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MORPHOLOGICAL SPECIES VARIABILITY IN THE STEM-BORER GENUS *Scirpophaga*, (LEPIDOPTERA: PYRALIDAE) ON GRAMINEOUS CROPS

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Abstract

The objective of this study is to observe variations between and within species using morphometry. Collections of Scirpophaga *were carried out at rice fields in the Northern Coastal area of Java (Pantura): Kerawang, Cikampek, Indramayu, Cirebon, at sugar-cane plantations in Yogyakarta and Pasuruan and various gramineous crops in areas of South Bandung and Lampung from March 1998 to March1999. Identification was done using morphology of adult characters. Variation within the population groups are recognized by taking measurement of parts of the head, for example measurement of the length and width of the head. Other characters used in keying adult Lepidoptera to family are those of wing venation. Also the morphology of male genitalia were used as main characters to differentiate species Results from this studies shown that: a)* Scirpophaga innotata. *Measurement of parts of the head from sample collected showed very little variation, thier were mentioned as a group. Variation based on wing size, length and width of forewing can be divided into two groups sizes; the large group size (950 – 1025 mm/100) and the small group size (850 – 860mm/ 100). Variation based on the size of male genitalia were more varied in ranging; between 20 – 26mm /100 in length and 23 – 35 mm / 100 but they can be put into one group. b)* Scirpophaga incertulas. *Measurement of parts of the head show little variation in the scattered diagram distribution, and is considered as the same population group. Variation based on wing size, length and width of forewing collected from various places in Java indicated that populations of this insect does not indicate any differences in term of types of wing venations and considered as similar populations. Variation based on the size of male genitalia seemed to the same group in the scattered diagram. c)* Scirpophaga excerptalis *Measurement of parts of the head (the length and width of the head) considerd as one population. Variation based on the size of male genitalia seemed to the same group in the scattered diagram.*

Introduction

Two species of stem borers viz. *S. incertulas* or yellow stemborer (YSB), *S. innotata* or white stemborer (WSB) are notoriously known to cause severe damage to mature paddy grown in the northern part of Java since 1912 (Dammerman, 1915). Outbreak of stem-borers on rice field in the northern part of West Java remains to occur despite the fact that various method of control measures. One of the factors which causing this failure lies in the miss-identification of the insect species and our failure to recognize the rich diversity of insect fauna in tropical agroecosystems. The identifications of stem borers to species level have been largely done using conventional characters of adults and the morphology of -earlier stages. Because of external morphological similarity among the species in this group, the identities of the various species in this genus become been very confusing.

The revision of rice stem-borers of the genus *Scirpophaga* in Indonesia, has been conducted by Hattori and Siwi in 1977, revealing that only 6 species have been

recognized i.e. *Scirpophaga incertulas (Walker); S. innotata (Walker); Chilo suppressalis (Walker); C. polychrysus (Meyrick)* and *C. auricilius Dudgeon* and *Sesamia inferens (Walker)* (Hattori & Siwi, 1986). From the existing 6 species of stem borers, only two species are members of sub-family Schoenobiinae, genus *Scirpophaga* that are represented as material of this study. Population of a single species occurring in different habitats in the same region are often visibly different The phenotype of animal population of the same species often varies according to locality, season or habitat (Mayr, 1969).

The need for taxonomic revision of the species has become timely since it was observed that the species might be develop a lot of variations depending on places of distribution and time (Mangoendihardjo *et al.*, 1995). Special measurements are traditionally given in particular taxonomic group. For comparative purposes it is important to give measurements that conform the system which is customary in the group under study. An adequate sample is imperative to allow a reasonable analysis of the total variation of a species. (Mayr, 1969).

The objective of this study was to observe variations between and within species using Parsimony test.

Material and Methodology

Collecting of *Scirpophaga* were carried out at rice fields in the Northern Coastal area of Java (Pantura) : Kerawang, Cikampek, Indramayu, Cirebon, at sugar-cane plantations in Yogyakarta and Pasuruan and various gramineous crops in areas of South Bandung and Lampung from March to August 1998. Specimen were collected using light trap and sweep net.

Identification was done based on the morphology of adult characters. Variation within the population groups are recognized by taking measurement of parts of the head (for example measurement of the length and width of the head), wing size(forewing length), and the morphology of male genitalia. To understand the species complex Parsimony test was conducted to study variation within species. The sample of genus *Scirpophaga* collected were presented in the table about species distribution and abundance in Java and Lampung during the surveys on March to Agust 1998.

Result and Discussion

Based on the observation on specimens collected, a lot of variations of *Scirpophaga* occured from various location in head size, wing size and character of male ganetalia

1. Analysis of variations of *Scirpophaga* based on head size, head length and width

Study on species variation using such characters is often very difficult, because of the similarity of characters in a population. Variation within the population groups

are often easily recognizable by taking measurement of parts of the head, such as measurement of the length and width of the head. Study on variation of *Scirpophaga* sp. At population level based on the measurement of the length and width of the head, revealed that there variation in the size of the head was an considerable:

1.1. ***Scirpophaga innotata*** population collected from Lohbener (see Table 1 code no. 9804002), Pasindangan (code no 9804003), Srengseng (code no 9804004) and Tanjung (Brebes) (code no 9804005) showed very little variation. Scattered diagram for head length and width of all population of the species indicated as one group (Figure 1).

1.2. ***Scirpophaga incertulas*** collected from Indramayu and Pekandangan (Table 2 code no. 9806007) are of the same population, but population from Tegalwaru, Cimalaya, Kerawang, Bandung is different to that of Indramayu and Pesindangan (Figure 2). The similarity of head size of *S. incertulas* population collected from Yogyakarta (Table 3 code no. 980701, 980702,980704, 980705) to that of Indramayu are considered as being one population, while the Garut (Table 1 code no. 984009) Ciasem (code no.9804001) and code no.771103 populations exhibit little variation in head size as shown in the scattered diagram distribution, and considered being of the same population group. The group collected from Yogyakarta and Indramayu (head length 100-130 mm/100, width 160-180 mm/100), are different in head size from Garut, Ciasem and Lampung (code no.771103) populations (head length 70-90 mm/100, width 125-155 mm/100) as shown in scattered diagram distribution (Figure 3).

