Observations on Relative Abundance, Phenology and Flower Preference of Thysanoptera in Sapporo and the Vicinity[1)]

By

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(With 7 Text-figures and 5 Tables)

Concerning the biology and ecology of thrips, a number of papers have so far been published, for instance, Bailey (1933), Sharga (1933), Davidson and Andrewartha and (1948) and Cederholm (1963), but the biological knowledge on this group is still far from satisfaction. In Japan, too, there have been reported several casual records on some species of economic importance but no comprehensive biological study has so far been carried out. Since 1969 the present writer has made a preliminary survey of thrips inhabiting Sapporo and the vicinity. Following the previous paper on taxonomy of the species collected (Kudô, 1970), the present paper deals with relative abundance, phenology and flower preference of the species sampled in the same locality.

The results are mostly based upon the periodical sampling on flowers executed at Bannaguro in Ishikari (BN) from May to September, 1969, at intervals of about ten days. Additional data taken from April to October, 1969, on the campus of Hokkaido University including the Botanical Garden (UC) are also incorporated when necessary. At collecting, 50 flowers, or in cases of compositae and clovers, 50 flower heads of each plant species were used as material in the serial arrangement of samples. Each flower, or flower head was separately packed in a polyethylene tube or bag. At the start or end of the blooming period, however, it was occasionally difficult to obtain 50 samples for each flower species. Thus, the procedure is not quantitatively complete but the writer believes that the results show to some fair extent, the basic pattern of the ecological distribution in the areas surveyed. Beside these surveys, the gathering of weed samples and the collection of soil specimens were also occasionally carried, though not intensively.

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Before going further, the writer wishes to express his cordial thanks to Prof. Mayumi Yamada and Dr. Shôichi F. Sakagami, Zoological Institute, Hokkaido University, for their valuable advices and help in the course of the present study. Sincere thanks are also addressed to Mr. Pierre Robert, princ. of the Shizuoka Seikogakuin, for his understanding and encouragements and his collaboration in reading the manuscript.

Results

1. *Relative abundance*: A total of 5,473 specimens, belonging to 11 species were obtained on flowers, through the serialization of samples made in BN. Table 1 illustrates these data with absolute numbers and percentage ratios. From the table, it appears that *Haplothrips niger*, *H. chinensis* and *Frankliniella intonsa* must be regarded as dominant species, occupying in combination 92.97% of the total individuals collected. Among the other eight species, *Aeolothrips fasciatus*, *Taeniothrips flavidulus* and *T.* ref. *distalis* are also relatively abundant. Besides these thrips species, ten other species were obtained on weeds (W) and soil surface (S) as follows:

W: *Chirothrips manicatus* (♀129/♂137), *Haplothrips niger* (71/0), *Anaphothrips obscurus* (45/0), *Haplothrips aculeatus* (22/7), *Frankliniella intonsa* (8/1), *Aptinothrips rufus* (5/0), *Frankliniella tenuicornis* (2/0), *Aeolothrips fasciatus* (1/0), *Sericothrips gracilicornis* (1/0), *Aptinothrips stylifera* (1/0) and *Thrips hawaiiensis* (1/0).

S: *Anaphothrips obscurus* (3/0), *Aptinothrips rufus* (2/0) and *A. stylifera* (1/0).

These individuals amounted to only about 7% of the total individuals collected in BN. Among them, *Anaphothrips obscurus* (Müller), *Frankliniella tenuicornis* (Uzel), *Aptinothrips rufus* (Gmelin) and *A. stylifera* Trybom were not obtained on flowers. *C. manicatus* is clearly dominant among these ten species. It does not

Table 1. Relative abundance on flowers in Bannaguro (BN)

Species	Number of individuals captured				
	♀	♂	♀ + ♂	% to total number	ratio of ♂/♀
1 *Haplothrips niger* (Osborn)	1,909	1	1,910	34.92	0.0005
2 *Haplothrips chinensis* Priesner	1,191	711	1,902	34.77	0.59
3 *Frankliniella intonsa* (Trybom)	1,028	246	1,274	23.28	0.24
4 *Aeolothrips fasciatus* (Linné)	135	63	198	3.59	0.47
5 *Taeniothrips flavidulus* Bagnall	64	25	89	1.63	0.39
6 *Taeniothrips* ref. *distalis* Karny	50	14	64	1.17	0.28
7 *Thrips tabaci* Lindeman	21	0	21	0.39	0/21
8 *Chirothrips manicatus* Haliday	6	0	6	0.11	0/6
9 *Sericothrips gracilicornis* Williams	4	0	4	0.07	0/4
10 *Haplothrips aculeatus* Fabricius	3	1	4	0.07	0.33
11 *Thrips hawaiiensis* (Morgan)	1	0	1	0.02	0/1
Total	4,412	1,061	5,473		0.24

figure here as numerous but some intensive sampling on grasses should be conclusive in asserting its existence on a pretty large scale.

Although sampling was made less regularly, the following species were obtained on flowers (F) and weeds (W) in UC.

F: *Frankliniella intonsa* (♀1,184/♂461), *Haplothrips niger* (170/0), *Taeniothrips flavidulus* (76/35), *T.* ref. *distalis* (72/12), *Thrips hawaiiensis* (55/0), *T. tabaci* (29/0), *Haplothrips chinensis* (13/2), *Thrips nigropilosus* Uzel (7/1), *Aeolothrips fasciatus* (3/1), *Chirothrips manicatus* (2/0) and *Anaphothrips obscurus* (1/0).

W: *Chirothrips manicatus* (269/23), *Haplothrips niger* (10/0), *H. aculeatus* (2/0) and *Anaphothrips obscurus* (1/0).

