Relation between Population Density of the Rice Bug, *Leptocorisa oratorius* Fabricius (Heteroptera: Alydidae), and Damage of Rice Grains *

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Abstract

Grain damage caused by the rice bug was investigated in relation to the insect population denensity in farmers' paddy fields. The insect populations on rice plants at the time of flowering included a smallar proportion of nymphs in paddy fields with early flowering plants, but a larger proportion of nymphs in the fields where rice flowered later. The increase in the number of nymphs in paddy fields after rice flowering, which was followed by a reduction in the number of adults, occurred earlier in the fields with later flowering plants as compared to the fields with early flowering plants. Grain damage was found to be proportional to the density of adults plus nymphs on rice plants at the time of flowering despite the difference in adult-nymphal structure in the populations and the difference in the changes of population density on rice plants after flowering. A density of 15～30 bugs per 20-stroke net-sweepings (approximately equivalent to 1～2 bugs per m^2) was estimated to cause a 10 % grain damage.

Additional key words : *Echinochloa crus-galli*, weeds, Sri Lanka

The economic threshold of the infestation of rice plants by the rice bug, *Leptocorisa oratorius*, has been reported to be 2 bugs per m^2 in Sri Lanka[9], 2～4 bugs per m^2 [1], 8 bugs per m^2 [4] and 10 bugs per 20 hills[11] in the Philippines, and 2 adults per hill in Malaysia[10] with less detailed investigations. Only a

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few studies on the relationship between the population density of the insect and grain damage have been carrid out[2,5,6]. These reports did not refer to the stage of grain development at which the bug damage occurs, except for one report[6]. Furthermore, no investigation on the change of rice bug density in rice plants during the period of grain filling has been carried out. Although Halteren[2] reported that the economic threshold can be derived from an equation between the insect population density per m^2 in bug-days and percentage of grain damage, it is considered that the economic threshold must be developed for controlling the insect at the time of rice flowering or immediately after flowering since the attack of panicles by the insect occurs from the very early stage of grain development[5,6,7,13].

We investigated the relationship between the rice bug population density at the time of rice flowering and grain damage in reference to the changes of population density during the filling period, in farmers' paddy fields in the 1989 Yala rice cropping season in Sri Lanka.

Materials and methods

1) Population density of the rice bug

To investigate grain damage in rice with different intensities of rice bug infestation, 24 target paddy fields were set up in four paddy areas, Ganetanna, Mawela, Attalapitiya and Beminiwatta around Hingula, Kegalla district. *L.oratorius* was the only ear-sucking hemipteran species observed predominantly in the fields. The insect populations in the target fields were sampled by 20-stroke net-sweepings using an insect net, 36cm in diameter at the time of rice flowering. The changes in the rice bug populations in rice plants during the filling period (around 30 days from flowering to ripening of rice panicles) were also investigated by net-sweepings at different times after flowering in some of the target fields with different rice flowering dates in Ganetanna.

2) Grain damage

Rice panicles were harvested from the target paddy fields at the yellow-ripening stage at the rate of 50 panicles per field. The panicle samples were hand-threshed to obtain the total spikelets for each sampling site. The spikelets were immersed in 15% ethyl alcohol to separate the unfilled and filled ones. The unfilled and filled materials were air-dried and weighed separately. Then one-tenth or one-fifth of the materials was taken from each panicle sample (portion size changed according to damage level), so that around 200 unfilled and 400 filled spikelets were sampled for examination. For precisely discriminating the unfilled grains with rice bug damage from those injured by other factors, unfilled grains were examined by staining the stylet sheaths of rice bugs which penetrated into the grain with the erythrosine dye after removal of the glumes as described earlier[13]. However, the examination of the presence of stylet-sheath heads on the glumes[13] was omitted. Filled spikelet samples were kept in 15% ethyl alcohol for 1 day without staining, to make the spikelets transparent, and were observed through a transmitted light-source to isolate pecky grains. The glumes of the pecky grains were removed for direct observation of the rice bug damage.

Results and discussion

1) Population density of the rice bug

As shown in Table 1, the rice bug density in rice plants at flowering was higher in smaller areas of paddy fields with early flowering plants (Ganetanna A and Mawela A fields) and fields with late flowering plants (Genetanna C fields). However, there was a difference in the adult-nymphal structure in the populations as follows: The populations showed a smaller proportion of nymphs in the fields with early flowering dates (Ganetanna A and B fields). On the other hand, the populations showed a larger proportion of nymphs in the fields with later flowering dates. The latter condition indicates that the apparent increase in the number of nymphs had been initated in the fields with plants before flowering. This difference in the populations is considered to

Table 1. Average data of the rice bug populations sampled by net-sweepings in paddy fields at rice flowering, which were correlated with grain damage inspected.