1.3. ***Scirpophaga excerptalis*** collected from Pasuruan showed small variation in the size of the head capsule, ranging between 90 - 125 mm/100 in length, and 160-190 mm/100 in width scattered diagram of the length and width of the head is very uniform, this considered as being one population group (Figure 4).

2. Analysis of Scirpophaga group based on wing size, length and width of forewing

2.1. ***Scirpophaga innotata.*** Specimens of *S. innotata* collected from Pakandangan (Indramayu) indicated higher variation. They can be divided into two groups sizes, the larger size group with the wing length ranged between 950 and 1025 mm/100, and the small size group with the wing length ranged between 850-860 mm/100. *Scirpophaga innotata* collected from Cipeuyeuh (Lemabang, Cirebon, West Java (Table 2 code no.9806010) were present within the distribution of the large size group of Pekandangan, Indramayu (Figure 5). The specimens of *Scirpophaga innotata* collected from Panyindangan Wetan of Indramayu (Table 2 code no.9806005) showed higher variation in the forewing sizes, almost similar to that of specimens from Pakandangan . Two groups of population sizes were indicated, the large (forewing length 950-1025 mm/100) and the small size

population (forewing legth ranged between 850-900 mm/ha) (Figure 6). Overlay figure 6 and 5 indicated similar pattern in the length and width of the insect's forewings. *Scirpophaga innotata* collected from Lohbenner (Table 1 code no. 9804002), Pasindangan (code no. 9804003) and Srengseng (code no. 9804004) from the region of Indramayu were present in a small group. The same was true for the specimens collected from Pakandangan (Table 2 code no. 9806007) and Panyindangan Wetan (code no. 980605) they were represented by the small size group.

White stemborer showed marked variation in wing size. The larger specimen of male and female have the forewing length between 13.5 - 16 mm, while the smaller specimens with the forewing length 11 - 13 mm.

2.1. ***Scirpophaga incertulas***. Specimens of *S. incertulas* collected from various places in west Java indicated that populations of this insect from north coast of West Java and Garut did not indicate any differences in term of types of wing venations. However, observation of specimens from various populations showed differences in size of the forewings. The length and width of the forewings are of various in size. The specimens collected from Lohbener (Table 1 code no.9804002), Pasindangan (Indramayu) (code no.9804003) and Serengseng (Indramayu) (code no.9804004) indicated little varition in the length and width of the forewings, ranged between 875-9500 mm/100 (Figure 7). The populations from the above places were considered as similar populations. The specimens of *S. incertulas,* despite the above morphological characters, populations collected from various sites were indicated to show marked variation in the wing size. *S. incertulas* collected from Yogyakarta, Indramayu and 771103 with the forewing are of homogenous in size, ranged between 1150 - 1325 mm/100 in length, and 300 - 400 mm/100 in width. They can be put together as similar variation of a large group. The smaller size group with the forewings between 1000 - 1100 mm/100 in length and 300 - 400 mm/100 in width are *S. incertulas* which were collected from Garut and Ciasem (Figure 8).

2.3. ***Scirpophaga excerptalis***. The population *Scirpophaga excerptalis* collected from Pasuruhan, although its morphological characters look very similar, are of various in wing size. They can be divided into two groups, the large group and the small group. The large group has the wing size of 1250 - 1325 mm/100 in length, 300 - 475 mm/100 in width; while the smaller group with the wing size of 1100 - 1200 mm/100 in length, 325 - 400 mm/100 in width (Figure 12). The Specimens of *S. excerptalis* collected from Jatitujuh, Cirebon were also very varied in its wing size. They can also be divided into two groups. The large group with the wing size ranged between 1280 - 1460 mm/100 in length; and 380 - 450 mm/100 in width. The small group with the wing size ranged between 1130 - 1210 mm/100 in length; and 375 - 400 mm/100 in width (Figure 13).

While S. excerptalis collected from Pasuruan, although its morphological characters look very similar, they can be divided into two groups, the large and small group. However S. eccerptalis from Jatitujuh, Cirebon falls into similar distribution.

3. Analysis of *Scirpophaga* based on characteristic of Male genitalia

Analysis of species variation based on the size of male genitalia, i.e. length and dth of the subteguminal process.

3.1. *Scurpophaga innotata* versus *Scirpophaga incertulas*. The male genitalia of *Scirpophaga innotata* is similar to *S. incertulas*, the only difference is that the subteguminal process of *S. innotata* is single spine, while in *S. incertulas* is bifid spine. However, when studying the male genitalia of this species, it can be seen that the size of subteguminal process within and between the populations are often different. The length and width of the subteguminal process of male genitalia of *Scirpophaga innotata* is much smaller in size than that of *S. incertulas*. The size of subteguminal process of *S. incertulas* collected from Garut (9804009), Ciasem (9804001) and Indramayu were not varied. From the scattered diagram they can be put into one group (Figure 9).

3.2. *S. innotata*. The size of subteguminal process of *S. innotata* collected from Lohbener (9804002), Muara Baru (9804003), Jatisari (9804004) and Panyindangan Wetan (9804005) were almost similar, ranges between 20-26 mm/100 in length, and 23 - 35 mm/100 in width. All of the population can be put together into one group. However variation in size of subteguminal process of *S. innotata* collected from Panyindangan Wetan (9806005) were more varied than that of other populations (Figure 10). The size distribution of subteguminal process of male genitalia of *S. innotata* collected from Indramayu, (9806007) and Cipeyeuh, Cirebon (9806010) falls into the same category (Figure 11). But they can be put together into the same group with those populations from Lohbener, Muara Baru, Jatisari and Panyindangan Wetan.

3.3. *S. incertulas*. The size of subtegumental process of those from Garut, Ciasem and Indramayu seemed to the same group in the scattered diagram distribution with that of the size of the specimens from Lohbener, Muara Baru, Jatisari and Panyindangan Wetan, as it is seen in the overlay scattered diagram.