The comparison of the samples taken from BN with those taken from UC shows a basic resemblance in faunal make-up, with 11 out of 16 species being identical. The other five were all rare species. The species dominant in both areas are *F. intonsa* and *C. manicatus*, but the former is more abundant in UC, where it comprises 67% of the total number of individuals. *H. niger* is dominant in both areas where the clover flowers preferred by this species, were also abundant, but it was less abundant in UC, although still occupying the second rank among the species collected on flowers. The marked difference was seen in *A. fasciatus* and *H. chinensis*, dominant or abundant in BN, but rare in UC. This difference was probably caused by parallel difference in the flower species.

The sex ratio for each species is also comprised in Table 1. In the case of nearly every species, females were more abundant than males. With *H. niger* only one male was found out of a total of 2,161 individuals. In the six following species, *S. gracilicornis*, *A. obscurus*, *A. rufus*, *A. stylifera*, *T. tabaci* and *T. hawaiiensis*, no males were obtained. In *C. manicatus*, the ratio was 1:1 on grasses in BN, but not in UC, this ratio was very low probably because the sampling of specimens did not occur at the peak of the male appearance. This result coincides with the previous papers (Morison, 1949; Kurosawa, 1968), recording the preponderance of females. It is possible that some of these species may reproduce, as reported by Pomeyrol (1928) and Sakimura (1938), through parthenogenesis. This would also account for foresaid female preponderance.

2. *Phenology*: Figure 1 shows the seasonal fluctuations of all the species studied and all individual numbers sampled, accompanied with climatic conditions, and Fig. 2 shows the phenology of six dominant species with sexes and larvae separately given, based upon the specimens obtained by periodical sampling on nine flower species (*Arabis japonica*, *Viola grypoceras*, European dandelion, white and red clovers, *Rosa rugosa*, *Lathyrus maritimus*, *Vicia cracca* var. *japonica* and *V. japonica*). Among these flowers, the samples from each flower or head were not separately preserved in *Vicia cracca* var. *japonica* and *V. japonica*. Because the sampling from those 50 flowers or heads was occasionally impossible, the estimated number obtained by the following conversion was used when 25 or less flowers were examined:

$$\text{Estimated number of thrips from 50 flowers} = \frac{\text{Actual number of thrips collected}}{\text{Number of flowers examined}} \times 50$$

Although the sampling period was short in BN, the thrips season in Sapporo and the vicinity seems to extend from late April to October, judging from the result in UC and other areas. The species number is the richest in July, distinctly decreasing thereafter. The individual number is the richest in early July and August, the upper curve being caused mainly by *H. niger* in early July and by *H. chinensis* and *F. intonsa* in August.

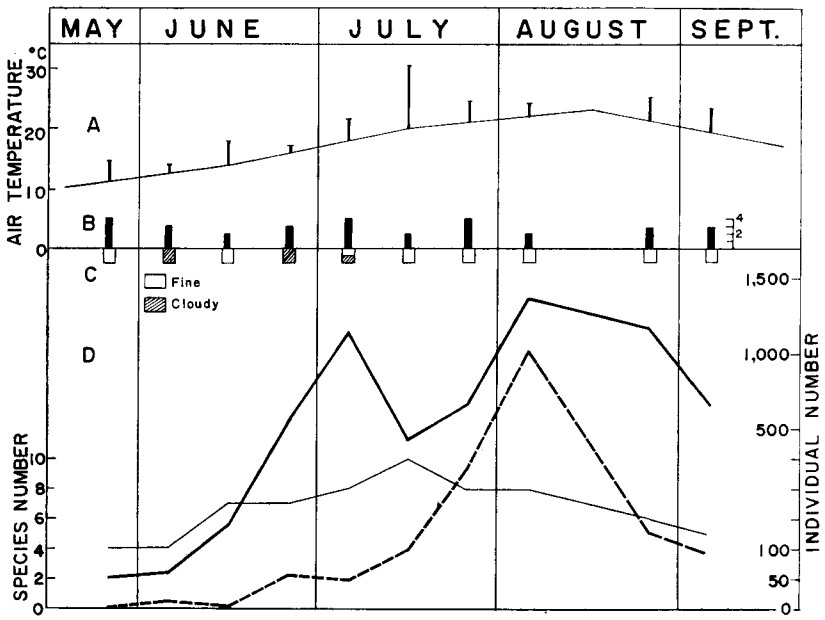

Fig. 1. Phenology of species and individuals and climatic conditions. A. Monthly mean air temperature (Vertical line temperature read at sampling). B. Wind class during sampling (0~5). C. General weather condition. D. Number of species (thin solid line) and individuals, both adults (thick solid line) and larvae (thick broken line).

In all abundant species, adults appear earlier than larvae, and females earlier than males. *A. fasciatus*, *F. intonsa* and *H. chinensis* are the earliest species, and the latters two are seen till the latest month. The active period of *T.* ref. *distalis* is the shortest, covering only 1.5 months from July to middle August. The latest species, *T. flavidulus* appears in middle July and is the richest in early September. Because the specific distinction in larval stage, especially in earlier instars, was accurately made only in three species, *A. fasciatus*, *H. chinensis* and

H. niger, the data on other species, namely, *F. intonsa*, *T.* ref. *distalis* and *T. flavidulus* are less accurate as to larval stages. The number of larvae is in most species distinctly fewer than adults, even though the early small larvae were failed to be sampled. This result seems to show that these species have one generation per

