

REPORT

Size of *Spodoptera exigua* (Lepidoptera: Noctuidae) Larvae Reared on Various Host Plants

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ABSTRACT The study of the larval size of *Spodoptera exigua* based on their head capsule was performed on larvae reared on leaves of cabbage, shallot, long beans and lady's fingers. It was found that there was no significant difference in the larval head capsule size of the 1st instar among the studied host plants. However, for the subsequent larval instar stages (i.e. from the 2nd to 6th instars), there were significant difference among treatments. Comparatively, this study has found that larvae reared on long beans have a bigger head capsule size compared to those reared on the other host plants. Larvae reared on shallot have the smallest head capsule size.

ABSTRAK Kajian mengenai saiz larva *Spodoptera exigua* berdasarkan kepada kapsul kepalanya telah dijalankan ke atas larva yang dibela dengan daun kobis, bawang, kacang panjang dan bendi. Didapati tiada perbezaan yang ketara bagi saiz kapsul kepala larva instar pertama di antara tanaman hos yang dikaji. Bagaimanapun, terdapat perbezaan yang signifikan pada peringkat instar larva yang berikutnya di antara tanaman hos. Secara perbandingan, kajian ini telah mendapati larva yang dibela dengan kacang panjang mempunyai saiz kapsul kepala yang lebih besar berbanding dengan hos tanaman yang lain. Manakala larva yang dibela dengan bawang mempunyai saiz kapsul kepala yang paling kecil.

(*Spodoptera exigua*, larval head capsule, size, host plant)

INTRODUCTION

Dyar's Law stated that the head capsule of caterpillars grow in geometrical progression, increasing in width at each moult by a ratio, usually about 1.4, which is constant for a species [1]. Several reports on *Spodoptera exigua* provide the larval body length but not much details on each of the instars, such as Atkins [2] who stated that newly hatched larvae are approximately 1 mm long and a full grown larvae measured 25 to 35 mm and, Anwar *et al.* [3] who reported that newly hatched larvae are 1 to 1.5 mm and full grown larvae are 25 to 30 mm long. Very little studies on head capsule width have been done on the size of the *S. exigua* larvae [4]. Thus, this study aimed to determine the effect of

host plant on the size of the *S. exigua* larvae, in particular the head capsule width.

MATERIALS AND METHODS

Larvae of *S. exigua*, which were reared individually in a plastic container [9.5 cm (top diameter) x 6.5 cm (bottom diameter) x 12.5 cm (height)] with a hole (4 cm diameter) on the top cover and covered with muslin cloth were observed daily for ecdysis. The head capsule which was detached from the individual newly moulted larva was collected and kept in a vial specimen filled with 70% alcohol for size measurement. The head capsule was kept in a vial specimen that was designated for each larva instar stages and the respective host plant. Host plant leaves used in this study were cabbage

(*Brassica oleracea* var. *capitata*, variety KK cross), shallot (*Allium cepa* var. Indian Rose), long beans (*Vigna unguiculata*) and lady's fingers (*Abelmoschus esculenta*). The measurements were based on 19 larval head capsules for cabbage, 33 for shallot and six for both long beans and lady's finger. Each of the head capsules was considered as a replicate. This experiment was conducted under laboratory conditions with a mean temperature of 25.7°C and relative humidity of 70.4%, measured using a thermohygrograph (Dickson THDx-CE).

The head capsule was measured by using a dissection microscope (at magnification of 40x) attached with a microscope graticule and calibrated with a ruler (i.e. 2mm = 80 epu). Measurement was taken at the widest point of the head capsule.

Data analysis

One way ANOVA (STATISTICA 6.0; StatSoft Inc., 1984 - 2001) was performed to detect effects of host plant on the larval size. When significant F values were obtained, means were separated using the Duncan's multiple range test.

For each of the host plant, a simple linear regression analyses was used to examine the relationship between the larval instar stages and its size.

RESULTS

There was no significant difference ($F = 1.61$; $df = 3, 13$; $P > 0.05$) in the larval head capsule size of the 1st instar among the host plants (Table 1).

However, for the subsequent larval instar stages (i.e. from the 2nd to 6th instars), there were significant differences ($P < 0.05$) among treatments (Table 1). At the 2nd instar, larvae reared on long beans have bigger head capsules compared to those reared on lady's fingers, while larvae reared on cabbage and shallot were intermediate in size. At the 3rd instar, larvae reared on long beans have bigger head capsules compared to those reared on shallot, while larvae reared on cabbage and lady's fingers were intermediate. At the 4th instar, larvae reared on long beans have bigger head capsules compared to those reared on cabbage, followed by shallot, while larvae reared on lady's finger were intermediate (i.e. between cabbage and shallot).

