-inducers in Taiwan	Gall-inducers in Japan
Regions	Neotropical	Tropical to Temperate	Subtropical to Temperate
Latitudes	8° and 12°N	22° and 25°N	24° and 54°N
Acari	6.8%	13.9%	12.0%
Coleoptera	1.4%	1.7%	1.4%
Diptera	71.7%	42.2%	45.6%
Hemiptera	7.1%	22.8%	20.6%
Hymenoptera	6.8%	14.0%	15.6%
Lepidoptera	5.7%	3.5%	4.1%
Thysanoptera	0.6%	1.9%	0.7%
Number of plant species per 1,000 km^2	3368	1676	1366
Number of cecidomyiid species per 1,000 km^2	290	197	143

The complete faunal study is a long-term project, and the data is still dynamic by further research. We observed a positive relationship between gall-inducing arthropod orders and host-plant families in Taiwan. In the present study, the types of galls were influenced by many factors such as the orders of gall inducers, positions of galls on plant organs, and plant groups.

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台灣造癭節肢動物之多樣性

潘亮瑜[1]、劉鎮[1]、楊曼妙[2]、董景生[1*]

[1] 行政院農委會林業試驗所植物園組　10079 台北市中正區三元街 67 號

[2] 國立中興大學昆蟲學系　40227 台中市南區興大路 145 號

* 通訊作者 email: gall@tfri.gov.tw

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摘　　要

根據 1995 至 2018 年於台灣、金門、澎湖、綠島與蘭嶼的植物癭普查，共採集到 4,328 種由節肢動物所造的癭，其中有 96.0%的造癭節肢動物為單食性。已記錄的七目造癭節肢動物中，雙翅目 (42.2%) 與半翅目 (22.8%) 為主要的兩個造癭類群。產癭的寄主植物則以樟科 (17.6%) 與殼斗科 (16.2%) 為本地優勢的寄主植物。這些植物癭中，封閉式癭 (65.8%) 種類較開放式癭 (32.2%) 多。多數寄主植物 (44.7%) 被造癭節肢動物引發 2 種以上的癭，最多達到 11 種外形的癭。若比較寄主植物的造癭部位，葉片為較常被造癭的器官 (55.6%)。在所有造癭的分類群中，癭蚋科在造癭種類數、蟲癭豐富度與寄主植物產癭部位都是最多樣化的類群。

關鍵詞：植物癭相、生物多樣性、癭形態、寄主植物、造癭節肢動物