3.4. *Scirpophaga excerptalis*. The size of subtegumenal process of *S. excerptalis* population collected from Pasuruan turned out to be varied. It is seen from the scattered diagram that the population can be divided into two groups, the larger size group with the subteguminal process of 52 - 58 mm/100 in length, and 56 - 60 mm/100 in width; and the samaller size with subteguminal process of 46 - 55 mm/100 in length and 46-56 mm/100 in width (Figure 14). The size of subteguminal process of male genitalia of *S. excerptalis* collected from Jatitujuh, Cirebon (9806011) (Figure 15) falls into the same distribution size as it is seen in the scattered diagram.

Table 1. Species distribution and abundance of genus *Scirpophaga* in Java during the surveys on March to April 1998.

Code	Collection date	Location/Vill./ District/ Province	SPECIES of *Scirpophaga* Inc M F	inno M F	excerp M F	others M F	Explanation Host Plant
9803001	24-25/3/98	Pasuruan, East Java			1 3		Sugar-cane
9804001	21/4/98	Ciasem, Subang, West Java	1 13				Light trap On rice
9804002	21/4/98	Lohbener, Indramayu, West Java		60			Light trap Accurate identification is being done
9804003	21/4/98	Pasindangan, Indramayu, West Java		33			Light trap on rice, accurate identification is being done
9804004	22/4/98	Srengseng, Indramayu, West Java		1			Hand picking on rice
9804005	22/4/98	Tanjung, Cilaku, Brebes Central Java		1			Hand picking on rice
9804006	22/4/'98	Kabunan, Taman, Pemalang, Central Java	2 21	3			
9804007	23/4/98	Ngemplak, Undakan, Kudus, Central Java	2 1				On rice
9804008	23/4/98	Kepanjen, Tulung, Klaten, Central Java	1 1				
9804009	24/4/98	Cigagak, Limbangan, Garut, West Java	4			2	Light trap on rice, accurate identification is being done
9804010	25/4/98	Sukamaju, Cianjur, West Java	0 0	0 0	0 0	0 0	After harvest

Note: Inc=Incertulas; Inno= Innotata; excerp=excerptalis; others = stemborer other genus

Table 2. Species distribution and abundance of genus *Scirpophaga* in Java and Lampung during the survey on May to June 1998.

Code	Collection Date	Location/ Village/District/ Province	Species of Scirpophaga Inc M	Inc F	inno M	inno F	excerp M	excerp F	others M	others F	Explanation Host Plant
9805001	14/5/98	Trimurjo, Metro Central Lampung		20							Light trap on rice
980501	17/5/98	Donokerto, Turi, Sleman, Yogya, DIY	Sesamia								Sample from UGM
980502	18/5/98	Trucuk,Bantul Yogya	2 Sesamia							7	Sample from UGM
980503	1/6/98	Yogya, DIY		3							Sample from UGM
980504	18/5/98	Yogya, DIY						1		1	Sugarcane, Anal-tuft yellow
980605	8/6/98	Cipeucang, Cilengsi, Bogor, West Java		5			1				From larvae of white-head stems
9806001	15/6/98	Tegalwaru, Cilamaya, Karawang, West Java					1				Light trap on rice
9806002	15/6/98	Sukamandi, Ciasem, Subang, West Java		36			2				
9806003	15/6/98	Muara Baru, Cilamaya, Karawang, West Java	8	53	16	47					Light trap on rice, Variations: size,wings black dot and colour
9806004	15/6/98	Panyuluh Utara, Jatisari, Karawang, West Java	2	21		2					Light trap
9806005	16/6/98	Panyindangan wetan, Indramayu, West Java			16	18					Light trap
9806006	16/6/98	Sindangkerto, Lohbener, Indramayu, West Java			16	18					Light trap

Table 2. Continued ...

Code	Collection Date	Location/ Village/District/ Province	Species of Scirpophaga Inc M F	inno M F	excerp M F	others M F	Explanation Host Plant
9806007	16/6/98	Pekandangan, Indramayu, West Java			92 28		Big size, Small size
9806008	16/6/98	Karanganyar, Indramayu, West Java	0 0 0	0	0	0 0 0 0	
9806009	17/6/98	Panyindangan wetan, Indramayu, West Java	Larvae Sesamia 1				Sample collected from "white heaf" stems
9806010	17/6/98	Cipeuyeuh, Lemahabang, Cirebon, West Java	13		2		Variations on samples collected
9806011	18/6/98	Jatiraga, Jati Tujuh, Cirebon, West Java			36	13 16	Light trap on sugar-cane plantation, closed with rice field. Found variations on samples
9806012	19/6/98	Cisurat, Darmaraja Sumedang, West Java	Larva Sesamia				"white head" stem
9806013	19/6/98	Bumi seurih, Malangbong, Sumedang, west Java	Larva (7)				"white head" stem
9806014	24/6/98	Kalensari, Wedasari, Indramayu, West Java	Larva(3)	Larva(24)	Chilo polychrysus		"white-head stem
9806015	25/6/98	Pekandangan, Indramayu, West Java			Sesamia inferens		99% this species collected from "white head "stem

Note: Inc=Incertulas; Inno= Innotata; excerp=excerptalis; others = stemborer other genus

Table 3. Species distribution and abundance of larvae genus *Scirpophaga* in Java during the surveys, July to August 1998, collected from the "white head" stem.

