SOME ASPECTS OF THE HOST PLANT RELATIONSHIPS OF POTATO TUBER MOTH, *PHTHORIMAEA OPERCULELLA* ZELL. (LEPIDOPTERA: GELECHIIDAE)

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ABSTRACT

Aspects of the behaviour and biology of potato tuber moth (Phthorimaea operculella Zell.) relevant to host-plant selection and utilization were investigated. Literature of relevance concerning this and other insects is reviewed.

Oviposition behaviour

To provide a basis for later experimental work the fecundity and oviposition behaviour of individual potato tuber moths was investigated. Fecundity ranged from 0 to 236 eggs deposited per female for moths provided with sugar solution and muslin over filter paper as an oviposition substrate. Fecundity under these conditions was not correlated with pupal weight but the number of mature eggs in the ovaries on emergence from the pupa was related to pupal weight. This initial egg complement accounted for slightly more than half the total number of eggs laid, so that further egg maturation must take place during adult life. Females kept with males throughout their lifespan did not lay more eggs than those separated from males after an initial mating, but unmated females laid very few eggs all of which were infertile. Peak oviposition (of mated females) occurred 2 to 5 days after adult emergence.

Mated moths were offered a range of materials in a series of experiments in order to define physically optimum substrates for oviposition. Surface depressions just large enough to accommodate eggs (0.2 - 0.5 mm^2) were preferred, but in addition hairy substrates were much more attractive than smooth. Mechanical stimulation of tactile hairs on the ovipositor, which was examined by scanning electron microscopy, may account for these effects. Moist substrates were highly deterrent for egg laying and also reduced the total number of eggs laid during the experimental period.

Four host plants (potato, egg plant, tobacco and tomato) and five non-host plants (silver beet, bean, pea, radish and ryegrass) were evaluated with respect to oviposition behaviour in a series of experiments. It was concluded that acceptable plants contain oviposition stimulant factors whilst unacceptable plants contain deterrent factors. Neither of these are however volatile and act for the most part only on contact. Active extracts were prepared from most plants but no attempt was made to identify individual active constituents. As these factors were released in experimental situations for the most part only when plant tissue was ruptured, it is uncertain how they are detected by the insect in the intact leaf. Strongly stimulative plants such as potato, egg plant and tobacco, induced greater total egg deposition as well as influencing the location of eggs.

Factors affecting fecundity

Anaesthetization with carbon dioxide as practised to facilitate handling of moths, had no effect on fecundity. Starved moths laid only slightly more eggs than the complement of fully developed eggs in the ovaries at eclosion from the pupa. Moths provided with water laid almost twice as many eggs but provision of 5% sucrose solution did not increase fecundity further.

Moths kept in the presence of potato tubers laid up to twice as many eggs over their life span compared to moths not so exposed. Isolated pieces of potato peel did not produce this effect. The factor(s) responsible for this stimulation of fecundity appears to be one of odour as tubers covered with muslin produced a similar effect compared to those to which moths had access to the surface.

Larval behaviour

Newly hatched first instar larvae move vigorously and continually in the absence of plant material and would be able to travel several metres before requiring to locate a suitable host plant if eggs were laid away from the plant. Mean life span of starved first instar larvae was 3-4 days at 20^{o}C and was not greatly influenced by relative humidity at this temperature.

First instar larvae tend to be positively phototactic but do not respond to moisture. Their ability to locate host plant material is poor and no strongly directional response was detected. Movement is arrested after contact is made with leaf tissue of host plants but not to any extent with non-host plants. Newly hatched first instar larvae begin to feed soon after coming into contact with leaves of host plants but will not feed to any extent on non-host plant tissue. Discriminatory ability is thus inherited.

Relative susceptibility of potato cultivars

Twelve named potato cultivars were compared for degree of tuber infestation in two small plot trials, one under glass and the other outdoors. Tuber moths were artificially seeded into the experimental areas in each case. Significant differences in degree of infestation were obtained between cultivars in the outdoor trial but not in that under glass.

In laboratory tests, differences in oviposition preference were detected between tubers of different cultivars but less so with foliage. Differences were also found between cultivars in the numbers of pupae recovered following the seeding of known numbers of first instar larvae onto tubers. Pricking the surface of tubers resulted in better percentage recovery of pupae for all cultivars. No close correlation was found between percentage pupation and resistance of tuber skin to rupture or with the number of eyes per tuber. Significant differences in fecundity were recorded according to the cultivar on which the larvae were fed.

When cultivars were ranked according to oviposition preference (bare tubers), percentage pupation and fecundity, there was a close correlation with ranking based on degree of infestation in the field, suggesting that such factors are largely responsible for the differences in levels of infestation found between cultivars under field conditions.

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