At the 5th instar, larvae reared on long beans and cabbage have bigger head capsules compared to those reared on shallot, while larvae reared on lady's finger were intermediate. At the 6th instar, larvae reared on long beans have bigger head capsules compared to those reared on cabbage, followed by shallot, while larvae reared on lady's finger were intermediate (i.e. between cabbage and shallot). Thus, this study has shown that larvae reared on long beans, have comparatively bigger head capsules compared to the other host plants (Table 1), while larvae reared on shallot have the smallest head capsule size.

Regression analyses also showed that there are significant relationships between larval size and instar stages on all tested host plants (Figure 1). This shows that the head capsule width increases as the larvae grow or moult.

Table 1. Head capsule width of *S. exigua* reared on various host plants

STAGE	HEAD CAPSULE WIDTH (MEAN ± S.E.)			
	CABBAGE	SHALLOT	LONG BEANS	LADY'S FINGERS
1 st instar	0.26 ± 0.01 a	0.26 ± 0.00 a	0.26 ± 0.00 a	0.28 ± 0.00 a
2 nd instar	0.37 ± 0.01 bc	0.34 ± 0.01 ab	0.39 ± 0.01 c	0.32 ± 0.00 a
3 rd instar	0.59 ± 0.03 bc	0.46 ± 0.03 a	0.67 ± 0.02 c	0.51 ± 0.09 ab
4 th instar	0.86 ± 0.02 b	0.68 ± 0.05 a	1.11 ± 0.02 c	0.75 ± 0.10 ab
5 th instar	1.13 ± 0.02 b	0.92 ± 0.08 a	1.27 ± 0.02 b	1.08 ± 0.12 ab
6 th instar	1.38 ± 0.00 b	1.12 ± 0.06 a	1.96 ± 0.08 c	1.16 ± 0.06 ab

*Mean accompanied by the same letter between columns are not significantly different