Code	Collection date	Location/Vill./ District/ Province	Species of stem borer genus *Scirpophaga* Larvae Inc	inno	excerp	others	Explanation Host Plant/ variety
980701	18/7/98	Sayegan/ Sleman, Yogya DIY	3	0	0	*Sesamia Chilo*	Cisadane
980702	18/7/98	Sayegan/ Sleman, Yogya DIY	14			*Sesamia Chilo*	Bogowonto
980703	18/7/98	Sayegan/ Sleman, Yogya DIY	0			*Sesamia*	IR 64
980704	18/7/98	Moyudan, Sleman,Yogya DIY	22			*Sesamia*	Cisadane
980705	21/7/98	Godean, Yogya DIY	12			*Sesamia Chilo*	
980801	3/8/98	Ujung Aris, Wedasari Indramayu West Java	29	36		*Chilo Sesamia*	
980802	4/8/98	Sindangkero, Lohbener, Indramayu, West Java	7	60		*Chilo*	IR 64
980803	4/8/98	Cisitu, Malangbong, West Java	1			*Sesamia*	Red rice

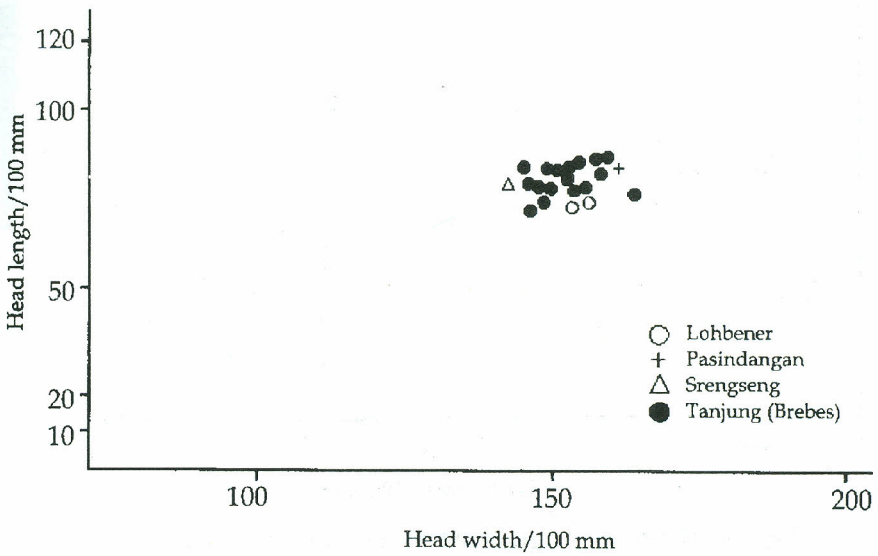

Figure 1. Scattered diagram of head size distribution of *S. innotata* in Lohbener, Pasindangan, Srengseng and Tanjung (Brebes).

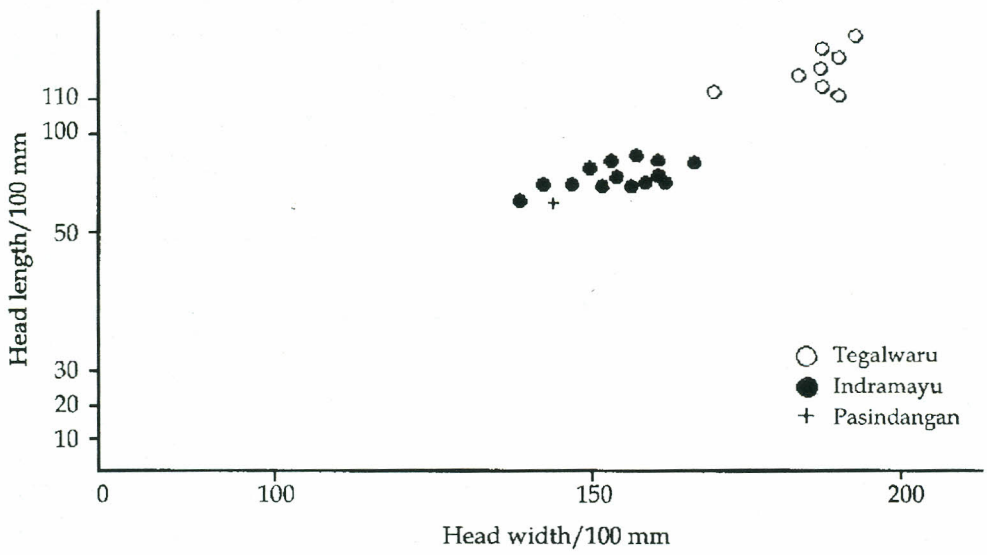

Figure 2. Scattered diagram of head size distribution of *S. innotata*.

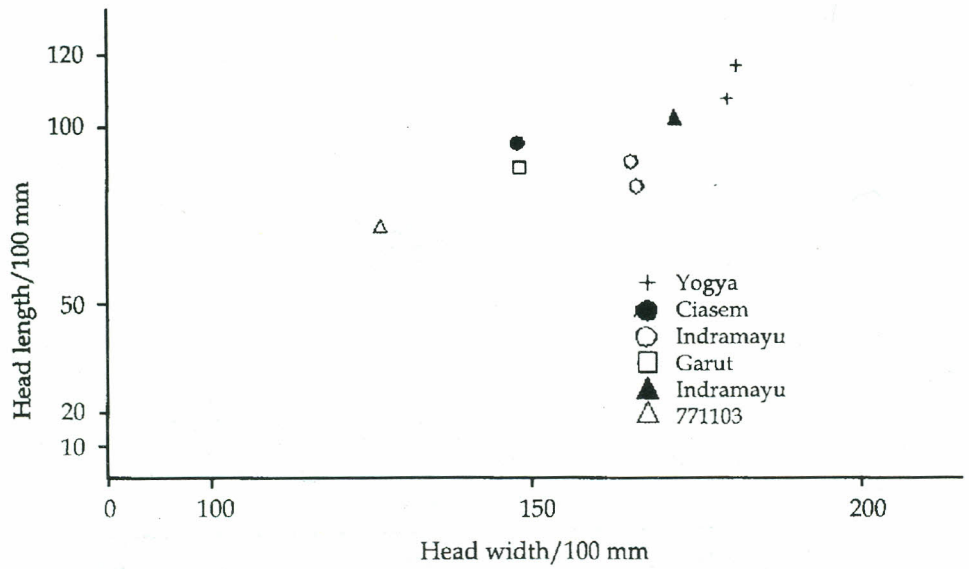

Figure 3. Scattered diagram of head size of *S. incertulas*.

