[Chem. Pharm. Bull. 21(10)2292—2302(1973)]

UDC 581.192 : 591.147.03

Screening of Japanese Ferns for Phytoecdysones. I[1]

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(Received April 2, 1973)

Japanese ferns from 20 families, representing 76 genera, 283 species, 39 varieties, and 1 form, have been subjected to screening tests by means of bioassay for the presence of phytoecdysones. A total of 170 species, 22 varieties, and 1 form have been found to show the insect moulting hormone activity. The taxonomical relationship is discussed.

After the structural elucidation of ecdysone and ecdysterone, the insect moulting hormones (zooecdysones) from animal sources, steroids identical with or similar to the zooecdysones have unexpectedly been found to be present also in plant sources.[3] This discovery has stimulated extensive surveys of plant materials in various parts of the world which have shown that active substances are widely distributed in the plant kingdom, and further have resulted in the isolations of a number of closely related congeners, now termed phytoecdysones.[4] We have been carrying out screening tests on plant materials by means of bioassay, and from our earlier experience it has been thought that the crude extracts of ferns especially show the insect moulting hormone activity in higher frequency than those of the other plant groups. Although preliminary screening results on some of Japanese ferns have been previously announced,[5,6] we now wish to report more extensive and systematic survey of Japanese ferns for phytoecdysones, which has been performed in order to seek new substances and to examine chemotaxonomical relationships.

Japanese islands lying off the east coast of Asia, long extend from northeast to southwest. The climate ranges from subarctic to subtropical with a heavy rainfall. These physical conditions make the flora of Japan very rich. Concerning ferns, some 400 species, belonging to 83 genera and 23 families, are recorded in Japan,[7] from which samples were selected so that they cover a wide taxonomical distribution as complete as possible. However, since many species are rare, the present investigation was limited to 251 species, 32 varieties, and 1 form belonging to 71 genera and 20 families (with the supplement of 32 species and 7 varieties as well as of 5 genera[7]), and consequently no representatives were chosen from 8 genera and 3 families. Whenever possible the plant materials were collected at various seasons and/or locations so that a total of 871 specimens were screened.

1) This paper forms Part XVII in the series on Steroids. Part XVI: H. Hikino, Y. Ohizumi, and T. Takemoto, *Chem. Pharm. Bull.* (Tokyo), **20**, 2454 (1972).
2) Location: *Aoba-yama, Sendai.*
3) K. Nakanishi, M. Koreeda, S. Sasaki, M.L. Chang, and H.Y. Hsu, *Chem. Commun.*, **1966**, 915; T. Takemoto, S. Ogawa, and N. Nishimoto, *Yakugaku Zasshi*, **87**, 325 (1967).
4) *cf.*, H. Hikino and Y. Hikino, "Fortschritte d. Chem. Org. Naturst.," Vol. 28, ed. by W. Herz, H. Grisebach, and A.I. Scott, Springer-Verlag, Wien, 1970, pp. 256—312.
5) T. Takemoto, S. Ogawa, N. Nishimoto, S. Arihara, and K. Bue, *Yakugaku Zasshi*, **87**, 1414 (1967).
6) S. Imai, T. Toyosato, M. Sakai, Y. Sato, S. Fujioka, E. Murata, and M. Goto, *Chem. Pharm. Bull.* (Tokyo), **17**, 335 (1969).
7) There are divided views on taxonomy of Japanese ferns. The classification in this work basically follows the manual of J. Ohwi ("Flora of Japan," Shibundo, Tokyo, 1972). Since this manual is not necessarily complete, certain different or newer taxa have been supplemented so that the classification may lack unity partially.

TABLE I. The Insect Moulting Hormone Activity of Japanese Ferns

Family	Species[a,b]	Japanese name	Date	Location[c,d]	Activity[e]
Equisetaceae					
	Equisetum arvense LINNÉ	Sugina	May	UZ, Higashine	–
			Jun	RZ, Shirasawa	–
	E. hyemale LINNÉ	Tokusa	May	MT, Towada	–
			Oct	UZ, Higashine	–
	E. ramosissimum DESFONTAINES var. *japonicum* MILDE	Inudokusa	Aug	SR, Shizuoka	–
Lycopodiaceae					
	Lycopodium alpinum LINNÉ var. *planiramulosum* TAKEDA*	Miyamahikageno-kazura	Aug	KG, Mt. Hakusan	–
	L. annotinum LINNÉ	Sugikazura	Aug	YZ, Mt. Rebundake	–
			Sep	YZ, Onnetō	–
	L. cernuum LINNÉ	Mizusugi	Oct	KI, Owase	–
			Nov	OS, Yakushima	–
	L. clavatum LINNÉ var. *nipponicum* NAKAI	Hikagenokazura	Jun	RZ, Mt. Izumi	–
			Jul	RC, Mt. Kurikoma	–
			Jul	RZ, Mt. Zaō	–
			Jul	SN, Mt. Togakushi	–
			Sep	YZ, Onnetō	–
			Oct	KI, Kozagawa	–
	L. complanatum LINNÉ	Asuhikazura	Jul	RZ, Mt. Zaō	–
			Aug	YZ, Mt. Rebundake	–
			Oct	KI, Owase	–
			Oct	IW, Mt. Azuma	–
	L. fargesii HERTER	Himosugiran	Aug	OS, Yakushima	–
	L. fordii BAKER	Nankakuran	Aug	OS, Yakushima	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	L. inundatum LINNÉ	Yachisugiran	Sep	IW, Yanohara	–
	L. obscurum LINNÉ	Mannensugi	May	RZ, Mt. Izumi	–
			Jul	SN, Mt. Togakushi	–
			Aug	OS, Yakushima	–
			Sep	ST, Minō	–
	L. phlegmaria LINNÉ	Yōrakuhiba	Aug	OS, Yakushima	–
	L. serratum THUNBERG	Tōgeshiba	Jun	RZ, Shirasawa	–
			Jul	RZ, Mt. Izumi	–
			Jul	SN, Mt. Togakushi	–
			Oct	TS, Mt. Taniyama	–
			Nov	OS, Yakushima	–
	L. sieboldi MIQUEL	Himoran	Aug	OS, Yakushima	–
	L. sitchense RUPRECHT var. *nikoense* TAKEDA	Takanehikageno-kazura	Aug	YZ, Rebundake	–
			Sep	IW, Mt. Azuma	–
			Nov	OS, Yakushima	–
Selaginellaceae					
	Selaginella doederleinii HIERONYMUS	Onikuramagoke	Nov	OS, Yakushima	–
	S. nipponica FRENCHET *et* SAVATIER	Tachikuramagoke	Oct	KI, Owase	–
			Nov	OS, Yakushima	–
	S. pachystachys KOIDZUMI	Katahiba	Jun	RZ, Mt. Izumi	–
			Aug	RZ, Mt. Izumi	–
			Aug	UZ, Mt. Zaō	–
			Oct	RZ, Mt. Izumi	–
			Nov	OS, Yakushima	–
	S. remotifolia SPRING var. *japonica* KOIDZUMI	Kuramagoke	Jun	RZ, Shirasawa	–
			Jul	SN, Mt. Norikura	–
			Aug	RZ, Mt. Izumi	–
			Sep	HD, Mt. Norikura	–
			Oct	KI, Kozagawa	–
	S. tamariscina SPRING	Iwahiba	Jul	RC, Mt. Kurikoma	–
	S. tamariscina SPRING	Iwahiba	Aug	RZ, Mt. Izumi	–
			Oct	KI, Kozagawa	–
			Oct	TS, Hayama	–
	S. uncinata SPRING	Konterikuramagoke	Oct	KI, Owase	–
			Oct	KI, Kozagawa	–
Ophioglossaceae					
	Botrychium daucifolium WALLICH*	Hōraihanawarabi	Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	B. japonicum UNDERWOOD	Ōhanawarabi	Oct	KI, Owase	–
	B. ternatum SWARTZ	Huyunohanawarabi	May	IW, Yanaizu	–
			Sep	ST, Minō	–
			Oct	RZ, Mt. Izumi	–
			Oct	TS, Mt. Ishidate	–
	B. virginianum SWARTZ	Natsunohanawarabi	Aug	RZ, Mt. Izumi	–
			Oct	RZ, Mt. Izumi	–
			Oct	KI, Owase	–
			Oct	TS, Behukyō	–
			Dec	MT, Mt. Hakkōda	–
	Ophioglossum vulgatum LINNÉ	Hirohahanayasuri	May	IW, Yanaizu	–
			Aug	RZ, Mt. Izumi	–
			Oct	RZ, Mt. Izumi	–
Marattiaceae					
	Angiopteris lygodiifolia ROSENSTOCK	Ryūbintai	Aug	SR, Shizuoka†	–
			Oct	SR, Shizuoka†	–
			Oct	KI, Owase	–
			Nov	OS, Yakushima	–
	A. Palmiformis CHRIST*	Hosobaryūbintai	Nov	OS, Yakushima	–
Osmundaceae					
	Osmunda asiatica OHWI	Yamadorizemmai	Apr	KI, Shingū	++
			Jun	RZ, Shirasawa	+++
			Aug	RZ, Mt. Izumi	+++
			Oct	RZ, Sakunami	+++
			Dec	RZ, Mt. Izumi	+++
	O. banksiaefolia KUHN	Shiroyamazemmai	Oct	SR, Shizuoka†	+++
	O. claytoniana LINNÉ	Onizemmai	Oct	SR, Shizuoka†	+++
	O. japonica THUNBERG	Zemmai	Jun	RZ, Shirasawa	+++
			Aug	RZ, Mt. Izumi	+++
			Oct	KI, Shingū	+++
			Oct	RZ, Mt. Izumi	+++
			Dec	RZ, Mt. Izumi	+++
	O. lancea THUNBERG	Yashazemmai	Jul	YT, Mt. Ōdaigahara	+++
			Oct	SR, Shizuoka†	+++
			Oct	KI, Owase	+++
			Oct	TS, Ioki	+++
	O. lancea THUNBERG var. *latipinnula* TAGAWA*	Ōbayashazemmai	Oct	KI, Owase	+++
Schizaeaceae					
	Lygodium japonicum SWARTZ	Kanikusa	May	UZ, Higashine	–
			May	YT, Murō	–
			Aug	AW, Mt. Kiyosumi	–
			Oct	SR, Shizuoka	–
Gleicheniaceae					
	Dicranopteris linearis UNDERWOOD	Koshida	Mar	ST, Minō	–
			May	YT, Nara	–
			Aug	AW, Mt. Kiyosumi	–
			Oct	KI, Owase	–
			Oct	TS, Mt. Taniyama	–
			Oct	TS, Mt. Yokogura	–