Paddy fields[a)]		Area (ha)	Flowering date	Weed infestation[b)]	No. of fields	Average no. of bugs: Adult	Y-nymph[c)]	0-nymph[c)]	Total
Ganetanna	A	0.2	Jun.16	+	2	83.0	1.0	0.0	84.0
	B	1.5	Jun.27	+	8	16.6	3.7	2.9	23.2
	C	0.14	Jul.12	−	3	18.5	112.7	71.4	202.6
Mawela	A	0.25	Jul.8	±	4	48.8	39.0	17.5	105.3
	B	0.8	Jul.20	−	3	12.0	18.7	3.3	34.0
Attalapitiya	A	0.3	Jul.9	−	2	15.5	19.5	6.5	41.5
Beminiwatta	C	0.3	Aug.3	±	2	3.0	14.0	0.5	17.5

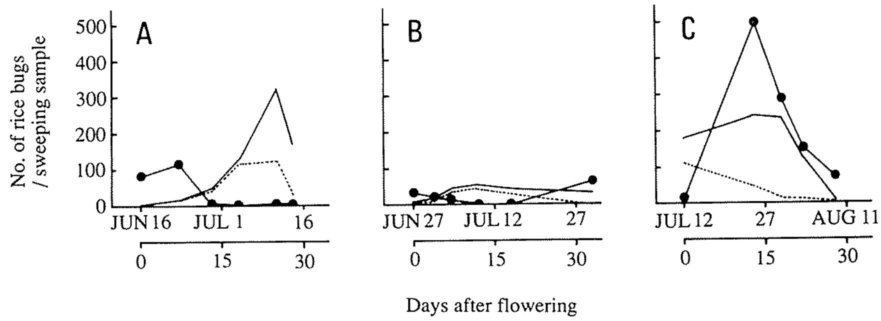
a) : A B C: fields with early flowering plants, main fields and fields with late flowering plants, respectively.
b) : − ± +: Panicles of *Echinochloa crus-galli* occurred seldom, at a level below 1 panicle/m^2 and above several panicles/m^2, respectively.
c) : Y-nymph, 0-nymph: 1st~3rd instar nymph and 4th~5th instar nymph, respectively.

be due to the difference in ovary maturation in the adult populations which attacked rice plants as follows: Female adults gradually initiated oviposition in early-flowering plants[12)]. On the other hand,a large part of the famales which immigrated in a field with late-flowering plants were already mature and ovipositing even when few rice plants bore panicles[12)]. Based on rearing experments, Morrill et al.[8)] reported that nymphs survive only on rice and weeds after panicle-bearing and that nymphal development takes place in paddy fields before panicle-bearing when the fields are infested with early-flowering weeds. According to the present study early nymphal development occurred in paddy fields with a small amount of weeds but not in weedy fields (Table 1). It remains to be determined how nymphs initiate their development in rice before panicle-bearing under field conditions.

As shown in Fig. 1, in paddy fields with different rice flowering dates in Ganetanna, the changes of rice bug populations during the filling period were as follows: The increase in the number of nymphs, which was followed by a remarkable reduction in the number of adults, occurred earlier in the main fields (B fields) as compared to A fields with early flowering plants. The reduction in the number of adults is considered to be due to the fact that ovipositing adult populations moved out of the infested fields as progeny nymphal populations developed. However, a larger number of nymphs occurred with fewer adults at the time of flowering in C fields with late flowering plants. It is considered that a large part of the ovipositing adult population which attacked C fields had moved out of the fields before rice flowering. Fig. 1 also indicates that a subsequent increase in the number of adults, which was followed by the increase in the number of nymphs, occurred earlier in C fields as compared to B fields but was not apparent in A fields. It appears that a large part of the new adults which emerged in A fields migrated to fields with later-flowering plants to feed on younger panicles, and took part in the drastic increase of adult density in C fields.

2) Grain damage

The main symptom associated with rice bug damage was the presence of spikelets with unfilled grains as observed earlier[13)]. As shown in Fig. 2, grain damage was found to be proportional to the total number of adults and nymphs in the samples collected by net-sweepings in paddy fields at the time of rice flowering despite the difference in the adult-nymphal structure in the populations (Table



A, B and C: as in Table 1;
—●— Adults, - - - - Nymphs in 1st~3rd instars, —— Total number of nymphs.

