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Determination of Larval Instars of the Rice Weevil Sitophilus oryzae (L.) (Coleoptera: Curculionidae) in Wheat

A. E. O'Donnell
Arkansas State University

THE DETERMINATION OF LARVAL INSTARS OF THE RICE WEEVIL **SITOPHILUS ORYZAE** (L.) (COLEOPTERA: CURCULIONIDAE) IN WHEAT

A. E. O'Donnell[1]

Literature concerning rice weevil biology has been divided into two main categories previously referred to as the large and small strains. Floyd and Newsom (1959) separated these and designated the large strain as the true rice weevil, **Sitophilus oryzae** L., while the small strain was classified as **S. sasakii** (Tak.). Kuschel (1961) stated the use of **sasakii** was nomenclaturaly incorrect.

Instar determinations based on head capsule width (Dyar, 1890) have been reported for the rice weevil, however, no other means of instar determination were found. This study was undertaken, with **S. oryzae** to obtain and compare capsule widths and larval weights for the four larval instars as a possible means of determining instar.

MATERIALS AND METHODS

The Pawnee (hard red winter) wheat used in this investigation was cold sterilized and then placed in steel drums to attain room temperature before tempering to 13.5% moisture content. A type "S" Steinlite moisture meter was used in all moisture determinations.

Cultures of **S. oryzae** were obtained by placing 200 four to seven day old adults (Richards, 1947) in a wide-mouth quart jar containing 75 gm of wheat. The jars were held at 80°F and 70% relative humidity for three days after which the adults were removed by screening; the wheat returned to the jars, and these returned to the controlled conditions as described above. Cultures were prepared every three days.

Beginning with four day old cultures, one culture was removed from the rearing room each day and passed through a Boerner divider to obtain sample uniformity. Infestation was determined from a 100 kernel sub-sample by staining with acid fuschin (Frankenfeld, 1948). The kernels were then placed under a dissecting microscope and were dissected to remove the larva and determine the instar as described below. In addition the culture age when the greatest percentage of the population were in instars 1-4 respectively was also determined. Preliminary investigations showed this to be 8, 11, 15 and 21 days respectively.

Instar was determined as follows: the head capsule of each larva was removed and mounted in canada balsam on a glass microscope slide and oriented so that the occipital foramen was against the slide

[1]Associate Professor of Biology, Arkansas State College, State College, Arkansas.

and the lateral margins were completely visible when viewed through a dissecting microscope. The slide was then transferred to a compound microscope and the greatest head capsule width measured using a calibrated occular micrometer.

To determine if weight might be used to determine instar, 30 larvae were removed from 8, 11, 15, and 21 day old cultures respectively and the weight of each larva compared to its head capsule width. Detection of infested kernels was done as previously described. Each larva immediately after removal from the wheat kernel, and prior to being weighed, was brushed with a fine camel's hair brush to remove any frass or other material clinging to the body surface. After weighing the head capsule was removed and measured as previously described.

RESULTS AND DISCUSSIONS

The minimum, mean and maximum head capsule widths for each instar are reported in Table 1. Eleven and fifteen day old cultures contained 2.5 and 1.4% of the population respectively for which instar could not be determined due to the small number of larvae encountered having isolated head capsule widths. Differences in head capsule widths were observed when results from this work were compared with those previously reported for **S. oryzae** (L.) (Cotton, 1920; Soderstrom, 1960) suggesting a possible species and/or nutritional difference to be the cause of these differences.

A positive relationship between larval weight and head capsule width was observed (Table 2). For first and second instar larvae each milligram of weight increase resulted in an increase of 1.253 mm in head capsule width. In third and early fourth instar larvae for each milligram of weight increase an increase of 0.249 mm in head capsule width was observed. In late fourth instar larvae each milligram of weight increase resulted in an increase of 0.038 mm in head capsule width.

Instar determinations based on weight are only partially satisfactory. First, second and late fourth instar larvae had independently grouped weights while identical weights were found in several third and early fourth instar larvae. Weight cannot be used to determine instar in the latter.

Table 1. Head Capsule Widths of **S. oryzae** larvae in Instars one through four reared in Pawnee wheat held at 80°F and 70% relative humidity.

Instar	No. of Larvae Measured	Culture Age (days)	Head Capsule Width — mm		
			Min.	Mean	Max.
1	128	8	0.16	0.20	0.22
2	121	11	0.25	0.28	0.29
3	146	15	0.34	0.39	0.43
4	116	21	0.49	0.54	0.64

Table 2. The mathematical relationship resulting from the comparison of larval weight and head capsule width.

Instar Comparison	Equation	Correlation[3] Coefficient (r)
1st and 2nd	$Y = 1.253 X + 0.168$	0.97^a
3rd and early 4th	$Y = 0.249 X + 0.304$	0.94^a
late 4th	$Y = 0.038 X + 0.458$	0.96^b

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[3]Similar letters indicate statistical significance at the 0.01 level. The remainder indicate significance at the 0.05 level.