Family	Species[a,b]	Japanese name	Date	Location[c,d]	Activity[e]
	Hicriopteris glauca ST. JOHN	Urajiro	Mar	ST, Minō	##
			Jul	ST, Inagawa	###
			Aug	KI, Shingū	##
			Sep	YT, Murō	###
			Oct	SR, Shizuoka	##
			Oct	TS, Mt. Yokogura	###
Hymenophyllaceae					
	Crepidomanes latealatum COPELAND	Aohoragoke	Apr	SR, Shizuoka	–
			Sep	KI, Kumano	–
			Oct	KI, Owase	–
			Oct	KI, Kozagawa	–
			Nov	OS, Yakushima	–
	Gonocormus minutus van den BOSCH	Uchiwagoke	May	ST, Minō	–
			Oct	SR, Shizuoka	–
			Oct	KI, Kozagawa	–
	Hymenophyllum barbatum MIQUEL	Kōyakokeshinobu	Oct	KI, Owase	–
	Mecodium flexile COPELAND	Ōkokeshinobu	May	KI, Katsuura	–
			Nov	OS, Yakushima	–
	M. polyanthos COPELAND	Hosobakokeshinobu	Oct	KI, Owase	–
			Oct	KI, Kozagawa	–
			Oct	SR, Shizuoka	–
	M. wrightii COPELAND	Kokeshinobu	Aug	YT, Yoshino	–
			Oct	KI, Owase	–
			Oct	IZ, Itō	–
	Selenodesmium obscurum COPELAND	Onihoragoke	Nov	OS, Yakushima	–
	Vandenboschia auriculata COPELAND	Tsuruhoragoke	Oct	KI, Owase	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	V. radicans COPELAND var. *orientalis* H. ITO	Haihoragcke	Oct	KI, Owase	–
			Oct	KI, Kozagawa	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	V. radicans COPELAND var. *nascana* H. ITO	Ryukyuhoragoke	Nov	OS, Yakushima	–
Pteridaceae					
	Adiantum capillus-veneris LINNÉ	Hōraishida	May	IZ, Itō	+
			Nov	SM, Kagoshima	+
	A. flabellulatum LINNÉ	Okinawakujakushida	Sep	SR, Shizuoka	##
	A. monochlamys EATON	Hakoneshida	Aug	YT, Shimokitayama	–
			Aug	AW, Mt. Kiyosumi	+
			Oct	TS, Mt. Ishidate	+
			Oct	SR, Shizuoka	+
			Oct	IZ, Itō	–
	A. pedatum LINNÉ	Kujakushida	Jun	RZ, Shirasawa	–
			Aug	YT, Nara	+
			Sep	RZ, Sekiyama	+
			Nov	UZ, Higashine	+
	Aleuritopteris argentea FÉE	Himeurajiro	Aug	SR, Shizuoka†	###
			Oct	IZ, Itō	##
			Nov	HZ, Nagasaki	##
	Cheilanthes chusana HOOKER	Ebigarashida	Nov	HZ, Nagasaki	–
	Cibotium barometz J. SMITH*	Takawarabi	Aug	SR, Shizuoka†	–
	Coniogramme fraxinea DIELS var. *intermedia* C. CHRISTENSEN	Iwaganezemmai	Mar	ST, Minō	–
			Aug	UZ, Higashine	–
			Sep	RC, Akka	–
			Sep	RC, Akka	–
			Nov	OS, Yakushima	–
	C. japonica DIELS	Iwaganesō	Mar	ST, Minō	–
	C. japonica DIELS	Iwaganesō	May	RZ, Sakunami	–
			Sep	RZ, Sakunami	–
			Sep	RZ, Akka	–
			Oct	TS, Mt. Taniyama	–
	Cryptogramma crispa R. BROWN	Rishirishinobu	Jul	YZ, Nemuro	–
	Dennstaedtia hirsuta METTENIUS	Inushida	Jun	RZ, Shirasawa	–
			Jul	KI, Mt. Ōdaigahara	–
			Oct	TS, Mt. Ishidate	–
			Oct	RZ, Mt. Izumi	–
			Nov	UZ, Sekiyama	–
	D. scabra MOORE	Kobanoishikaguma	Aug	ST, Minō	–
			Aug	YT, Nara	–
			Oct	KI, Kozagawa	–
			Oct	TS, Mt. Sembon	–
			Nov	OS, Yakushima	–
	D. scabra MOORE var. *glabrescens* TAGAWA*	Usugekobanoishikaguma	Nov	OS, Yakushima	–
	D. wilfordii KOIDZUMI	Ōrenshida	May	RZ, Shirasawa	–
			Jul	SN, Mt. Togakushi	+
			Sep	RC, Akka	##
			Oct	UZ, Higashine	##
	Histiopteris incisa J. SMITH	Yunomineshida	May	KI, Yunomine	+
			Nov	OS, Yakushima	+
	Hypolepis alte-gracillima HAYATA*	Seitakaiwahimewarabi	Nov	OS, Yakushima	##
	H. punctata METTENIUS	Iwahimewarabi	Apr	YS, Kibune	##
			Oct	KI, Owase	–
	Lindsaea commixta TAGAWA*	Shin-edauchihongūshida	Nov	OS, Yakushima	–
	L. cultrata SWARTZ	Hongūshida	May	KI, Nachi	–
			Oct	IZ, Itō	–
			Nov	OS, Yakushima	–
	L. javanensis BLUME*	Sankakuhongūshida	Nov	OS, Yakushima	–
	L. orbiculata METTENIUS var. *chienii* OHWI	Edauchihongūshida	Oct	KI, Owase	–
			Oct	TS, Ioki	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	L. parvipinnata K. IWATSUKI*	Himehongūshida	Nov	OS, Yakushima	–
	Microlepia marginata C. CHRISTENSEN	Humotoshida	Aug	YT, Nara	–
			Oct	IZ, Itō	–
			Oct	KI, Owase	–
			Oct	SR, Shizuoka	–
			Nov	OS, Yakushima	–
	M. obtusiloba HAYATA*	Kōshunshida	Nov	OS, Yakushima	+
	M. strigosa PRESL	Ishikaguma	Oct	KI, Kushimoto	–
			Oct	IZ, Itō	–
			Nov	OS, Yakushima	–
			Nov	SM, Kagoshima	–
	M. substrigosa TAGAWA	Usubaishikaguma	Sep	SR, Shizuoka†	–
			Nov	OS, Yakushima	–
	Monachosorum arakii TAGAWA	Himemukagoshida	Oct	KI, Owase	–
	M. flagellare HAYATA	Ōhujishida	Oct	KI, Owase	–
	M. maximowiczii HAYATA	Hujishida	Sep	SR, Shizuoka†	–
	Onychium japonicum KUNZE	Tachishinobu	Aug	YT, Murō	–
			Oct	IZ, Itō	–
			Oct	SR, Shizuoka	–
			Oct	YT, Murō	–
	Pteridium aquilinum KUHN var. *latiusculum* UNDERWOOD	Warabi	May	UZ, Higashine	##
			Jun	RZ, Shirasawa	###
			Oct	RZ, Shirasawa	###