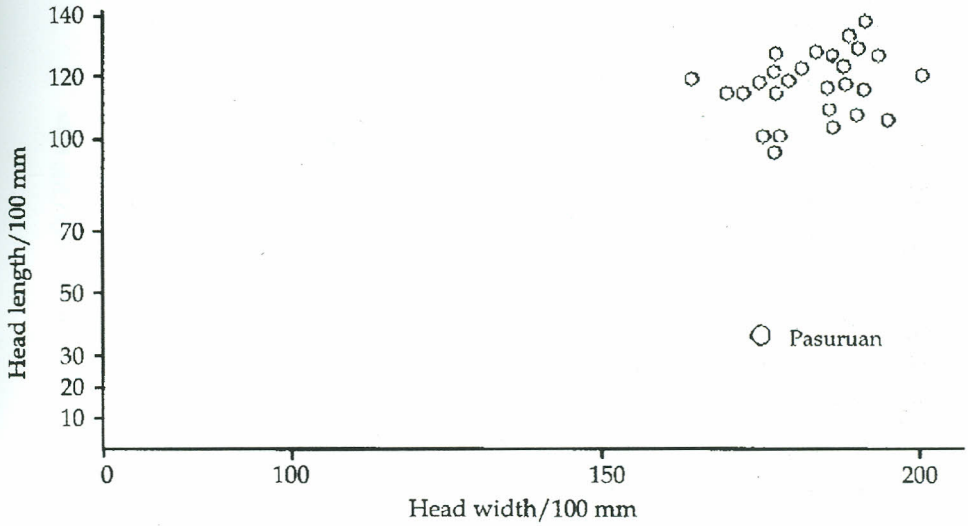

Figure 4. Scattered diagram of head size variation of *S. exerptalis of* Pasuruan.

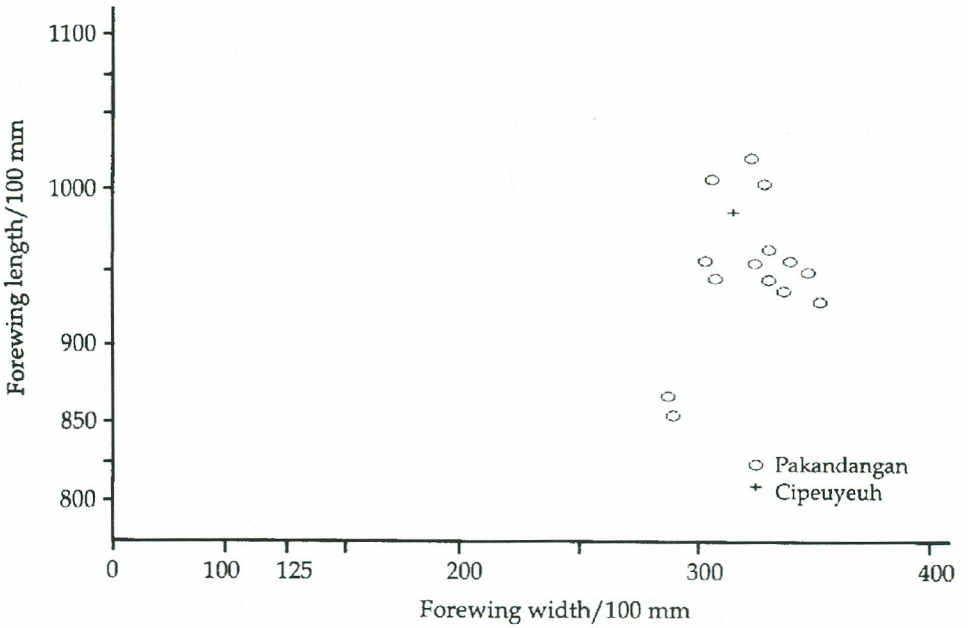

Figure 5. Scattered diagram of forewing size distribution of *S. innotata* collected from Pakandangan and Cipeuyeuh.

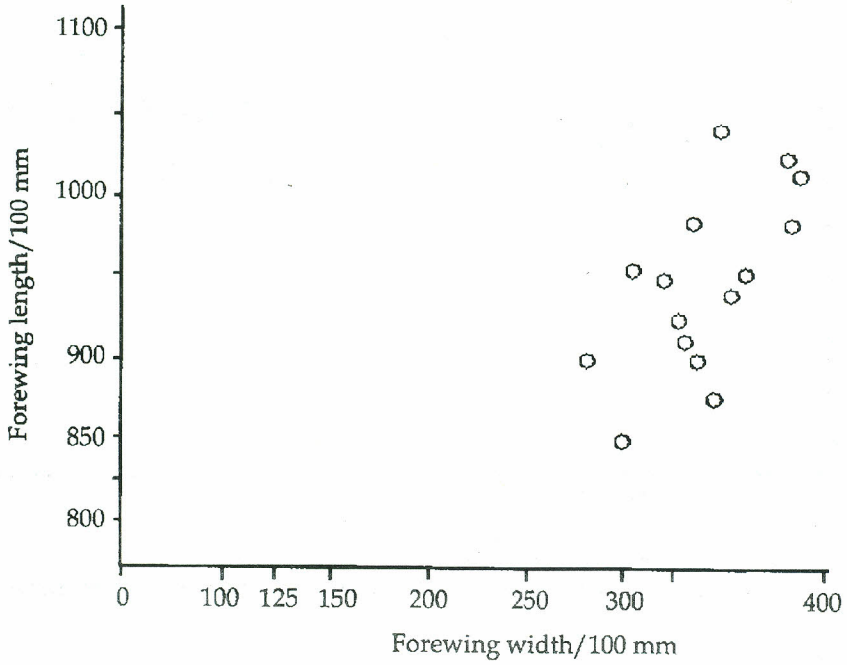

Figure 6. Scattered diagram of forewing size distribution of *S. innotata* collected from Panyindangan Wetan.