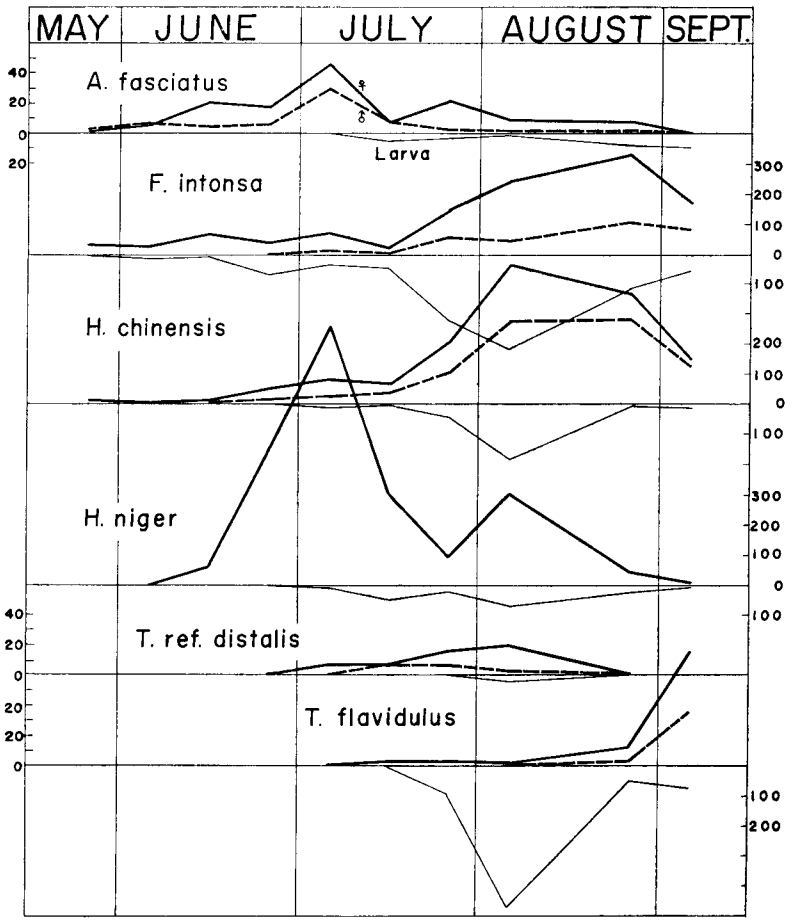

Fig. 2. Phenology of each species shown by individual number, females and males (thick solid and broken lines, above) and larvae (below) separately given.

year in Sapporo, but further critical studies are required to clarify the problem. According to Sakimura (1937) and Kurosawa (1968), *Thrips tabaci* has five or six generations per year in Tokyo and the vicinity.

Although the data are not sufficient, the phenology shows a similar tendency

in UC, too. *F. intonsa* has the longest active period, appearing in late April and being observed until late October. *H. chinensis* appears in early May and disappears in middle September. *T.* ref. *distalis* and *H. niger* behave as in NB, while *T. flavidulus* does slightly differently. The latter appears in late April and disappears soon after. After 2~2.5 months, it reappears in early or middle July and being seen until the latest month together with *F. intonsa.*

3. *Flower preference*: The flower preference and its phenology in the area surveyed is referred to briefly.

3.1. *Relative flower preference of each species*: The flower preference of seven abundant species obtained by quantitative sampling is given in Fig. 3 with percentage ratios. *H. niger* and *T.* ref. *distalis* show the narrowest preference range. Throughout the periodical sampling, the specimens of *H. niger* obtained on flowers other than white and red clovers are less than one percent. But a greater number of host plants would probably be certified by further systematic sampling, because some forty or fifty specimens were obtained on *Plantago lanceolata* by occasional sampling. Although some females of *T.* ref. *distalis* were obtained on red clover before the bloom of *Vicia cracca* var. *japonica*, after the bloom of the latter all specimens came from this plant. The preference in *T. flavidulus* is also high for *Vicia*. Both sexes show the same tendency in all species.

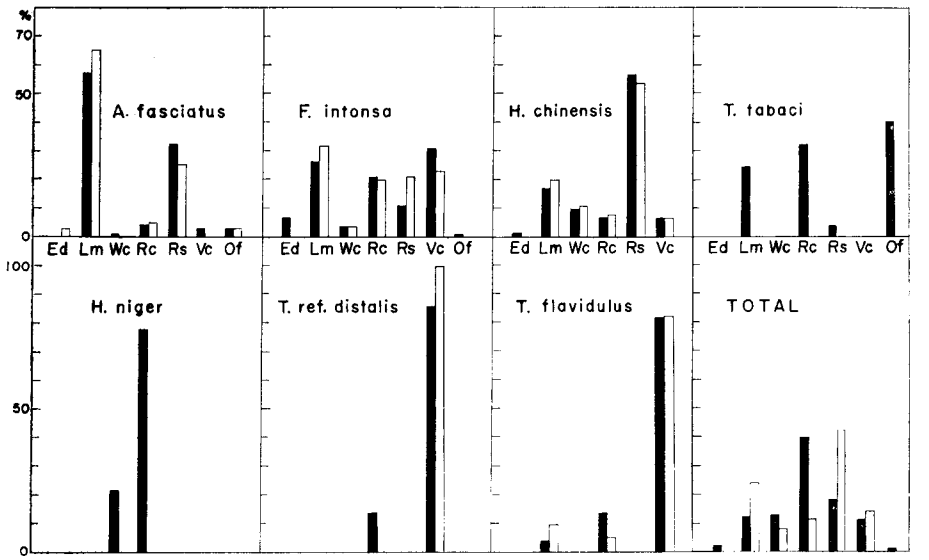

Fig. 3. Flower preference shown with percentage ratio in certain relatively abundant species, females (black) and males (white) separately given. Ed; European dandelion, Lm; *Lathyrus maritimus*, Wh; white clover, Rc; Red clover, Rs; *Rosa rugosa*, Vc; *Vicia* spp., Of; Other flowers.

The slight difference is apparently caused by the difference in the period of appearance.