Family	Species[a,b]	Japanese name	Date	Location[c,d]	Activity[e]
	Pteridium aquilinum KUHN var. *latiusculum* UNDERWOOD	Warabi	Oct	RZ, Mt. Izumi	###
			Nov	RZ, Mt. Izumi	###
	Pteris cretica LINNÉ	Ōbanoinomotosō	Apr	IZ, Itō	+
			Sep	ST, Minō	+
			Oct	SR, Shizuoka	–
			Oct	KI, Kumano	+
			Nov	MS, Kawasaki	–
	P. cretica LINNÉ var. *albolineata* HORT.	Matsuzakashida	Mar	ST, Minō	+
			Aug	ST, Minō	+
			Oct	SR, Shizuoka	+
			Oct	TS, Ioki	+
			Nov	MS, Kawasaki	+
	P. dispar KUNZE	Amakusashida	Oct	SR, Shizuoka†	–
			Oct	KI, Owase	–
			Oct	TS, Mt. Taniyama	–
	P. grevilleana WALLICH*	Ashigatashida	Nov	OS, Yakushima	##
	P. inaequalis BAKER	Ōbanoamakusashida	Oct	SR, Shizuoka†	–
			Oct	KI, Owase	+
	P. inaequalis BAKER var. *aequata* TAGAWA	Ōbanohachijōshida	Apr	KI, Katsuura	–
			Aug	KI, Katsuura	–
			Oct	KI, Owase	–
	P. multifida POIRET	Inomotosō	Mar	ST, Minō	+
			Aug	KI, Mt. Ōdaigahara	+
			Oct	TS, Mt. Ishidate	+
			Oct	TS, Bchukyō	+
			Nov	MS, Kawasaki	+
	P. quadriaurita RETZIUS	Hachijōshida	May	KI, Katsuura	–
			Oct	KI, Owase	–
			Oct	KI, Kozagawa	–
			Oct	SR, Shizuoka	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	P. ryukyuensis TAGAWA	Ryukyuinomotosō	Nov	SM, Kagoshima	##
	P. semipinnata LINNÉ	Ōamakusashida	Aug	SR, Shizuoka†	–
			Oct	SR, Shizuoka†	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	P. setuloso-costulata HAYATA*	Togchachijōshida	Nov	OS, Yakushima	##
	P. tokioi MASAMUNE*	Hikageamakusashida	Sep	SR, Shizuoka†	##
			Nov	OS, Yakushima	##
			Nov	OS, Yakushima	##
	P. vittata LINNÉ	Moejimashida	Oct	SR, Shizuoka†	+
	P. wallichiana AGARDH	Nachishida	Aug	KI, Nachi	–
			Oct	KI, Owase	–
			Oct	SR, Shizuoka	–
			Nov	OS, Yakushima	–
	P. yakuinsularis KURATA*	Yakushimahachijō-shida	Nov	OS, Yakushima	+
	Sphenomeris chinensis MAXON	Horashinobu	May	ST, Minō	–
			Aug	KI, Kushimoto	–
			Oct	SR, Mt. Ogasa	–
			Oct	TS, Mt. Taniyama	–
			Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
	S. chinensis MAXON var. *littoralis* OHWI	Hamahorashinobu	May	IZ, Itō	##
			Nov	OS, Yakushima	+
Davalliaceae					
	Davallia mariesii MOORE	Shinobu	Mar	ST, Minō	+
			Aug	AW, Mt. Kiyosumi	+
			Aug	YT, Yoshino	##
	Davallia mariesii MOORE	Shinobu	Sep	ST, Sengari	##
			Oct	TS, Ioki	##
	Humata repens DIELS	Kikushinobu	Aug	SR, Shizuoka†	+
			Sep	SR, Shizuoka†	+
			Oct	KI, Kozagawa	##
	Nephrolepis auriculata TRIMEN	Tamashida	Oct	SR, Shizuoka†	–
			Oct	IZ, Itō	–
			Oct	TS, Mt. Taniyama	–
			Nov	OS, Yakushima	–
Plagiogyriaceae					
	Plagiogyria adnata BEDDOME	Takasagokijinoo	Oct	KI, Owase	–
			Oct	KI, Kozagawa	–
	P. euphlebia METTENIUS	Ōkijinoo	Mar	ST, Minō	##
			May	YT, Murō	##
			Aug	AW, Mt. Kiyosumi	##
			Aug	YT, Kawakami	##
			Oct	SR, Shizuoka	###
			Oct	TS, Mt. Sembon	###
			Nov	OS, Yakushima	###
	P. japonica NAKAI	Kijinooshida	Mar	ST, Minō	##
			May	YT, Murō	##
			Aug	AW, Mt. Kiyosumi	##
			Aug	YT, Kawakami	##
			Oct	SR, Shizuoka	###
			Oct	TS, Mt. Sembon	###
			Nov	OS, Yakushima	###
	P. matsumureana MAKINO	Yamasotetsu	Jun	RZ, Shirasawa	–
			Aug	KI, Mt. Ōdaigahara	+
			Sep	RZ, Sekiyama	##
	P. stenoptera DIELS	Shimayamasotetsu	Nov	OS, Yakushima	–
			Nov	OS, Yakushima	–
Cyatheaceae					
	Cyathea boninsimensis COPELAND	Hego	Oct	SR, Shizuoka†	##
			Nov	OS, Yakushima	##
	C. metteniana C. CHRISTENSEN *et* TARDIEU*	Chabohego	Aug	SR, Shizuoka†	##
	Gymnosphaera denticulata COPELAND	Kusamaruhachi	Apr	KI, Shingū	–
			Oct	KI, Katsuura	–
			Oct	KI, Owase	+
			Oct	KI, Kozagawa	+
Aspidiaceae					
	Acrophorus stipellatus MOORE	Taiwanhimewarabi	Nov	OS, Yakushima	##
	Athyrium aphanoneuron OHWI	Atsubakinoborishida	Nov	OS, Yakushima[1]	+
			Nov	OS, Yakushima[1]	+
			Oct	SR, Shizuoka†[2]	###
			Nov	OS, Yakushima[2]	###
			Nov	OS, Yakushima[2]	###
			Nov	OS, Yakushima[2]	###
			Nov	OS, Yakushima[3]	–
			Nov	OS, Yakushima[3]	+
			Nov	OS, Yakushima[3]	+
			Nov	OS, Yakushima[3]	##
			Nov	OS, Yakushima[4]	–
			Nov	OS, Yakushima[4]	–
	A. crenulatoserrulatum MAKINO	Ipponwarabi	Sep	RZ, Ōkura	##
			Sep	RC, Akka	###
			Nov	UZ, Higashine	##
	A. decurrenti-alatum COPELAND	Shikechishida	May	YT, Murō	+
			Oct	KI, Kozagawa	–
			Oct	SR, Shizuoka	+