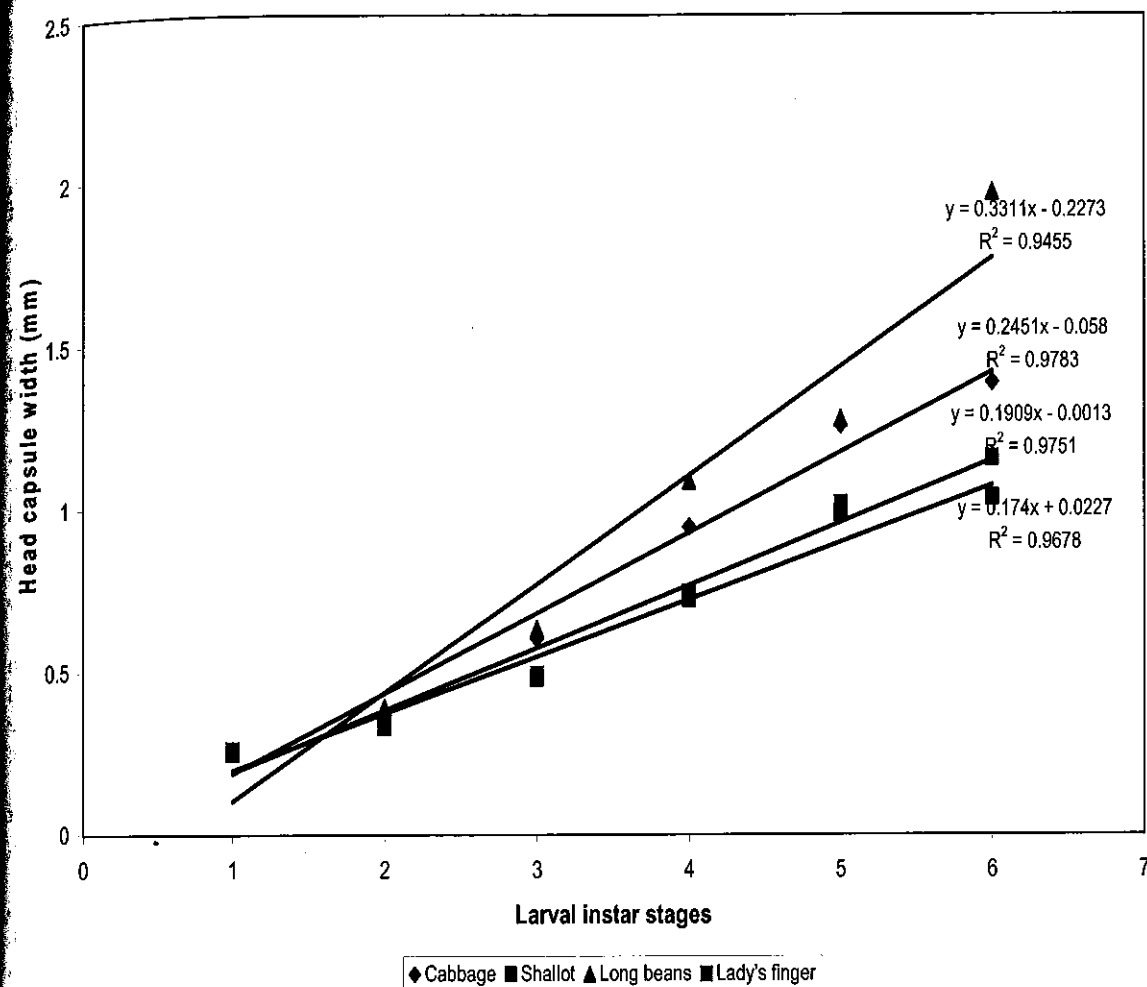


Figure 1. Relationship between larval instar stages and head capsule width of *S. exigua* larvae reared on cabbage, shallot, long beans and lady's finger

DISCUSSION

In an insect species, during normal growth and development, each instar is characterized by certain dimensions (constitutive size of the instar). Dyar's Law has formulated a rule to describe this phenomenon by taking the width of the head capsule as an indicator of growth in larvae. Thus, in this study, the head capsule width was chosen to specify the size of the larvae rather than the body length because it is more reliable and definite. Further, results of this study also showed that the head capsule width increases as the larvae grow or moult on all tested host plants.

Drooz [5] demonstrated that host plant does influence head capsule size. This is congruent with the result of this study. It was found that larvae reared on the long beans have the widest

head capsule compared to the other host plants. Perhaps this is due to the host plant nutrition content, which needs further investigation. Results of this study also show that the host plant does not affect the first instar larva head capsule size. A similar phenomenon was also reported by Beckwith [6], where larval head capsule widths during the early instars of the elm spanworm (*Ennomos subsignarius*) were scarcely affected by the host plants (i.e. grand fir, douglas fir and subalpine fir), but differences began to appear in the mean width of the 3rd instar.

There was no other information on head capsule size of *S. exigua* in relation to host plant or diet found in the literature except by Atkins [2] who stated that head width of a full grown larva was 2 mm when reared on citrus. Capinera [4] reported a complete head capsule width of 5 larva instars

of *S. exigua* but he did not mention on what host plant or diet they were reared on. Several reported information on size were on the length of the larva body, such as Atkins [2] who stated that newly hatched larvae are approximately 1 mm long and a full grown larvae measured 25 to 35 mm when reared on citrus; Khalid-Ahmed *et al.* [7] stated that a full grown larva was about 2.2 to 2.5 cm when reared on chilli and Anwar *et al.* [3] reported that newly hatched larva is 1 to 1.5 mm and a full grown larva is 25 to 30 mm long when reared on an artificial diet. We presumed that they did not make a thorough study on the larval length of the *S. exigua* since they did not state the other larva instar body length. However, Wilson [8] has made a detailed study on the larval body length of the *S. exigua*. He reported that the average length for the 1st, 2nd, 3rd, 4th and 5th instars were 2.49 mm, 5.77 mm, 8.88 mm, 13.78 mm and 22.85 mm respectively. Unfortunately, he did not mention the host plant or diet they were reared on.

There have been no reports documenting the effect of host plant on larval head capsule size. This was supported by Novotny and Basset [9] who stated that the generality of the body size versus host specificity relationship is far from established, as it has been addressed by only a few studies. However, the few studies regarding that particular relationship were using either larval length or adult body size. For example, Palumbo *et al.* [10] reported that larval length of beet armyworm was longer when reared on lettuce than broccoli during at the same age. Thus, results of this study could be useful for future reference.

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SERIES B

**PHYSICAL
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