In UC, the percentage preference ratio of relatively abundant species is as follows (♀/♂):

F. *intonsa* *Trifolium pratense* (21/46), *Taraxacum officinale* (23/19), *Vicia cracca* var. *japonica* (21/14), *Medicago sativa* (5/0), *Trifolium repens* (6/12), *Gagea lutea* (5/0), others (9/0)

H. niger *T. pratense* (93/0), *T. repens* (5/0), *T. officinale* (2/0)

T. ref. *distalis* *V. cracca* var. *japonica* (100/100)

T. flavidulus *T. officinale* (30/34), *Cardiocrinum Glehni* (15/51), *T. pratense* (18/3), *V. cracca* var. *japonica* (14/3), others (12/9)

Although *H. niger* and *T.* ref. *distalis* showed the same preference to that in BN, *F. intonsa* and *T. flavidulus* behaved differently as to predominantly preferred flowers:

	BN	UC
F. intonsa	*Lathyrus maritimus*	*Trifolium pratense*
	Vicia cracca var. *japonica*	*Taraxacum officinale*
		V. cracca var. *japonica*
T. flavidulus	*V. cracca* var. *japonica*	*T. officinale*
		Cardiocrinum Glehni

Taraxacum officinale and *Trifolium pratense* are important requisite for these two species in UC. But here the importance of *Taraxacum* is probably caused in part by frequent sampling during the spring and autumn bloom of this plant. Further, though not quantitatively determined, *Anemone Raddeana* and *Gagea lutea* are also an important requisite in spring in UC. Both *F. intonsa* and *T. flavidulus* are seen on *Anemone* in April and the former on *Gagea* in early May. Finally, the preference of *T. flavidulus* for *Vicia* is remarkably higher in BN than in UC.

3.2. *Phenology of flower species preferred*: Figure 4 shows the monthly phenology of flower preference by all the thrips species collected in 1969. From the succession of flower species predominantly preferred, the phenology of flower-thrips relationship in the area surveyed can be devided into four periods as follows:

I. Dandelion period: May. Characterized by the full bloom of *Taraxacum officinale*. Other important flowers are not yet in bloom.

II. Clover period: Late June to late July. Characterized by the predominance of *Trifolium repens* and *T. pratense*, which absorbed here about 70% of total individuals, with the predominance of *H. niger*.

III. *Rosa* period: Late July to late August. *Rosa rugosa* becomes important in relation with the increase of *H. chinensis* and *F. intonsa*, though flowers of clovers and even of *Rosa rugosa* decrease in this period.

IV. *Lathyrus* period: Late August to middle September. Characterized by decrease of flower species in bloom and second blooming of *Lathyrus maritimus*.

Lathyrus is an important flower from early June to the middle of the same month, but its second blooming is more important, especially with regard to *H. chinensis* and *F. intonsa*.

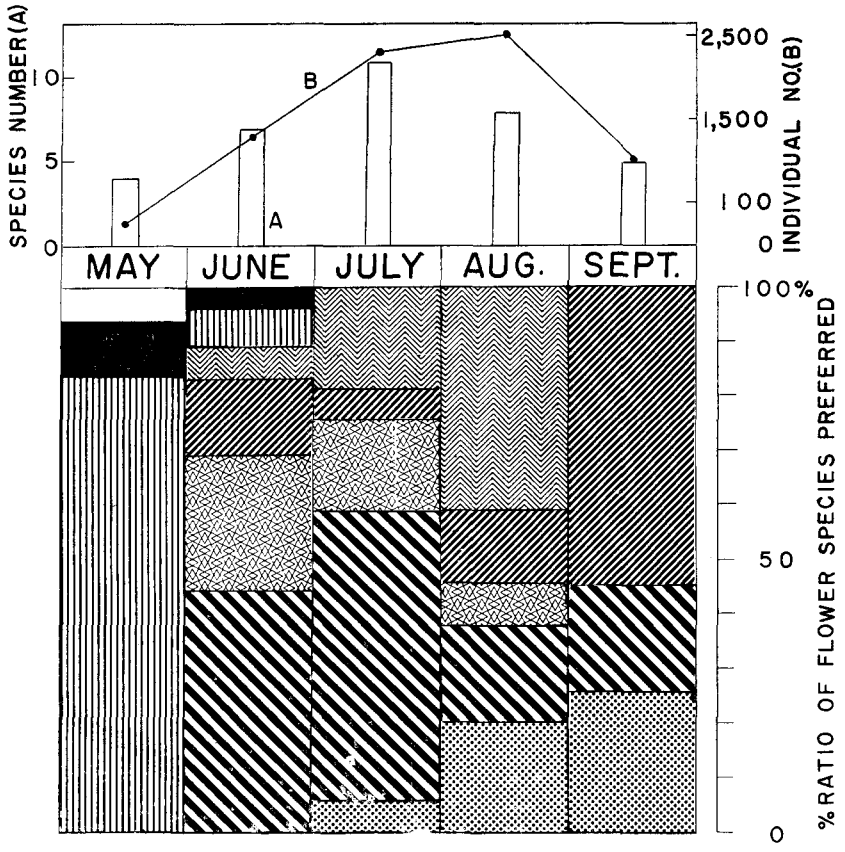

Fig. 4. Phenology of flowers preferred by thrips. A. Species number. B. Individual number. Below: Percentage ratio of flower species preferred in each month. Various patterns showing flower species are explained in Fig. 5.

Figure 5 shows the change of flower preference in relatively abundant thrips species during their active period, given by percentage ratios. The succession is remarkable in the following three species, in part, depending on the order of blooming.

A. fasciatus: *Lathyrus maritimus*→*Rosa rugosa*

H. chinensis: European dandelion→*Rosa rugosa*→*L. maritimus*

T. ref. *distalis*: Red clover→*Vicia* spp.

On the other hand, such succession is not seen in *H. niger*, *T. flavidulus* and *F. intonsa*; the former two species continuously attaching themselves to legumes, while the latter prefers a variety of flowers.