Family	Species[a,b]	Japanese name	Date	Location[c,d]	Activity[e]
	A. decurrenti-alatum Copeland	Shikechishida	Nov	YT, Yoshino	+
			Nov	OS, Yakushima	++
			Nov	OS, Yakushima	++
	A. doederleinii Ohwi	Shimashiroyamashida	Nov	OS, Yakushima	+
			Nov	OS, Yakushima	+
	A. dubium Ohwi	Herashida	Aug	AW, Mt. Kiyosumi	+
			Sep	YT, Nara	++
			Oct	SR, Shizuoka	+
			Oct	KI, Kozagawa	+
			Oct	TS, Ioki	++
			Oct	TS, Mt. Taniyama	++
	A. fluviale C. Christensen	Hosobashikechishida	Nov	OS, Yakushima	++
	A. grammitoides Milde	Hosobashikeshida	Sep	RZ, Ayashi	−
			Oct	RZ, Sakunami	−
			Oct	MS, Kawasaki	−
	A. grammitoides Milde var. *simplicifolium* Ohwi	Hitotsubashikeshida	Oct	SR, Shizuoka†	−
	A. hachijoense Ohwi	Shiroyamashida	Sep	SR, Shizuoka†	++
			Oct	KI, Owase	++
			Nov	OS, Yakushima	++
	A. henryi Diels	Ōhimewarabi	Sep	YS, Kibune	−
			Oct	SR, Shizuoka	+
	A. iseanum Rosenstock	Hosobainuwarabi	Oct	KI, Owase	+++
	A. iseanum Rosenstock var. *angustisectum* Tagawa*	Togaribainuwarabi	Nov	OS, Yakushima	++
	A. japonicum Copeland	Shikeshida	Jun	RZ, Mt. Taihaku	−
			Aug	RZ, Mt. Izumi	−
			Aug	YS, Kibune	−
	A. japonicum Copeland var. *dimorphophyllum* Ohwi	Seitakashikeshida	Aug	SR, Shizuoka†	−
			Sep	SR, Shizuoka†	−
	A. japonicum Copeland var. *grammitoides* Milde*	Koshikeshida	Nov	OS, Yakushima	++
	A. maximum Copeland	Hirohanokogirishida	Aug	SR, Shizuoka	+
			Nov	OS, Yakushima	−
			Nov	OS, Yakushima	−
	A. melanolepis H. Christ	Meshida	Aug	ST, Mino	+
			Oct	KI, Owase	++
	A. mesosorum Makino	Nuriwarabi	Aug	IG, Kōchidani	+
			Sep	RC, Akka	+
			Sep	YS, Kibune	+
			Oct	KI, Owase	+
			Oct	TS, Mt. Taniyama	+
			Nov	OS, Yakushima	+
	A. mettenianum Ohwi	Miyamanokogirishida	May	KI, Nachi	##
	A. mettenianum Ohwi var. *fauriei* Ohwi	Hosobanokogirishida	Nov	OS, Yakushima	##
	A. multifidum Rosenstock	Satomeshida	May	RZ, Sakunami	−
			Jun	RZ, Shirasawa	−
	A. multifidum Rosenstock f. *acutissimum* Kurata	Togaribameshida	Aug	IG, Kōchidani	++
			Aug	IG, Kōchidani	−
			Sep	RZ, Sekiyama	−
	A. naganumanum Ohwi	Hikagewarabi	Oct	SR, Shizuoka†	++
	A. nakanoi Makino	Himehōbishida	Aug	SR, Shizuoka†	+++
			Nov	OS, Yakushima	+++
			Nov	OS, Yakushima	+++
	A. niponicum Hance	Inuwarabi	May	RZ, Sakunami	+++
			Sep	RZ, Sekiyama	+++
			Oct	KI, Owase	+++
			Nov	UZ, Higashine	+++
			Nov	RZ, Sekiyama	+++
	A. nipponicola Ohwi	Onihikagewarabi	Sep	SR, Shizuoka†	+
	A. okudairai Ohwi	Iyokujaku	May	YT, Murō	−
	A. otophorum Koidzumi	Taniinuwarabi	Oct	KI, Owase	++
			Oct	KI, Kozagawa	++
	A. petri Ohwi	Hirohamiyamanoko-girishida	Nov	OS, Yakushima	+++
			Nov	OS, Yakushima	+++
	A. procerum Milde	Aoigawarabi	Nov	OS, Yakushima	++
			Nov	OS, Yakushima	++
	A. pycnosorum H. Christ	Miyamashikeshida	Aug	ST, Minō	+
			Oct	KI, Kozagawa	++
			Nov	RZ, Sekiyama	−
	A. spinulosum Milde	Miyamainuwarabi	Aug	KI, Katsuura	+++
	A. squamigerum Ohwi	Kiyotakishida	Jun	RZ, Mt. Taihaku	++
			Sep	RZ, Shirasawa	++
			Sep	RC, Akka	++
			Sep	ST, Minō	++
	A. subrigescens Hayata	Otomeinuwarabi	Nov	OS, Yakushima	+++
			Nov	OS, Yakushima	+++
	A. unifurcatum C. Christensen	Ōhimewarabimodoki	Aug	YT, Mt. Ōdaigahara	+++
			Oct	SR, Shizuoka	++
	A. vidalii Nakai	Yamainuwarabi	May	RZ, Sakunami	+++
			Aug	IG, Kōchidani	+++
			Sep	RZ, Sekiyama	+++
			Nov	UZ, Higashine	+++
	A. virescens Ohwi	Kokumōkujaku	Sep	SR, Shizuoka†	−
			Oct	KI, Owase	−
			Oct	KI, Owase	−
			Nov	OS, Yakushima	+
	A. wardii Makino	Hirohanoinuwarabi	Aug	ST, Minō	+++
			Aug	IG, Kōchidani	+++
			Oct	KI, Kozagawa	+++
			Oct	KI, Owase	+++
	A. wardii Makino var. *majus* Makino	Ōhirohanoinuwarabi	Oct	KI, Owase	+++
	A. wichurae Ohwi	Nokogirishida	Aug	KI, Nachi	−
			Oct	KI, Owase	−
			Oct	SG, Yugawara	−
			Oct	SR, Shizuoka	−
			Oct	TS, Ioki	−
			Oct	TS, Mt. Taniyama	−
	A. yakushimense Tagawa*	Yakushimataniinu-warabi	Nov	OS, Yakushima	++
			Nov	OS, Yakushima	++
	A. yokoscense H. Christ	Hebinonegoza	Jun	RZ, Mt. Izumi	+++
			Sep	RZ, Sendai	+++
			Sep	ST, Minō	+++
			Sep	RZ, Okunikkawa	+++
	Bolbitis subcordata Ching	Hetsukashida	Sep	SR, Shizuoka†	−
			Nov	OS, Yakushima	++
			Nov	OS, Yakushima	++
	Ctenitis eatoni Ching	Horakaguma	Aug	SR, Shizuoka†	+
	C. hendersoni H. Itō	Hōraihimewarabi	Oct	KI, Owase	−
			Nov	OS, Yakushima	−
	C. maximowicziana Ching	Shiragashida	Aug	AW, Mt. Kiyosumi	++
			Aug	KI, Katsuura	++
			Sep	YT, Murō	++
			Oct	TS, Mt. Yokogura	++
			Oct	KI, Owase	++
			Oct	SG, Yugawara	++
	C. sikokiana H. Itō	Hōnokawashida	Oct	KI, Owase	−
			Oct	KI, Kozagawa	−