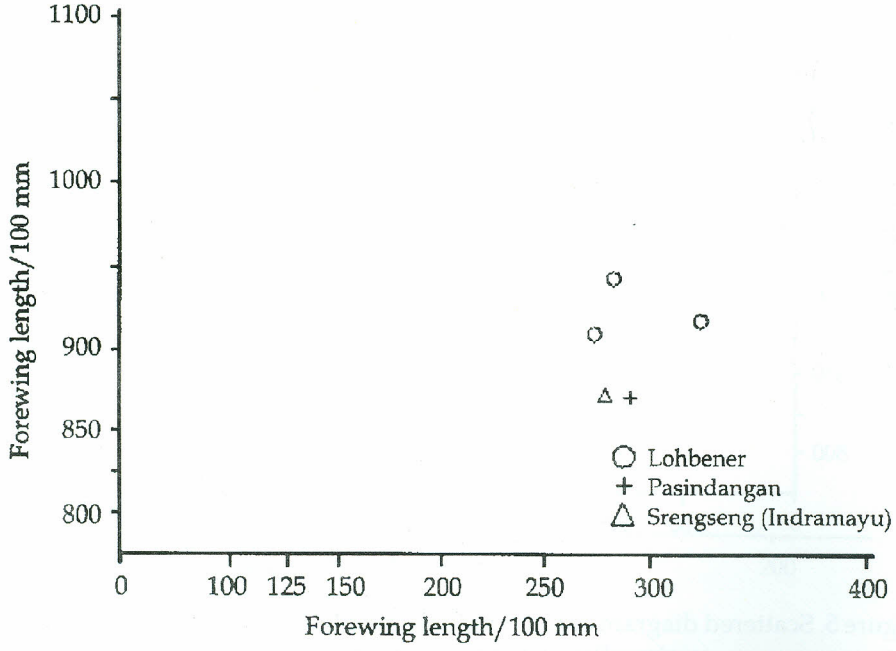

Figure 7. Scattered diagram of forewing size distribution of *S. incertulas* collected from Lohbener, Pasindangan and Srengseng.

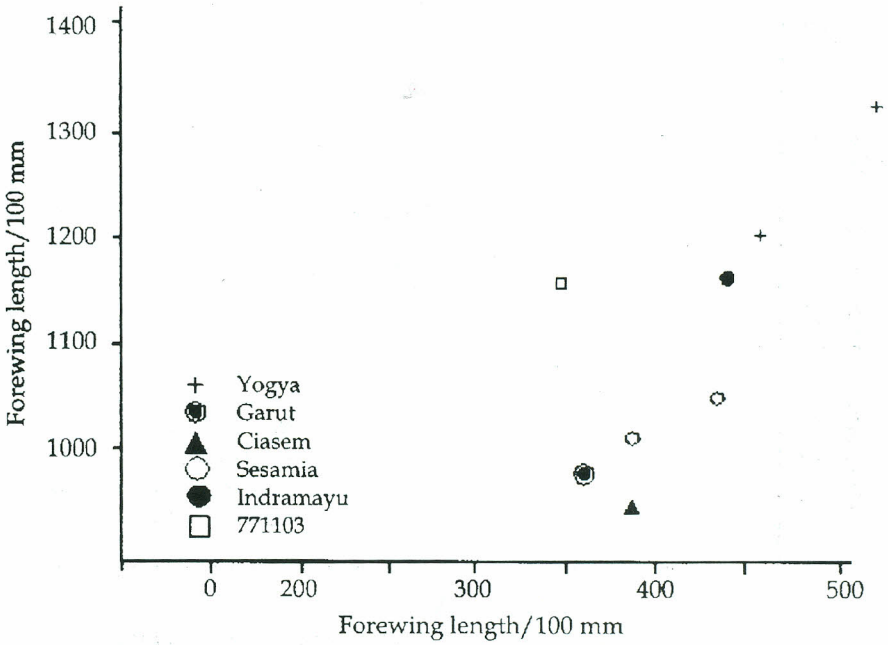

Figure 8. Scattered diagram of forewing size distribution of *S. incertulas* collected from Yogyakarta, Garut, Ciasem, Indramayu and 771103.

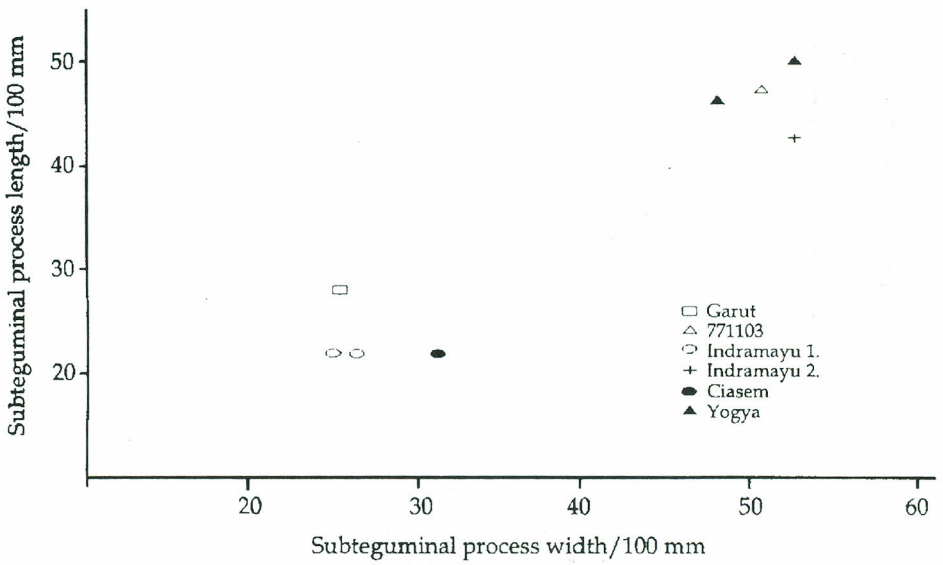

Figure 9. Scattered diagram of subteguminal process of *S. innotata* from Garut, Indramayu, Ciasem and Yogyakarta.