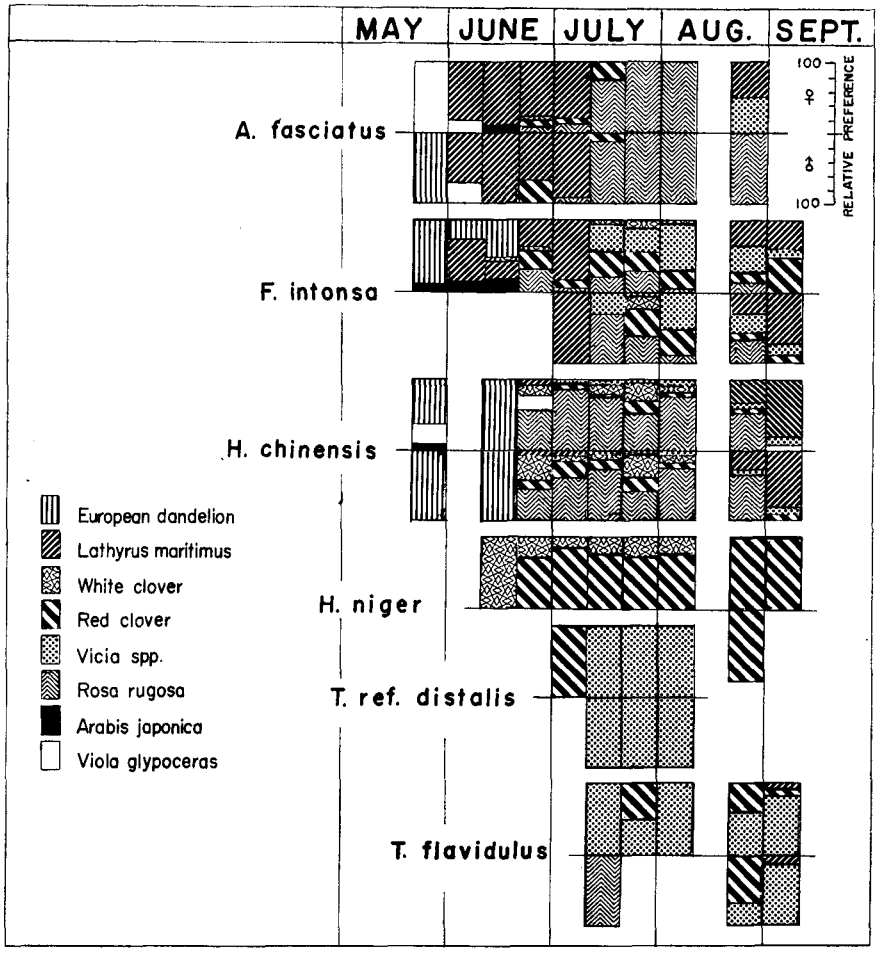

Fig. 5. Phenology of flowers preferred by in six relatively abundant thrips species. Females (above) and males (below) separately given. [White parts in the graphi of *H. chinensis* (late June and early September) are erroneous, actually represent red clover, not *Viola glypoceras* (noticed in proof).]

Figure. 6 shows the change of thrips assemblage given by percentage ratios in flower species regularly sampled during their bloom. The flower-thrips relation is given as follows:

Taraxacum officinale	*F. intonsa*
Lathyrus maritimus	*A. fasciatus* & *F. intonsa* → *H. chinensis* & *F. intonsa*
Trifolium repens	*H. niger* → *H. chinensis*
T. pratense	*H. niger* → *F. intonsa*
Rosa rugosa	*H. chinensis*
Vicia spp.	*T.* ref. *distalis* → *F. intonsa* → *T. flavidulus*

The relation of *H. chinensis* to *Lathyrus maritimus* is most remarkable. While *H. chinensis* is hardly seen in the first bloom of *Lathyrus*, it becomes predominant in the second bloom, occupying, together with *F. intonsa*, 50–60% of all thrips individuals on this flower, this being partly caused by the disappearance of *Rosa rugosa*.

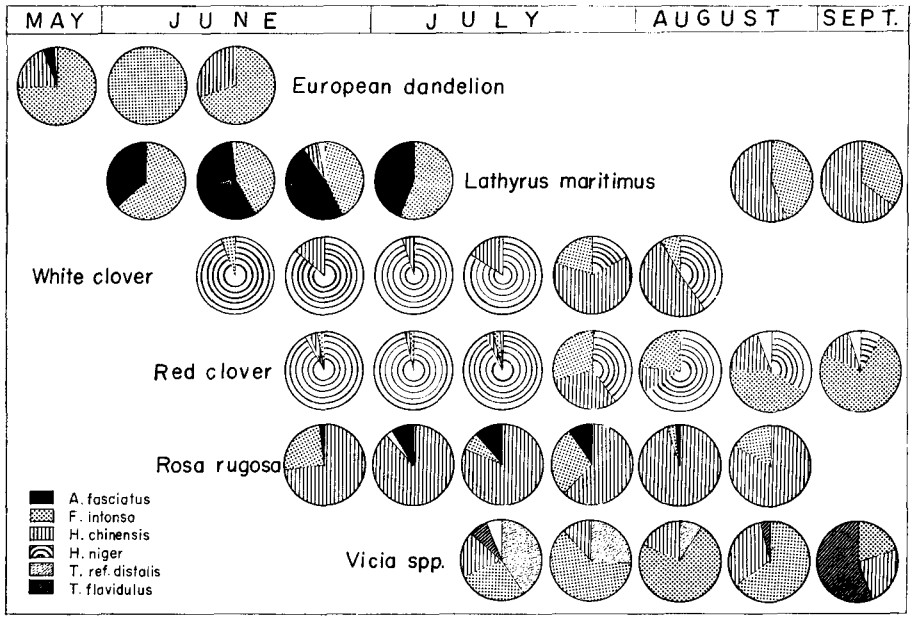

Fig. 6. Phenological sequence of six dominant thrips species in six flower species. (White sectors-non-dominant species).