Family	Species[a,b]	Japanese name	Date	Location[c,d]	Activity[e]
	C. sinii OHWI	Satsumashida	Sep	SR, Shizuoka†	+
	C. subglandulosa CHING	Katsumōinode	May	KI, Katsuura	−
			Aug	AW, Mt. Kiyosumi	−
			Aug	SR, Shizuoka†	+
			Nov	OS, Yakushima	+
	Cyclosorus acuminatus NAKAI	Hoshida	Aug	ST, Minō	−
			Oct	SR, Shizuoka	−
			Oct	TS, Ioki	−
	C. dentatus CHING	Inukehoshida	Oct	SR, Shizuoka†	−
	C. goggilodus LINK	Tetsuhoshida	Apr	KI, Shingū	−
			Oct	SR, Shizuoka†	−
	C. parasiticus FARWELL	Kehoshida	Nov	OS, Yakushima	−
			Nov	SM, Kagoshima	−
	C. subpubescens CHING*	Kushinohashida	Aug	SR, Shizuoka†	−
	C. triphyllus TARDIEU-BLOT	Kōmorishida	Oct	SR, Shizuoka†	++
			Nov	OS, Yakushima	+
	Cystopteris fragilis BERNHARDI	Nayoshida	Aug	KI, Katsuura	−
	Dictyocline griffithii MOORE var. *pinnatifida* BEDDOME	Amishida	Oct	KI, Owase	++
			Oct	KI, Kozagawa	++
			Nov	OS, Yakushima	+
			Nov	OS, Yakushima	+
	Diplazium owaseanum KURATA*	Owaseshida	Oct	KI, Owase†	+++
	D. taiwanense TAGAWA*	Niseshiroyamashida	Nov	OS, Yakushima	+++
	D. yakumontanum TAGAWA*	Yakushimawarabi	Nov	OS, Yakushima	++
	Dryopteris austriaca WOYNAR	Shiranewarabi	Aug	RZ, Mt. Izumi	+
			Nov	RZ, Sekiyama	+
	D. bissetiana C. CHRISTENSEN*	Yamaitachishida	Oct	TS, Mt. Taniyama	+
	D. championi CHING	Saikokubenishida	Sep	ST, Minō	−
	D. chinensis KOIDZUMI	Misakikaguma	Aug	AW, Mt. Kiyosumi	+++
	D. commixta TAGAWA	Tsukushiiwahego	Oct	KI, Owase†	−
	D. crassirhizoma NAKAI	Oshida	May	RZ, Shirasawa	++
			Jul	SN, Togakushi	+++
			Aug	RC, Mt. Kurikoma	++
			Oct	RZ, Sekiyama	+++
			Nov	RZ, Sekiyama	+++
	D. cycadina C. CHRISTENSEN	Iwahego	Sep	YT, Murō	++
			Oct	KI, Kozagawa	++
			Oct	TS, Mt. Taniyama	++
			Oct	TS, Mt. Yokogura	++
			Oct	KI, Owase†	+++
	D. dickinsii C. CHRISTENSEN	Ōkujakushida	Oct	KI, Owase†	−
	D. erythrosora O. KUNTZE	Benishida	Apr	KI, Katsuura	−
			Aug	IG, Kōchidani	−
			Oct	KI, Owase	−
	D. erythrosora O. KUNTZE var. *cystolepidota* NAKAI	Tōgokushida	Aug	ST, Minō	−
			Aug	IG, Kōchidani	−
	D. erythrosora O. KUNTZE var. *hoidzumiana* H. ITO*	Hokozakibenishida	Nov	OS, Yakushima	+
			Nov	OS, Yakushima	+
	D. formosana C. CHRISTENSEN	Takasagoshida	Nov	OS, Yakushima	++
	D. fuscipes C. CHRISTENSEN	Marubabenishida	May	YT, Mt. Kasuga	−
			Oct	KI, Owase	−
	D. gymnosora C. CHRISTENSEN	Nukaitachishida	Apr	SR, Shizuoka	−
	D. hayatai TAGAWA	Inutamashida	Nov	OS, Yakushima	++
	D. hondoensis KOIDZUMI	Ōbenishida	Apr	KI, Katsuura	+
	D. indusiata MAKINO *et* YAMAMOTO	Nukaitachishidamodoki	Sep	SR, Shizuoka†	−
			Oct	KI, Owase	−
			Nov	OS, Yakushima	−
			Nov	OS, Yakushima	−
	D. lacera O. KUNTZE	Kumawarabi	Aug	IG, Kōchidani	+
			Oct	RZ, Sakunami	+
	D. lacera O. KUNTZE	Kumawarabi	Nov	RZ, Sekiyama	+
	D. lacta C. CHRISTENSEN*	Iwakagewarabi	Sep	RC, Akka	+
	D. melanocarpa HAYATA*	Kuromincitachishida	Nov	OS, Yakushima	++
	D. monticola C. CHRISTENSEN	Miyamabenishida	Sep	SR, Shizuoka†	+
	D. polita ROSENSTOCK*	Taitōbenishida	Nov	OS, Yakushima	+++
	D. polylepis C. CHRISTENSEN	Miyamakumawarabi	Jun	RZ, Shirasawa	−
			Oct	RZ, Sakunami	−
	D. pycnopteroides C. CHRISTENSEN	Wakanashida	Oct	KI, Owase†	−
	D. sabaei C. CHRISTENSEN	Miyamaitachishida	Jun	RZ, Shirasawa	−
			Aug	KI, Mt. Ōdaigahara	−
			Aug	RZ, Mt. Izumi	−
	D. sieboldii C. CHRISTENSEN	Ōmitsude	Sep	SR, Shizuoka†	−
			Oct	KI, Owase†	−
	D. sordidipes TAGAWA	Yogoreitachishida	Nov	OS, Yakushima	+
			Nov	OS, Yakushima	++
	D. sparsa O. KUNTZE	Nagabanoitachishida	Sep	SR, Shizuoka†	−
			Sep	ST, Minō	−
			Oct	KI, Owase	−
	D. tasiroi TAGAWA	Tsukushiōkujaku	Oct	KI, Owase†	+++
	D. tokyoensis C. CHRISTENSEN	Tanihego	Sep	RZ, Sekiyama	++
			Oct	RZ, Mt. Izumi	++
	D. uniformis MAKINO	Okumawarabi	May	RZ, Mt. Banzan	++
			Oct	RZ, Sakunami	+
	D. varia O. KUNTZE var. *sacrosancta* OHWI	Himeitachishida	Aug	SR, Shizuoka	+++
			Oct	KI, Owase	++
	D. varia O. KUNTZE var. *setosa* OHWI	Itachishida	Aug	AW, Mt. Kiyosumi	+
			Aug	IG, Kōchidani	+
			Oct	SR, Shizuoka	++
	D. varia O. KUNTZE var. *subtripinnata* H. ITO	Ōitachishida	Aug	SR, Shizuoka	+
	Elaphoglossum tosaense MAKINO	Hirohaastsuita	Oct	KI, Kozagawa	++
			Nov	OS, Yakushima	++
	E. yoshinagae MAKINO	Atsuita	Nov	OS, Yakushima	−
	Lastrea angulariloba TAGAWA*	Ōhashigoshida	Sep	SR, Shizuoka†	++
			Oct	KI, Owase	+
			Nov	OS, Yakushima	++
	L. beddomei BEDDOME	Hosobashorima	Nov	OS, Yakushima	+
	L. cystopteroides COPELAND	Himehashigoshida	Nov	OS, Yakushima	+
	L. decursive-pinnata J. SMITH	Gejigejishida	Aug	AW, Mt. Kiyosumi	−
			Aug	IG, Kōchidani	+
			Aug	YT, Yoshino	+
			Oct	MS, Kawasaki	−
			Oct	KI, Kozagawa	−
			Oct	TS, Ioki	+
	L. dryopteris BORY	Usagishida	Aug	KA, Mt. Kitadake	−
	L. glanduligera MOORE	Hashigoshida	Oct	SG, Yugawara	−
			Oct	KI, Owase	+
			Nov	OS, Yakushima	++
	L. glanduligera MOORE var. *hyalostegia* OHWI	Kohashigoshida	Sep	SR, Shizuoka†	+++
			Nov	OS, Yakushima	+++
			Nov	OS, Yakushima	+++
	L. gracilescens MOORE	Shimayawarashida	Nov	OS, Yakushima	+
	L. japonica COPELAND	Hariganewarabi	Jun	RZ, Mt. Taihaku	+++
			Aug	IG, Kōchidani	+++
			Sep	RZ, Sendai	+++
			Oct	SG, Yugawara	+++
			Oct	TS, Mt. Sembon	+++
	L. laxa COPELAND	Yawarashida	Aug	IG, Kōchidani	−
			Sep	ST, Minō	−
			Oct	SR, Shizuoka	−