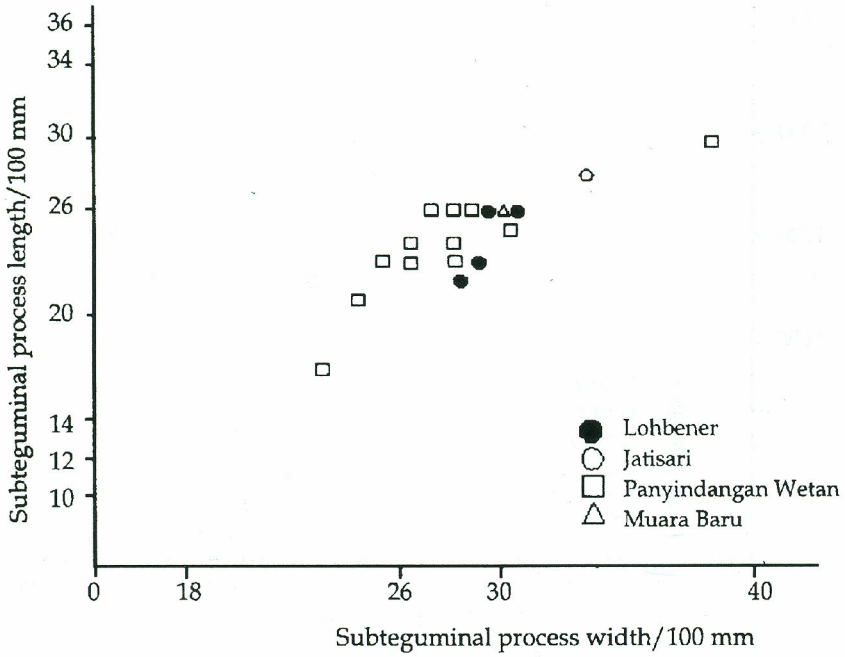

Figure 10. Scattered diagram of the size of subteguminal process of *S. innotata* from Lohbener, Jatisari, Panyindangan Wetan and Muara Baru.

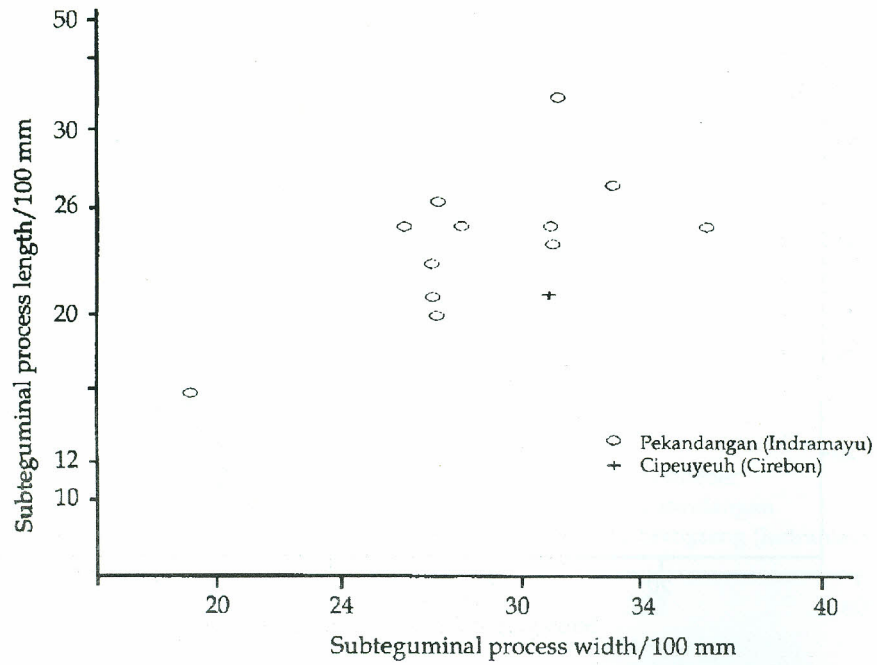

Figure 11. Scattered diagram of subteguminal process of *S. innotata* collected from Indramayu and Cipeuyeuh.

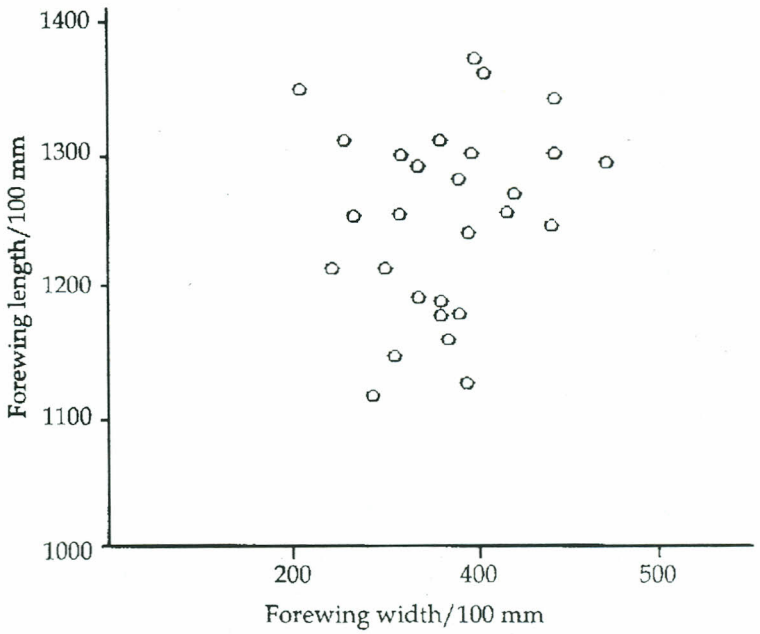

Figure 12. Scattered diagram of the forewing size variation distribution of *S. excerptalis* collected from Pasuruan.