4. *Frequency distribution of individuals per flower*: The frequency distribution of adult individuals (both sexes combined) per flower or head was examined, all the data being the results of quantitative periodical sampling. The results in three predominant species, i.e., *H. niger*, *H. chinensis* and *F. intonsa* are shown in Tables 2~4, and the same for all species combined, in Table 5.

The degree of clustering was determined by using I_δ index of Morishita (1959) as follows:

Table 2. Frequency distribution of

		Individual number found in											
		0	1	2	3	4	5	6	7	8	9	10	11
White clover	VI *m*	14	4	2	2		3						
	VI *l*	25	3	7	4	4	1	2			1		1
	VII *e*	28	2	4		6	2	1	3			2	
	VII *m*	12	14	2	3	1	1	1		1			
	VII *l*	33	12	3	1			1					
	VIII *e*	12	14	14	4	5	1						
	Total	124	49	32	14	16	8	5	3	1	1	2	1
Red clover	VI *l*	12	2	3	3			1			1		
	VII *e*	8	3	2	3	5	1	1	2	2	4	1	1
	VII *m*	10	10	2	5	4	4	2	4	1	1		
	VII *l*	25	13	4	3	1	1	1	1				
	VIII *e*	8	10	4	7	6	1	1		4	2		
	VIII *l*	22	19	5	1	3							
	IX *e*	41	8	1									
	Total	126	65	22	22	19	7	6	7	7	8	1	1

Cases of flower head with indivudals more than 16, all one head unless mentioned: 23, 26, 33, 36, 46, 47, 53, 64, 77, 92; VII*m*, 16(two heads), 19; VII*l*, 19; VIII*e*,

Table 3. Frequency distribution of

		Individual numbers found in											
		0	1	2	3	4	5	6	7	8	9	10	11
White clover	VI *l*	45		2		2		1					
	VII *e*	45	3	2									
	VII *m*	30	3		1	1							
	VII *l*	21	11	3	4	2	4	1	1		1		1
	VIII *e*	22	12	6	3		2	2		1			
	Total	163	29	13	8	5	6	4	1	1	1		1
Rosa rugosa	VI *l*	36	8	2	1	1		1					1
	VII *e*	21	8	7	5	2	2	3	1	1			
	VII *m*	31	6	3	5	2		1					
	VII *l*	18	8	5	5	3	4	2		1			1
	VIII *e*	7	2	4	2	2	4	3	1	2		1	
	VIII *l*	5	3	2		2	1	2	1	2			
	Total	118	35	23	18	12	11	12	3	6		1	2

Cases of flower or flower head with individuals more than 20: White clover: VIII *l*, 20, 21, 39.

Haplothrips niger in each flower

each flower head							No. of flowers examined	Total No. of individuals	Iδ
12	13	14	15	16–20	21–40	41–100			
							25	29	2.34
		1			1		50	119	3.69
1				1			50	121	3.08
							35	50	2.00
							50	27	2.99
							50	79	1.07
1		1		1	1		260	425	3.35
					1	2	25	170	5.68
1	1	1		2	5	6	50	730	2.92
1		1	2	3			50	229	1.99
				1			50	71	4.75
1	1			3	1		50	227	2.47
							50	44	1.37
							50	10	1.11
3	2	2	2	9	7	8	325	1,481	6.31

White clover: VI*l*, 23; VII*e*, 18; Red clover: VI *l*, 39, 42, 57, VII*e*, 17, 20, 21, 16, 17, 18, 19, 26.

Haplothrips chinensis in each flower

each flower (*Rosa*) or flower head									No. of flowers examined	Total No. of Individuals	Iδ
12	13	14	15	16	17	18	19	<20			
									50	18	9.48
									50	7	4.76
									35	10	7.00
			1						50	105	2.78
					1			1	50	103	4.59
			1		1			1	235	243	6.16
									50	36	6.43
									50	88	1.93
	1							1	50	81	7.31
	1			1		1			50	143	2.67
4	2	1		3	1	1	1	9	50	562	1.93
1		1	1		1			3	25	193	2.25
5	4	2	1	4	2	2	1	13	275	1,103	3.73

VIII *e*, 23; *Rosa rugosa*: VII *m*, 27; VIII *e*, 20, 21, 22, 23, 31, 33, 39, 40, 48;

$$I\delta = n \frac{\sum_{i=1}^{n} fx_i^2 - N}{N(N-1)}$$

where n is the number of flowers or flower heads examined, N is $\sum x_i$, that is, the total of individual numbers sampled and f is the number of flowers or flower heads belonging to the appropriate size group. The index I_δ gives 1, >1 and <1 according to whether the distribution is Poisson or clustered or spaced.

The values of I_δ given in the tables show in most cases the clustered distributions. Exceptions are: Poisson: *H. niger* (white clover, early August; red clover, early September), *F. intonsa* (*Rosa rugosa*, early August); Spaced: *F. intonsa* (red clover, late June & early July; *R. rugosa*, early July). In general I_δ becomes higher in parallel with the increase of individual numbers. The relations between males and females, as well as adults and larvae, will be discussed elsewhere.

5. *Diurnal activity*: Diurnal activity of *Haplothrips chinensis* was observed on *Rosa rugosa*, using ten flowers found within about 3×3 m. sq. The individual numbers of thrips on flowers and on the other parts were separately counted every 2 hours strating from August 10, 1969 at 8:00 in the morning until seven o'clock the next day morning. Although the observation is still of a preliminary nature, the result given in Fig. 7 shows the following tendency.