Family	Species[a,b]	Japanese name	Date	Location[c,d]	Activity[e]
	L. laxa COPELAND	Yawarashida	Nov	OS, Yakushima	−
	L. oligophlebia COPELAND	Himewarabi	May	UZ, Higashine	##
			Sep	YS, Kibune	##
			Oct	SR, Shizuoka	##
			Oct	KI, Kozagawa	##
	L. oligophlebia COPELAND var. *lasiocarpa* OHWI	Aragehimewarabi	Nov	OS, Yakushima	+
	L. omeiensis COEPLAND	Mizoshidamodoki	Oct	SR, Shizuoka	−
			Oct	KI, Owase	−
	L. phegopteris BORY	Miyamawarabi	Jun	RZ, Mt. Izumi	−
			Aug	KA, Mt. Kitadake	−
	L. quelpaertensis COPELAND	Ōbashorima	Jun	RZ, Mt. Izumi	##
			Jul	RC, Mt. Kurikoma	##
			Sep	Mt. Nakuidake	+
	L. subochthodes TAGAWA	Ibukishida	Aug	OM, Mt. Ibuki	+
			Oct	SR, Shizuoka†	−
			Oct	KI, Kozagawa	+
			Nov	OS, Yakushima	−
	L. thelypteris BORY	Himeshida	May	RZ, Ayashi	###
			Aug	IG, Kōchidani	###
			Sep	RZ, Ayashi	###
			Oct	RZ, Ōkura	###
			Oct	RZ, Ayashi	###
	L. totta OHWI	Mizoshida	May	RZ, Mt. Banzan	+
			Sep	YT, Murō	−
			Sep	RZ, Okunikkawa	+
			Oct	RZ, Mt. Izumi	+
			Nov	OS, Yakushima	−
			Nov	UZ, Higashine	+
	L. uraiensis COPELAND*	Taiwan-hariganewarabi	Nov	OS, Yakushima	##
	Matteuccia orientalis TREVISAN	Inugansoku	Jun	RZ, Shirasawa	###
			Aug	IG, Kōchidani	###
			Aug	RZ, Mt. Izumi	###
			Aug	YT, Nara	###
			Oct	RZ, Mt. Izumi	###
	M. struthiopteris TODARO	Kusasotetsu	**May**	RZ, Mt. Izumi	###
			Aug	IG, Kōchidani	###
			Aug	RZ, Mt. Izumi	###
			Oct	RZ, Mt. Izumi	###
	Onoclea sensibilis LINNÉ	Kōyawarabi	**May**	RZ, Mt. Banzan	###
			Sep	RZ, Ōkura	###
			Oct	RZ, Ōkura	###
	Phanerophlebia falcata COPELAND	Oniyabusotetsu	Apr	KI, Shingū	+
			Jul	SG, Hayama	+
			Oct	TS, Ioki	−
			Oct	KI, Kozagawa	+
	P. fortunei COPELAND	Yabusotetsu	May	RZ, Shirasawa	−
			Sep	RZ, Okunikkawa	+
			Nov	RZ, Sekiyama	+
	P. fortunei COPELAND var. *clivicola* OHWI	Yamayabusotetsu	Nov	RZ, Sekiyama	+
			Dec	UZ, Yamadera	+
	P. fortunei COPELAND var. *intermedia* OHWI	Miyakoyabusotetsu	Oct	SR, Shizuoka†	−
			Oct	KI, Owase	−
	P. macrophylla OKUYAMA	Hirohayabusotetsu	Apr	KI, Katsuura	+
			Aug	SR, Shizuoka†	−
	P. tachiroana COPELAND	Hosobayabusotetsu	Aug	SR, Shizuoka†	+
	P. vittata COPELAND	Miyajimashida	Oct	SR, Shizuoka†	##
			Oct	KI, Owase†	+
			Nov	OS, Yakushima	##
	Phegopteris subaurita TAGAWA*	Mimigatashida	Oct	SR, Shizuoka†	−
	Polystichum craspedosorum DIELS	Tsurudenda	Oct	SG, Yugawara	−
			Oct	TS, Behukyō	−
	P. deltodon DIELS	Tachidenda	Oct	KI, Owase†	+
	P. eximium C. CHRISTENSEN var. *minus* TAGAWA	Komochiinode	Aug	SR, Shizuoka†	+
			Oct	KI, Owase	+
	P. hancochii DIELS*	Taiwan-jūmonjishida	Sep	SR, Shizuoka†	+
	P. makinoi TAGAWA	Katainode	May	YT, Murō	+
			Aug	IG, Kōchidani	+
	P. microchlamys KODAMA	Karakusainode	Jul	RC, Mt. Kurikoma	####
			Aug	RZ, Mt. Izumi	###
	P. otomasui KURATA*	Nampiinode	Oct	KI, Owase†	####
	P. polyblepharum PRESL	Inode	Apr	IZ, Itō	##
			Aug	IG, Kōchidani	+
			Aug	YT, Nara	##
			Oct	SR, Shizuoka	##
			Nov	OS, Yakushima	+
	P. pseudo-makinoi TAGAWA	Saikokuinode	Apr	KI, Hongū	##
			Sep	YT, Murō	##
	P. pseudo-makinoi TAGAWA var. *ambiguum* TAGAWA	Inodemodoki	Apr	SR, Shizuoka	−
			Oct	KI, Owase†	−
	P. retroso-paleaceum TAGAWA	Sakageinode	Aug	RZ, Mt. Izumi	+
			Aug	YT, Nara	+
			Nov	RZ, Sekiyama	##
	P. retroso-paleaceum TAGAWA var. *coraiense* TAGAWA	Iwashiroinode	May	RZ, Mt. Banzan	−
			Sep	RZ, Okunikkawa	−
			Nov	RZ, Sekiyama	−
	P. retroso-paleaceum TAGAWA var. *ovato-paleaceum* TAGAWA	Tsuyanashiinode	Aug	ST, Minō	−
			Aug	IG, Kōchidani	−
	P. rigens TAGAWA	Oniinode	Oct	SG, Yugawara	−
	P. tripteron PRESL	Jūmonjishida	May	RZ, Mt. Izumi	−
			Jun	RZ, Shirasawa	−
	P. tsussimense J. SMITH	Himekanawarabi	Aug	ST, Minō	−
	Rumohra amabilis CHING	Ōkanawarabi	Oct	KI, Owase	−
			Nov	OS, Yakushima	−
			Nov	OS, Yakushima	−
			Nov	OS, Yakushima	+
			Nov	OS, Yakushima	+
	R. aristata CHING	Hosobakanawarabi	Mar	ST, Minō	−
			May	YT, Murō	−
			Sep	ST, Minō	−
			Oct	TS, Mt. Taniyama	−
			Oct	KI, Owase	−
	R. assamica CHING	Otokoshida	Oct	KI, Owase†	−
	R. maximowiczii CHING	Nantaishida	Oct	SR, Shizuoka	+
	R. miqueliana CHING	Naraishida	Aug	RZ, Mt. Izumi	+
			Sep	RZ, Mt. Izumi	+
			Dec	UZ, Yamadera	+
	R. nipponica CHING	Midorikanawarabi	Apr	KI, Katsuura	−
	R. pseudo-aristata H. ITO	Kobanokanawarabi	Aug	KI, Kushimoto	−
			Oct	KI, Owase†	−
			Nov	OS, Yakushima	+
	R. simplicior CHING	Hakatashida	Sep	YT, Murō	−
			Sep	SR, Shizuoka†	##
	R. standishii CHING	Ryōmenshida	Jun	RZ, Okunikkawa	+
			Sep	RZ, Shirasawa	+
			Nov	RZ, Sekiyama	###
	Tectaria kwarenkoensis TAGAWA*	Karenkōamishida	Aug	SR, Shizuoka†	−
	Woodsia polystichoides EATON	Iwadenda	Jun	RZ, Shirasawa	−
			Nov	RZ, Sekiyama	−
			Dec	UZ, Yamadera	−

