Techniques for Determining Mechanisms of Resistance: Antibiosis

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Abstract The adverse effects of feeding continuously on a plant for the insect are measured by antibiosis. The test is conducted under confined conditions. The antibiotic factor manifests on the growth and development of the insect. In this chapter, procedures for the tests have been outlined for the sesame shoot webber and the rice planthopper. The indices associated with tests of antibiosis are provided.

Keywords Antibiotics · Growth and development · Growth indices · Parafilm sachets

1 Introduction

Often antibiosis mechanism of resistance is assessed under no-choice tests, with the insects confined on plants or plant materials inside a cage. Such tests are performed mostly in the greenhouse or in the laboratory, sometimes under field conditions. Meridic or artificial diets can also be used in antibiosis tests.

Antibiosis is defined as the influence of crop cultivar on growth and development of insect. If the cultivar is susceptible, it favours the growth and development of insects. If it is resistant, it disturbs the growth and development of insects (Sharma and others. 2005).

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2 Lepidopteran Insects

Well-grown test plants are selected for antibiosis study. Neonate larvae are released individually in the screening cages enclosing the foliage of the test plant. The larvae are observed once in 2 days, given with fresh foliage whenever needed, and percent larval mortality; pupation percentage and pupal weight; larval, pupal and adult longevity; and adult emergence including malformation if any are recorded. The influence of the test plant on the growth and development of insects is assessed by calculating various indices as mentioned below:

$$\text{Growth index} = \frac{\text{Percentage of pupation}}{\text{Average duration of larval period}}$$

$$\text{Larval pupal index} = \frac{\text{Average larval period on standard host} \times \text{Average pupal period on standard host}}{\text{Average larval period on test host} \times \text{Average pupal period on test host}}$$

$$\text{Pupal index} = \frac{\text{Average pupal wt.(mg) on test host}}{\text{Average pupal wt (mg) on standard host}}$$

$$\text{Adult index} = \frac{\text{Average adult longetivity on test host}}{\text{Average adult longetivity on standard host}}$$

$$\text{Survival index} = \frac{\text{Average adult emergence per cent on test host}}{\text{Average adult emergence per cent on standard host}}$$

$$\text{Ovipositional index} = \frac{\text{Average number of eggs laid on test host}}{\text{Average number of eggs laid on standard host}}$$

3 Antibiosis of Selected Sesame Accessions Against Shoot Webber, *Antigastra catalaunalis*

Selected sesame accessions (30, 45 and 60 days old) are tested for their antibiotic effects, if any, against *A. catalaunalis*. The selected accessions are raised in earthen pots, and five neonate larvae are released individually on the plants at the respective age. The released larvae are caged and observed once in 2 days and allowed to pupate. Larval, pupal and adult longevity, pupation percentage, pupal weight and adult emergence percentage including malformation, if any, are recorded (Balaji and Selvanarayanan 2009).

Based on the above observations, developmental indices as mentioned above were computed by the following methods described by Dubey et al. (1981).

4 Sap-Feeding Insects

The known number of insects (nymphal stage) is released in a test plant. Then the nymphal, adult period, mortality at various insect stages is being observed. Based on the results, the resistance will be calculated.

5 Hoppers

Several methods have been developed for assessing the antibiosis resistance of rice varieties to the brown planthopper. These methods include hopper feeding, survival of nymphs and population growth. The feeding activity of hoppers is determined by measuring the amount of honeydew excreted. This technique has proved useful for determining the level of resistance of rice varieties to the brown planthopper, whitebacked planthopper and green leafhopper.

6 Quantifying Honeydew Excretion

Honeydew excreted by the brown planthopper is used as a criterion for determining the amount of sap ingested by the insect on resistant and susceptible rice cultivars. The quantity of honeydew excreted is low on resistant cultivars and high on susceptible cultivars.

Materials Required Potted rice cultivars (susceptible and resistance), filter paper, Petri dish, plastic cup, cellophane tape, cotton plug, hoppers and 0.001% ninhydrin solution.

Procedure

- The experiment is set up as shown in the diagram using 40–50-day-old potted, susceptible and resistant variety.
- Known number of planthoppers (2–3 pairs) are released into plastic cup.
- The planthoppers excrete honeydew on filter paper.
- The filter paper is sprayed with 0.001% ninhydrin in acetone solution.
- The areas of honeydew spots that are bluish or purple are measured, and that indicated the intensity of feeding by the planthoppers.
- Each treatment including the control is replicated several times.
- The amount of honeydew excreted is highly correlated with weight gain over the same time period for a given rice variety.

Note Using the parafilm sachets, the quantity of honeydew excreted by one insect during a 24-h period can be worked out. This is used as a parameter in comparing the insect's feeding activity on susceptible and resistant crop varieties (Fig. 1).

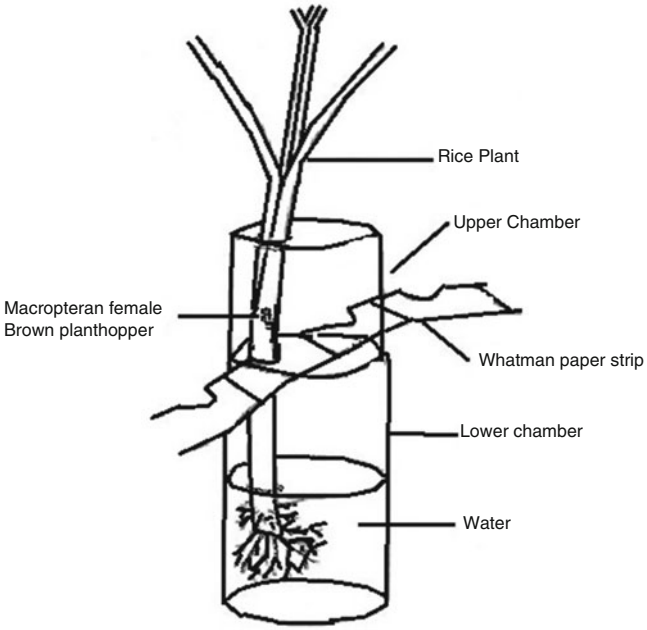

Fig. 1 Laboratory set-up for estimating hopper-excreted honeydew on filter paper. (Source: Paguia et al. (1980))

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Further Reading

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