The individuals on flowers increase in the daytime with active movements but decrease in the morning and evening. At night many individuals are resting on parts other than flowers, especially at the joints of the leaves and stalks. The activity is highest in the forenoon, and movements are very quick between 9:00–12:00, with characteristic raising of their abdominal tips. Further, a mating like behaviour is often observed during these hours: When a male and a female come to face to face, the former gets on the latter and the both move their abdomens, though actual copulation was never seen. In this observation, the smaller individual, which always gets on the larger, was regarded as the male, because the sexes are not so clearly recognized as in the species of the suborder Terebrantia.

In the afternoon, this activity is less intensive than in the forenoon. The movements on petals become slow. Even though many individuals still remain on flowers, they tend to congregate in and around androecia without making any movement.

Concluding Remarks

In spite of the importance of thrips as phytophagous insects, from both the scientific and economic points of view, their biology and ecology have so far relatively been neglected in comparison with other insects. In Japan, there has not been published any work dealing with the quantitative analysis of the local

Table 4. Frequency distribution of *Frankliniella intonsa* in each flower

		Individual numbers found in each flower or flower head											No. of flowers examined	Total No. of individuals	Iδ
		0	1	2	3	4	5	6	7	8	9	10	>10			
Lathyrus maritimus	VII *e*	39	7	2	2									50	17	2.94
	VII *m*	38	7	4	1									50	18	
	VII *l*	41	6	1		2								50	16	2.29
																5.42
	VIII *e*	24	6	6	7	2	3	1	1					50	75	1.89
	VIII *l*	9	5	3	2	2							4	25	74	2.77
	IX *e*	11	5	2	1	1	1			1		1	2	25	66	3.14
	Total	162	36	18	13	7	4	1	1	1		1	6	250	266	4.05
Red Clover	VI *l*	20	5											25	5	0.00
	VII *e*	45	5											50	5	0.00
	VII *m*	43	6	1										50	8	1.79
	VII *l*	22	10	11	4	3								50	56	1.33
	VIII *e*	23	13	4	2	2	1	3				1	1	50	79	2.87
	VIII *l*	29	13		2	2	1		2	1				50	54	3.55
	IX *e*	21	12	5	2	3	2		1	2			2	50	96	2.71
	Total	203	64	21	10	10	4	3	3	3		1	3	325	303	4.01
Vicia spp.	VII *m*	42	7	1										50	9	1.39
	VII *l*	25	15	2	3	4			1					50	51	2.20
	VIII *e*	6	13	5	3	10	4	1	3		2		3	50	178	1.68
	VIII *l*	10	11	6	5	1			2				5	40	120	2.52
	IX *e*	20	4	3	2	1								30	20	2.37
	Total	103	50	17	13	16	4	1	6		2		8	220	378	3.25
Rosa rugosa	VI *l*	41	7	2										50	11	1.82
	VII *e*	47	3											50	3	0.00
	VII *m*	45	3	1	1									50	8	7.14
	VII *l*	22	14	7	3		2		1				1	50	68	3.25
	VIII *e*	36	11	3										50	17	1.10
	VIII *l*	13	4	4	1		1			1			1	25	41	3.72
	Total	204	42	17	5		3		1	1			2	275	148	6.82

Cases of flower or flower head with individuals more than 11: *Lathyrus maritimus*: VIII *l*, 11, 12 (two heads), 14; IX *e*, 11, 16; Red clover: VIII *e*, 11: IX *e*, 11, 12; *Vicia* spp.: VIII *e*, 11, 15 (two heads); VIII *l*, 11, 12, 13, 14 (two heads) ; *Rosa rugosa*: VIII *l*, 14; VIII *l*, 13.

Table 5. Frequency distribution in

		Individual numbers found in											
		0	1	2	3	4	5	6	7	8	9	10	11
Lathyrus maritimus	V *e*	34	8	5	3								
	V *m*	27	11	8	2	1		1					
	VI *l*	30	11	5	1	3							
	VII *e*	17	5	3	5	5	5	3	3		1	3	
	VIII *l*	7		3	2	3		2		1	2		
	IX *e*	3		6	1	2			1	2	2	1	
	Total	118	35	30	14	14	5	6	4	3	5	4	
White clover	VI *m*	13	4	3	2		3						
	VI *l*	24	2	8	4	3	1	2		1	1		1
	VII *e*	28	2	3		4	4	2	3			2	
	VII *m*	10	14	4	3	1	2		1				
	VII *l*	12	11	8	2	3	3	3	1	2	2		
	VIII *e*	8	6	13	5	3	2	4	2	2	1	1	1
	Total	95	39	38	16	14	15	11	7	5	4	3	2
Red clover	VI *l*	10	3	2	1	2	1	2		1			
	VII *e*	4	5	4	2	6	2	1	1		5	3	
	VII *m*	8	9	4	5	4	3	3	1	4		1	1
	VII *l*	9	11	3	3	11	3	3	1	1		2	
	VIII *e*	5	8	3	5	5	4	1		4	2	2	2
	VIII *l*	13	12	7	4	5	3	1	1		2		1
	IX *e*	12	13	6	7	5	2			2			1
	Total	61	61	29	27	38	18	11	4	11	10	8	5
Rosa rugosa	VI *l*	32	8	3	4		1	1					
	VII *e*	18	11	5	4	2	4	3	2	1			
	VII *m*	23	13	2	2	6	1	1					
	VII *l*	8	8	8	4	4	3	4	1	2	1	2	
	VIII *e*	3	5	2	5	2	2	2	4	1	1	1	
	VIII *l*	5		2	1	1	2	2	1	2	1		
	Total	89	45	22	20	15	13	13	8	6	3	3	