Family	Species[a,b]	Japaness name	Date	Location[c,d]	Activity[e]
Blechnaceae					
	Blechnum amabile MAKINO	Osashida	May	RZ, Okunikkawa	卄
			Jul	RC, Mt. Kurikoma	−
			Sep	RZ, Okunikkawa	卄
			Oct	SR, Shizuoka	卄
			Oct	TS, Mt. Yokogura	卄
	B. castaneum MAKINO	Miyamashishigashira	Sep	MT, Mt. Hakkōda	卄
	B. niponicum MAKINO	Shishigashira	May	RZ, Ayashi	卄
			Sep	RZ, Sekiyama	卄
			Sep	RZ, Okunikkawa	卄
			Oct	ST, Minō	卄
			Oct	TS, Mt. Sembon	卄
			Nov	RZ, Sekiyama	卄
	B. orientale LINNÉ	Hiryūshida	Aug	SR, Shizuoka†	−
			Nov	OS, Yakushima	−
	Woodwardia harlandii HOOKER var. *takeoi* MASAMUNE	Hosobaōkaguma	Nov	OS, Yakushima	卄
			Nov	OS, Yakushima	卄
	W. japonica SMITH	Ōkaguma	Sep	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
	W. orientalis SWARTZ	Komochishida	Aug	YT, Shimokitayama	卄
			Oct	SR, Shizuoka	卄
			Oct	KI, Owase	卄
			Oct	KI, Kozagawa	卄
			Oct	YT, Murō	卄
			Nov	SM, Kagoshima	卄
	W. unigemmata NAKAI	Haikomochishida	Oct	SR, Shizuoka†	卄
			Oct	SG, Yugawara	卄
Aspleniaceae					
	Asplenium antiquum MAKINO	Taniwatari	Aug	SR, Shizuoka†	卄
			Sep	OS, Tanegashima	卄
			Oct	OS, Tanegashima	卄
			Oct	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
	A. cheilosorum KUNTZE	Usubakujaku	Nov	OS, Yakushima	卄
	A. ensiforme WALLICH*	Shimaōtaniwatari	Aug	SR, Shizuoka†	卄
			Oct	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
	A. griffithianum HOOKER	Husasajiran	Nov	OS, Yakushima	−
	A. incisum THUNBERG	Toranooshida	Jun	RZ, Mt. Taihaku	−
			Aug	RZ, Mt. Izumi	−
			Oct	UZ, Yamadera	−
	A. normale DON	Nuritoranoo	Aug	KA, Mt. Kitadake	−
			Sep	ST, Minō	−
			Oct	KI, Kozagawa	−
			Nov	OS, Yakushima	−
	A. obliquissimum HAYATA*	Yakushimahōbishida	Nov	OS, Yakushima	−
	A. prolongatum HOOKER	Hinokishida	Apr	SR, Shizuoka	−
			Oct	KI, Owase	+
			Nov	OS, Yakushima	+
	A. pseudo-wilfordii TAGAWA	Okutamashida	Aug	YT, Kamikitayama	+
			Oct	KI, Owase	−
	A. ritoense HAYATA	Kōzakishida	Oct	KI, Owase	+
	A. ruta-muraria LINNÉ	Ichōshida	Sep	RC, Akka	−
	A. sarelii HOOKER	Kobanohinokishida	Aug	ST, Minō	−
			Oct	SR, Shizuoka	−
			Oct	KI, Owase	−
			Oct	KI, Kozagawa	−
	A. scolopendrium LINNÉ	Kotaniwatari	May	IW, Yanaizu	+
			Oct	UZ, Yamadera	+
			Nov	RZ, Sekiyama	+
	A. trichomanes LINNÉ	Chasenshida	Oct	SR, Shizuoka	−
			Oct	KI, Kozagawa	−
	A. unilaterale LAMARCK	Hōbishida	Oct	KI, Kozagawa	−
			Nov	OS, Yakushima	−
	A. wilfordii METTENIUS	Aoganeshida	Oct	KI, Owase	−
			Nov	OS, Yakushima	−
			Nov	OS, Yakushima	−
	A. wrightii EATON	Kurumashida	Aug	KI, Katsuura	−
			Sep	KI, Owase	−
			Oct	SR, Shizuoka	−
	A. yakumontanum MASAMUNE*	Yakushimashida	Nov	OS, Yakushima	+
	A. yoshinagae MAKINO	Tokiwashida	Oct	KI, Owase	−
	Camptosorus sibiricus RUPRECHT	Kumonosushida	May	OM, Mt. Ibuki	−
			Sep	RC, Akka	−
polypodiaceae					
	Cheiropleuria bicuspis PRESL	Sujihitotsuba	Oct	KI, Owase	−
			Nov	OS, Yakushima	−
	Colysis elliptica CHING	Iwahitode	Sep	ST, Minō	卄
			Oct	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
	C. hemionitidea PRESL	Taiwankuriharan	Sep	OS, Tanegashima	卄
			Oct	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
			Nov	OS, Yakushima	卄
			Dec	OS, Tanegashima	卄
	C. pothifolia PRESL	Ōiwahitode	Sep	SR, Shizuoka†	卄
			Oct	TS, Ashizuri	卄
			Oct	SR, Shizuoka†	卄
	C. shintenensis H. ITO	Hitotsubaiwahitode	Nov	OS, Yakushima	卄
	C. wrightii CHING	Yarinohokuriharan	Oct	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
			Nov	OS, Yakushima	卄
	C. wrightii CHING var. *henryii* TAGAWA*	Ōyarinohokuriharan	Oct	SR, Shizuoka†	卄
			Nov	OS, Yakushima	卄
	Crypsinus engleri COPELAND	Takanohauraboshi	Nov	OS, Yakushima	卄
	C. hastatus COPELAND	Mitsudeuraboshi	Mar	ST, Minō	卄
			Jul	RZ, Matsushima	卄
			Oct	SR, Shizuoka	卄
			Oct	KI, Owase	卄
			Oct	TS, Mt. Taniyama	卄
			Nov	OS, Yakushima	卄
			Nov	OS, Yakushima	卄
	C. yakushimensis TAGAWA	Himetakanohaura-boshi	Nov	OS, Yakushima	卄
			Nov	OS, Yakushima	卄
	Lemmaphyllum microphyllum PRESL	Mamezuta	Mar	ST, Minō	+
			Apr	IY, Matsuyama	卄
			Aug	KI, Nachi	卄
			Sep	YS, Kibune	卄
			Oct	ST, Minō	卄
			Oct	SG, Yugawara	卄
			Oct	TS, Hayama	卄
			Oct	TS, Mt. Ishidate	卄
			Nov	OS, Yakushima	卄
			Nov	OS, Yakushima	卄
	Lepisorus monilisorus TAGAWA*	Chiziminokishinobu	Nov	OS, Yakushima	卄
	Loxogramme grammitoides C. CHRISTENSEN	Himesajiran	Oct	KI, Kozagawa	卄
	L. salicifolia MAKINO	Iwayanagishida	Oct	KI, Kozagawa	+
			Nov	OS, Yakushima	+
			Nov	OS, Yakushima	+

Family	Species[a,b]	Japaness name	Date	Location[c,d]	Activity[e]
	L. saziran TAGAWA	Sajiran	Aug	AW, Mt. Kiyosumi	+
			Oct	SR, Shizuoka	+
			Oct	KI, Owase	+
			Oct	TS, Mt. Ishidate	+
			Nov	OS, Yakushima	+
	Microsorium buergerianum CHING	Nukaboshikuriharan	Oct	SR, Shizuoka†	+
			Nov	OS, Yakushima	++
			Nov	OS, Yakushima	++
			Nov	OS, Yakushima	++
	M. hancockii CHING	Hokozakiuraboshi	Nov	OS, Yakushima	++
	Neocheiropteris ensata CHING	Kuriharan	Mar	ST, Minō	+++
			Aug	KI, Nachi	++
			Oct	KI, Owase	+++
			Oct	SR, Shizuoka	+++
			Oct	KI, Kozagawa	+++
			Oct	TS, Mt. Taniyama	+++
			Nov	OS, Yakushima	+++
	Pleopeltis annuifrons NAKAI	Hoteishida	Oct	KI, Kozagawa	+
			Oct	TS, Mt. Ishidate	++
	P. onoei OKUYAMA	Himenokishinobu	Sep	SR, Shizuoka†	+++
			Oct	RZ, Mt. Ōmori	+++
			Oct	TS, Mt. Ishidate	+++
	P. thunbergiana KAULFUSS	Nokishinobu	Mar	ST, Minō	+++
			May	YT, Nara	+++
			Oct	RZ, Sendai	+++
			Oct	RZ, Mt. Ōmori	+++
			Oct	KI, Owase	+++
			Oct	TS, Mt. Taniyama	+++
			Oct	TS, Hayama	+++
			Oct	ST, Minō	+++
			Nov	OS, Yakushima	+++
	P. ussuriensis REGEL *et* MAACK var. *distans* OKUYAMA	Miyamanokishinobu	Jul	YT, Mt. Ōdaigahara	+++
			Aug	SN, Mt. Yatsugatake	+
			Nov	OS, Yakushima	++
	Polypodium fauriei H. CHRIST	Oshakujidenda	May	RZ, Mt. Taihaku	+++
			Nov	RZ, Sakunami	+++
	P. formosanum BAKER	Taiwan-aonekazura	Aug	SR, Shizuoka†	+
			Oct	SR, Shizuoka†	+
			Nov	OS, Yakushima	++
	P. niponicum METTENIUS	Aonekazura	Oct	SR, Shizuoka	−
			Oct	KI, Negoro	+
	P. vulgare LINNÉ	Ōezodenda	Nov	OS, Yakushima	+++
	Pyrrosia hastata CHING	Iwaomodaka	May	ST, Minō	+
			Oct	TS, Mt. Ishidate	+
			Nov	OS, Yakushima	++
	P. linearifolia CHING	Birōdoshida	Mar	ST, Minō	++
			Aug	KI, Nachi	++
			Sep	RZ, Okunikkawa	++
			Oct	SR, Shizuoka	++
			Oct	RZ, Mt. Ōmori	++
			Oct	TS, Mt. Ishidate	++
	P. lingua FARWELL	Hitotsuba	Mar	ST, Minō	+
			Aug	KI, Nachi	−
			Aug	AW, Mt. Kiyosumi	+
			Oct	SR, Shizuoka	−
			Oct	TS, Mt. Ishidate	+
			Oct	TS, Mt. Taniyama	+
			Nov	OS, Yakushima	+
			Nov	OS, Yakushima	+
	Vittariaceae				
	Vittaria flexuosa FÉE	Shishiran	Apr	SR, Shizuoka	−
			Aug	AW, Mt. Kiyosumi	+
			Oct	SR, Shizuoka	+
			Oct	KI, Owase	−
			Oct	TS, Mt. Yokogura	+
			Nov	OS, Yakushima	+
	V. zosterifolia WILLDENOW	Amamoshishiran	Nov	OS, Yakushima	++
	Marsileaceae				
	Marsilea quadrifolia LINNÉ	Denjisō	Aug	SR, Shizuoka	+
	Salviniaceae				
	Azolla imbricata NAKAI	Akaukikusa	Oct	SR, Shizuoka	+
	Salvinia natans ALLIONI	Sanshōmo	Sep	RZ, Ayashi	+