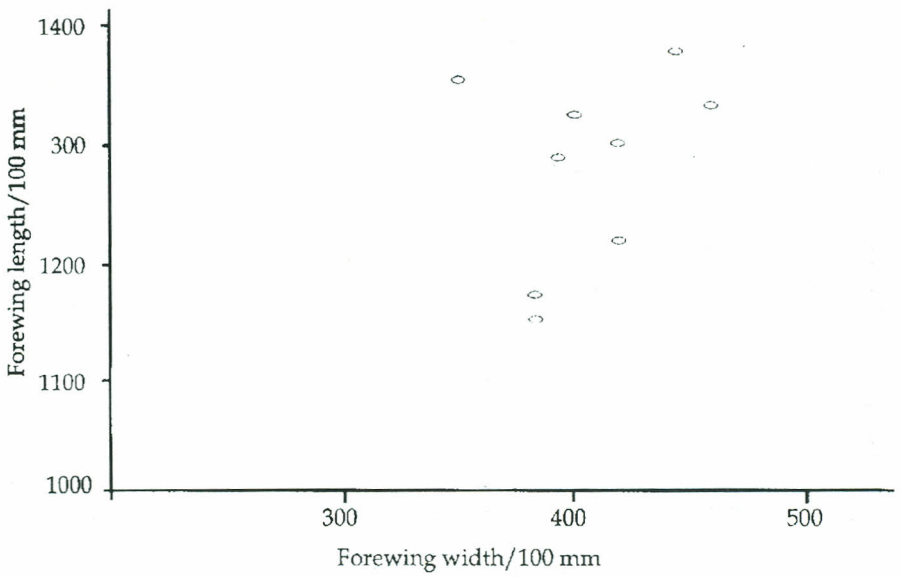

Figure 13. Scattered diagram of the forewing size variation distribution of *S. excerptalis* collected from Jatitujuh.

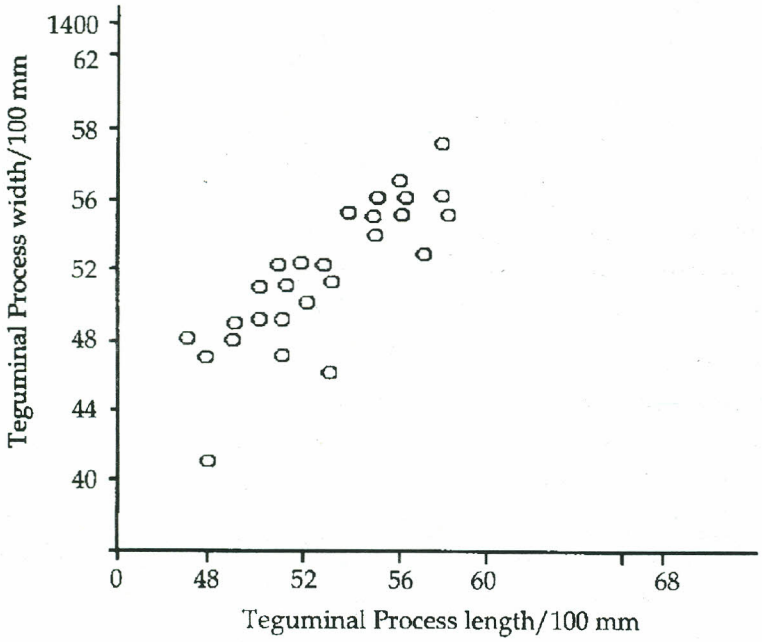

Figure 14. Scattered diagram of size of sbteguminal *S. excerptalis* collected from Pasuruan.

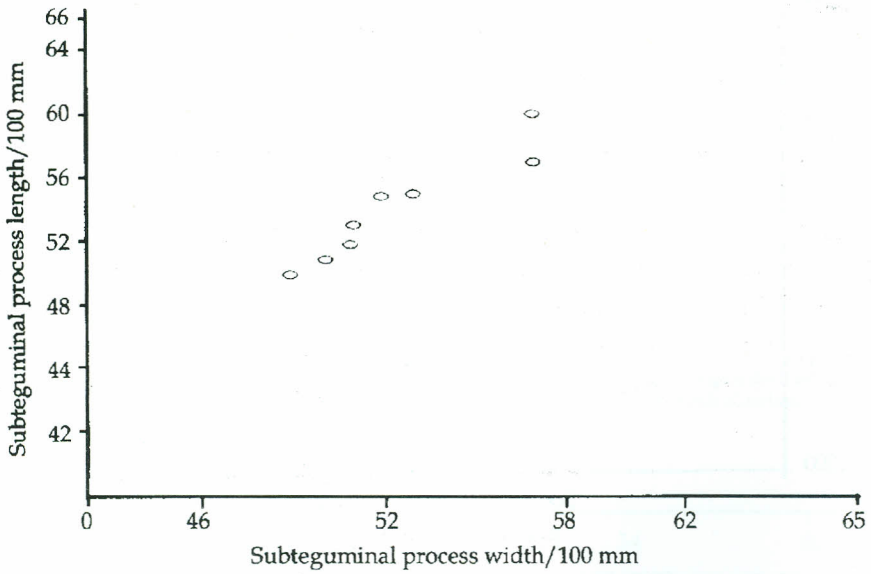

Figure 12. Scattered diagram of subteguminal process variation of *S. excerptalis* collected from Jatitujuh, Cirebon.

Summary

Scirpophaga innotata

Measurement of parts of the head from sample collected showed very little variation, they are mentioned as one group. Variation based on wing size, length and width of forewing can be divided into two groups sizes, the larger group size (950 - 1025 mm/100) and the small group size (850 - 860mm/ 100). Variation based on the size of male genitalia were more varied range between 20 - 26mm /100 in length and 23 - 35 mm / 100 but they can be put into one group.

Scirpophaga incertulas

Measurement of parts of the head show little variability in the scattered diagram distribution, and considered as the same population group. Variation based on wing size, length and width of forewing collected from various places in Java indicated that populations of this insect does not indicate any differences in term of types of wing venations and considered as similar populations. Variation based on the size of male genitalia seemed to be the same group in the scattered diagram.

Scirpophaga excerptalis

Measurement of parts of the head (the length and width of the head) considerd as one population. Variation based on the size of male genitalia seemed to the same group in the scattered diagram.

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