Cases of flower or flower head with individuals more than 31, all one flower or 16 (two heads), 18, 19; White clover: VI*l*, 15, 23; VII*e*, 18; VI*e*, 18; VIII*l*, 16(two 36, 37, 46, 49, 53, 65, 77, 92; VII*m*, 15 & 16 (two heads), 19; VIII*l*, 15, 24; VIII*e*, 17, 17(three flowers), 18, 19, 21 (two flowers), 22, 23, 32, 34, 40, 41, 51; VIII*l*, 15, 20, 22

each flower (all species combined)

each flower or flower head						No. of flowers examined	Total No. of individuals	Is
12	13	14	15–20	21–30	>30			
						50	27	1.99
						50	43	1.94
						50	36	2.06
						50	149	1.71
		1	2	1	1	25	169	2.21
1	1		5			25	183	1.53
1	1	1	7	1	1	250	607	3.94
						25	31	2.10
		1	1	1		50	139	3.37
	1		1			50	128	2.96
1							72	1.64
	1		2			50	50	1.67
			1	1		50	196	2.23
1	2	1	5	2		260	722	2.71
					3	25	185	5.01
1		2	2	4	8	50	766	2.75
1		1	5			50	248	1.84
		1	1	1		50	191	1.42
2		2	3	1	1	50	342	2.11
			1			50	130	2.07
	1	1				50	130	2.13
4	1	7	12	6	12	325	1,992	3.93
1						50	49	4.51
						50	101	1.82
	1				1	50	104	6.30
	1		3		1	50	238	2.33
2	3	1	7	4	5	50	590	1.89
1		1	2	3	1	25	233	1.98
4	5	2	12	7	8	275	1,315	2.09

head unless mentioned: *Lathyrus maritimus*: VIII*l*, 17 (two heads) 22, 37; IX*e*, 15, heads) VIII*e*, 20, 29; Red clover: VII*l*, 42, 57; VII*e*, 15, 18, 22, 23 (two heads), 29, 18, 19, 29, 40; VIII*l*, 15; *Rosa rugosa*: VII*m*, 33; VIII*l*, 15, 17, 31; VIII*e*, 15, 16, (three flowers), 41.

thrips assemblage in relation to food plants. The present study is the first outcome of an attempt to fulfill this lack of information, and the relative abundance, phenology and flower preference in two localities in and near Sapporo, Hokkaido, Northern Japan, were presented. As mentioned in the taxonomic study published previously (Kudô, 1970), a greater number of species is expected from the area concerned, and from Hokkaido in general. Nevertheless, the present study shows the presence of a more or less definite structure and phenology of the thrips assemblage, with a limited number of dominant species, such as *Chirothrips manicatus*, *Frankliniella intonsa*, *Haplothrips niger* and *H. chinensis*, each with characteristic flower preference, either wide as in *F. intonsa*, or narrow and specialized to legumes as in *H. niger* and *Taeniothrips* ref. *distalis*. To give a precise picture of the local thrips assemblage, further accumulation of various data is necessary. The present study may be regarded as a basis for such studies in the future.

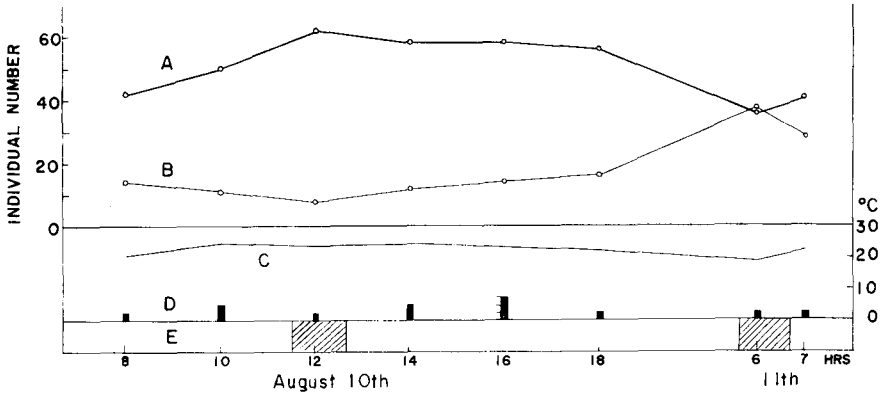

Fig. 7. Diurnal activity of *Haplothrips chinensis* on *Rosa rugosa* observed on 10-11th August, shown with individual numbers on flower (A) and on the part except flower (B). C. Air temperature. D. Wind class (*cf.* Fig. 1). E. General weather condition (*cf.* Fig. 1).

Summary

Relative abundance, phenology and flower preference of thrips were studied, based upon the periodical sampling on flower made at Bannaguro in Ishikari and partly at the campus of the Hokkaido University, with the following results.

1) Out of a total of 5,473 individuals belonging to 11 species sampled, the most predominant species are *Haplothrips niger* and *H. chinensis* (both 35% of total individuals) followed by *Frankliniella intonsa*. These dominant species occupy 93% of the total individuals.

2) The active period of adult thrips in the area is from late April to late October. The thrip season in the area is devided into two distinct phases, the

spring-summer phase consisting of *Aeolothrips fasciatus* and *Haplothrips niger* and the summer-autumn phase of *Frankliniella intonsa* and *Haplotrhips chinensis.*

3) As to the specific difference in flower preference, most specimens were obtained from a limited number of flower species; among these species, European dandelion, *Gagea lutea* and *Arabis japonica* are important in spring, while legumes, especially red clover, and *Rosa rugosa* in summer.

4) The frequency distribution on flower showed a clustered distribution in most cases analysed.

5) Diurnal activity studied with *Haplothrips chinensis* showed the movement from flower to leaves or stalks in the evening and the opposite movement in the morning, with the highest activity between 10:00–12:00.

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Postscript: The species previously reported (Kudô 1970) as *Taeniothrips* ref. *distalis* Karny was found to be *Odontothrips loti* Haliday out of the best intentions of Dr. K. Sakimura in Hawaii. Therefore *T.* ref. *distalis* of the present paper is also *O. loti* Haliday. This was the first record of the genus from Japan.