a) The classification principally follows the manual of Ohwi.[7] The taxa, whose sources of nomenclature are literatures other than the above manual, are asterisked (*cf.*, footnote 7).

b) The families are arranged in the sequence adopted by Ohwi, and genera and species are given in alphabetical order within the families.

c) abbreviations: AW=Awa, HD=Hida, HZ=Hizen, IG=Iga, IW=Iwashiro, IY=Iyo, IZ=Izu, KA=Kai, KG=Kaga, KI=Kii, MS=Musashi, MT=Mutsu, OM=Ōmi, OS=Ōsumi, RC=Rikuchū, RZ=Rikuzen, SR=Suruga, SG=Sagami, SM=Satsuma, SN=Shinano, ST=Settsu, TS=Tosa, UZ=Uzen, YS=Yamashiro, YT=Yamato, YZ=Yezo, †=cultivated

d) Areas of the indicated locations vary. Specimens from the same species collected at the same time at distinct places in a location with a large area were all screened.

e) Assays were carried out on *Sarcophaga peregrina*.[8] A test solution containing a methanol extract from a dried plant material (10 mg) was injected into each isolated larval abdomen. The results are expressed in terms of the activity indexes which are corresponding to the following average per cent puparium formation: −=0, 0<+≦20, 20<++≦40, 40<+++≦60, 60<++++≦80, 80<+++++≦100%.

[1-4]: *Athyrium aphanoneuron* may further be classified into four taxa. See the text (p. 2301).

A number of screening methods for the insect moulting hormone activity have been developed; each has respective advantage. The screening operation used for the present bioassay was the *Sarcophaga* test,[8] which is rather easily carried out and gives quantitative results.

It was reported in a previous paper that the chance of finding the hormone activity from fresh plant materials was higher than that from dried ones such as crude drugs.[6] However, it was not clear whether the difference in activity between fresh and dried samples arose fortuitously or because of decomposition during drying and storing. It was found in the present work that plant materials showed activity regardless of the conditions; *i.e.*, fresh or dried, new and old. In fact, dried specimens 20 years old still gave positive responses.

The insect moulting hormone activities of the *pteridophyta* species of Japanese origin were summarized in Table I. Of the total 283 species, 39 varieties, and 1 form of ferns tested, 170 species, 22 varieties, and 1 form (48 genera and 13 families) showed activity towards insect,[9] while 113 species and 17 varieties (28 genera and 7 families) exhibited negative responses. Therefore, it was confirmed that ferns in general show a high probability of containing phytoecdysones.

Among the ferns found to give positive responses, 51 species and 7 varieties exhibited remarkable activity. In particular, probability of finding the strong activity was high in ferns belonging to the families Osmundaceae, Plagiogyriaceae, Cyatheaceae, Aspidiaceae, Blechnaceae, and Polypodiaceae. On the other hand, it is of interest chemotaxonomically that 7 families found to contain no active species namely Equisetaceae, Lycopodiaceae, Selaginellaceae, Ophioglossaceae, Marattiaceae, Schizaeaceae, and Hymenophyllaceae are those whose degrees of differentiation are considered to be low from a viewpoint of taxonomy. In spite of the same species being concerned, samples of different collecting dates and/or locations sometimes showed different responses. In some extreme cases, a specimen was active while another specimen in the same species was inactive. An interesting example is *Athyrium aphanoneuron* which, according to another taxonomical view, is classified into *Diplazium crassiusculum* Tagawa (Ibudakekinoborishida,[1] in Table I), *D. donianum* Tardieu (Kinoborishida,[2] in Table I), *D. donianum* Tardieu var. *aphanoneuron* Tagawa (Atsubakinoborishida,[3] in Table I), and *D. lobatum* Tagawa (Kirebakinoborishida,[4] in Table I). Among these taxa, only *D. donianum* exhibits the strong hormone activity and the remaining *D. crassiusculum*, *D. donianum* var. *aphanoneuron*, and *D. lobatum* show only little or no activity. Therefore, the detailed classification of this group may be significant from the viewpoint of chemotaxonomy. Further, the results of the present screening test on certain plants are contradictory to those of the previous reports.[5,6] Therefore, variation of contents depending upon the seasons and locations may be significant. On the whole, it was noticed that the activity of a sample collected in autumn tends to be higher than that collected in spring. Whereupon it follows that description of the collecting dates and locations is considered to be indispensable to the record of the hormone activity of plant materials.

Experimental

Materials——A total of 871 specimens were selected, most of which were wild and some of which were cultivated at herbal gardens. Samples from whole plants were subjected to the following extraction for bioassay. Sampling from a large fern was performed so that a sample represented a whole plant as complete as possible.

Preparation of Test Solutions——A dried plant material (1 g) in MeOH (20 ml) was heated under reflux for 2 hr. After filtration the extract was concentrated under reduced pressure to give the dried residue which was dissolved in 10% aqueous EtOH (1 ml). The filtrate was used as a test solution.

Biological Assay——Assays were carried out on larvae of *Sarcophaga peregrina* as described by Ohtaki, *et al.*[8] Thus, final instar larvae, which at 24 hr after ligation formed puparia at their anterior ends but did not pupate behind ligature, were employed as test insect.

8) T. Ohtaki, R.D. Milkman, and C.M. Williams, *Biol. Bull.*, **135**, 332 (1968).
9) Taxa each of which contains at least one active specimen are counted as positive.

An aliquot of the test solution (10 μl) was injected into each isolated larval abdomen which was kept at 26°. Ten individuals were used for each plant sample. The assays were evaluated 24 hr after injection when each abdomen was scored as having undergone complete, marked, slight, or no puparium formation; these responses being equated to 100, 75, 50, and 0%, respectively, for the purpose of calculating the weighed average per cent puparium formation.[8] The results in Table I are expressed in terms of the activity indexes as −, +, ++, +++, ++++, and +++++, these indexes being corresponding to the following average per cent puparium formation: −=0, 0<+≦20, 20<++≦40, 40<+++≦60, 60<++++≦80, 80<+++++≦100%.

Acknowledgement We are indebted to Dr. Y. Saiki, Shizuoka College of Pharmacy, to Dr. Y. Tsuda, Showa College of Pharmacy, and to Mr. H. Okuyama, the National Science Museum, for donation of some of the samples.