Fig. 1. Changes in rice bug populations in rice plants in Ganetanna. Data are the average of 2, 5 and 2 fields in A, B and C, respectively.

1) and the difference in the change of population density during the filling period (Fig. 1).

In the previous studies[2,5,6] emphasis had been placed on the injury caused by the adults. The feeding activity of the nymphs varies with the instar and nymphs in younger instars are less active[3]. According to the present study it is considered that nymphs contribute as much as the adults to grain damage since nymphal development takes around 20 days[8,12]. As a result, the infestation of rice plants by nymphs and new adults which emerge from the nymphs extends over the filling period,whereas the initial adult infestation lasts only for a short period of time after flowering as indicated in Figs. 1A and 1B. Thus, grain damage is caused by the insect infestation which shows different patterns in the change of population density during the filling period as indicated in Fig. 1. However, it has been observed that grain damage was generally proportional to the intensity of rice bug infestation of rice plants 7 days after flowering (3 days before the majority of grains reached the milk-ripe stage), despite the fact that a considerable proportion of grains was damaged at the dough and hard-dough stages when the level of rice bug infestation was lower, whereas grain damage mainly occurred from the very early stage of grain development to the milk-ripe stage when the insect infestation was severe[13]. The results shown in Fig. 2 indicate that grain damage can be generally forecaseted on the basis of the density of adults plus nymphs at the time of rice flowering. The equation in Fig. 2 indicates that the density levels which cause 10, 20 and 40% grain damage are approximately 16, 56 and 120 bugs per 20-stroke net-sweepings. Therefore, on the average, a density of 15~30 bugs per 20-stroke net-sweepings, which is equivalent to 1~2 bugs per m^2 in direct count, according to Sugimoto & Nugaliyadde (unpublished), is estimated to cause a 10% grain damage.

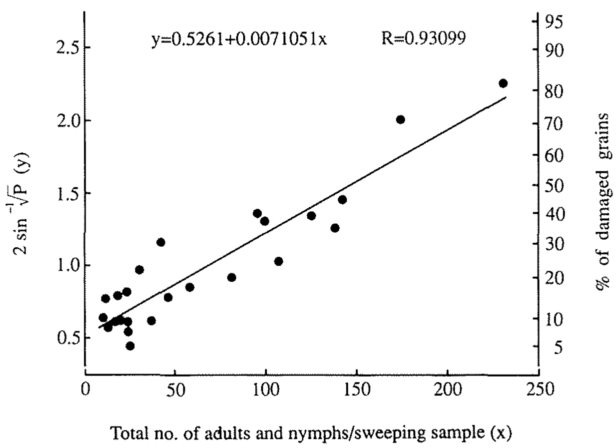


Fig.2. Relation between total number of adult and nymphal rice bugs collected by 20-stroke net-sweepings at rice flowering and percentage of damaged grains with an angular transformation ($\theta = 2 \sin^{-1}\sqrt{P}$) in paddy fields surveyed.

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タイワンクモヘリカメムシの生息密度と米粒の被害との関係

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摘　要

熱帯アジアにおける稲作重要害虫の一つであるタイワンクモヘリカメムシの生息密度の経済的要防除水準については，既にスリランカ，フィリピン，マレイシア等の国々での報告があるが，その基礎となる生息密度と米粒の被害率との関係の研究は少ない。またこれらの報告の大部分では，要防除水準は米粒の発育ステージとの関係なしに示されている。

筆者らはスリランカにおいて，開花日の水田における本害虫の生息密度を口径36cmの捕虫網の20回振りによる「すくい取り法」によって調査し，稲穂を黄熟期に採取して米粒の被害率を調査した。また調査対象水田の一部では稔実過程における本害虫生息状況の推移を併せて調査した。その結果，開花日の水田における生息虫は，早期開花水田では成虫が主体であったが，中～後期開花水田では幼虫数が成虫数を上回った。また開花後の稲における幼虫生息数の増加及び新成虫の発生は早期開花水田では遅く，後期開花水田では早かった。このような開花日及びそれ以後における本害虫生息状況の相違にもかかわらず，開花日における「すくい取り法」による成幼虫合計採集虫数と米粒の被害率との間に直線的関係が認められ，この関係から20回振りでのすくい取り虫数15～30頭（1～2頭／m^2相当）の生息密度により被害粒率10％の被害が生ずると推定された。

キーワード：稲害虫，タイワンクモヘリカメムシ，ヒエ，雑草，スリランカ

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