RELATIONSHIP BETWEEN TARO FEATHERY MOSAIC DISEASE AND ITS INSECT VECTOR, *Tarophagus proserpina* Kirk.

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ABSTRACT

Adults and nymphs of the taro planthopper, *Tarophagus proserpina* Kirk., were equally efficient in transmitting taro feathery mosaic disease. Both the minimum acquisition feeding period and minimum inoculation feeding period were about 5 min. A single insect could induce the disease in a healthy plant and percentage infection increased as the number of insects was also increased. Starving the insects for 1-6 hours prior to acquisition feeding produced more infected plants than shorter or longer starvation periods. Infective insects could transmit the disease until death and most individuals transmitted the pathogen intermittently.

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KEY WORDS: Pathogen-vector relationship. Taro feathery mosaic disease. *Tarophagus proserpina* Kirk.

INTRODUCTION

Taro feathery mosaic (TFM) disease has been reported to occur in Eastern and Central Visayas (Palomar et al., 1983) but its distribution is most likely not only nationwide but also worldwide (Gollifer and Brown, 1972). Four plant species belonging to Araceae and two nonaraceous species were found to be hosts of TFM (Palomar et al., 1984).

Very little is known about the causal agent of the disease except that it can be transmitted both mechanically by finger rubbing and biologically by the taro planthopper, *Tarophagus proserpina* Kirk. This study presents the pathogen-vector relationship in TFM.

MATERIALS AND METHODS

Transmission Efficiency

Adults and nymphs of the taro planthopper (Fig. 1) were introduced separately to healthy taro (Kalpao variety) plants to determine whether they would differ in percentage infection after 24-hr acquisition feeding and infection feeding periods.

Varying numbers of insects (1, 2, 4, 8 and 16) were also tested for their ability to transmit the pathogen. Percentage infection in test plants was determined after a 24-hr infection feeding.

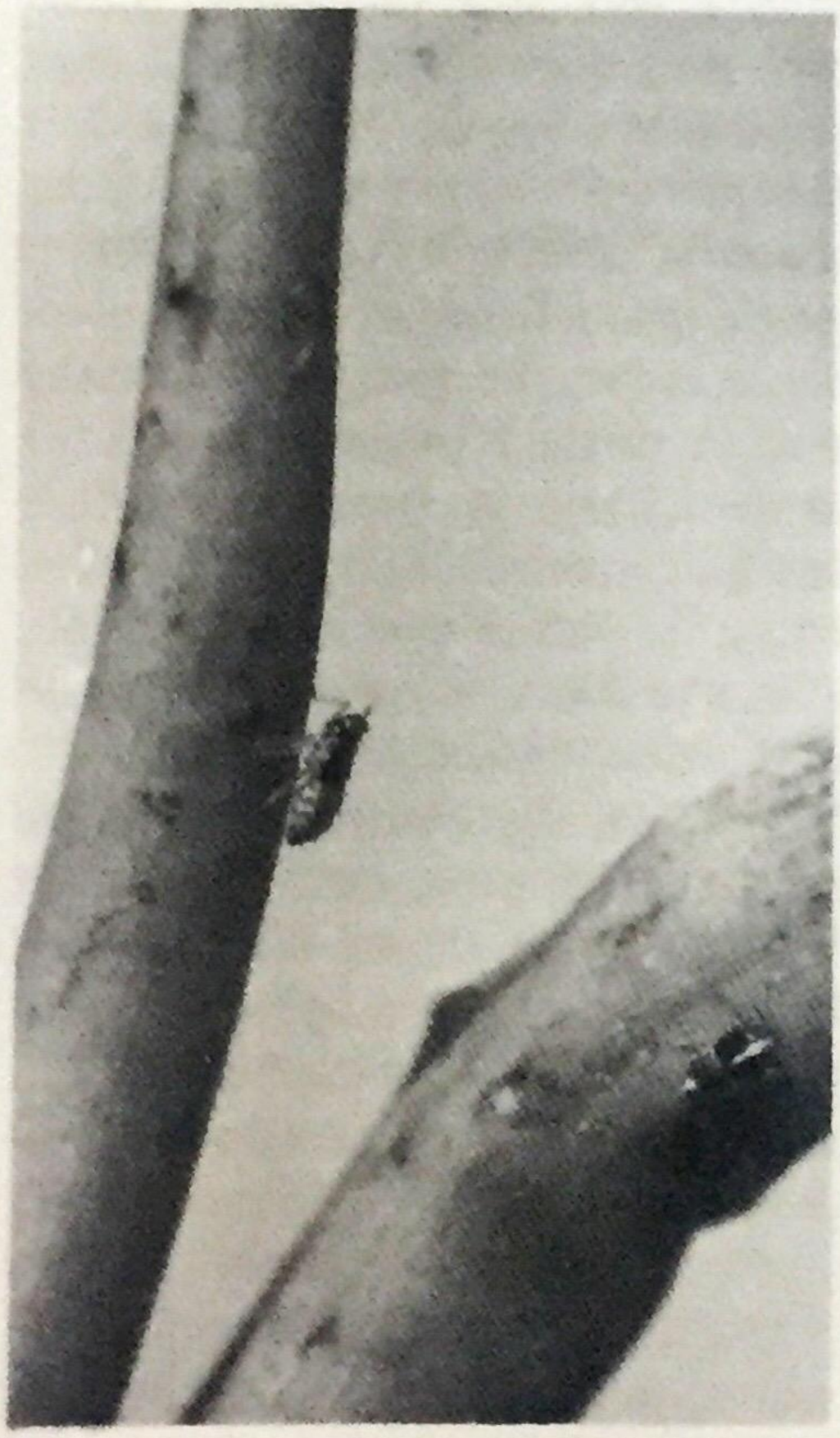

Figure 1. Planthopper *(Tarophagus proserpina* Kirk.) nymphs feeding on Kalpao taro petioles.

Starvation Effect

Another batch of insects was starved at different time durations (30, 60, 120, 360 and 480 min) prior to acquisition feeding. The percentage infection in test plants was determined after inoculation.

Feeding Period

The minimum acquisition feeding and minimum inoculation feeding periods were also studied using the adults of *T. proserpina*. Minimum acquisition feeding experiment was done by transferring virus-free insects successively and individually to healthy plants inside test tubes after allowing acquisition feeding periods of 2, 5, 10, 15 and 30 min. The insects were removed from the test tubes after 24 hours and the plants were grown in tin cans with soil.

In inoculation feeding, insects reared on diseased plants were transferred individually to healthy plants at time intervals of 2, 5, 10, 15 and 30 min. Ten insects were used for every time interval in these experiments.

Serial Transmission

For the serial transmission experiment, 50 insects (nymphs only) were allowed to feed individually on healthy plants for 24 hours. They were transferred to diseased plants for another 24 hours before they were individually placed in test tubes with a small healthy taro plant. The test tubes were covered with nylon tulle to prevent the escape of the

vectors (Fig. 2). Each vector was then introduced to one taro plant for an inoculation feeding of 24 hours. Daily transfer of insects to a plant was done to determine the incubation period of the pathogen in the insect and to test their infective capacity and retention period in transmitting the pathogen. Three separate trials were conducted for this experiment.

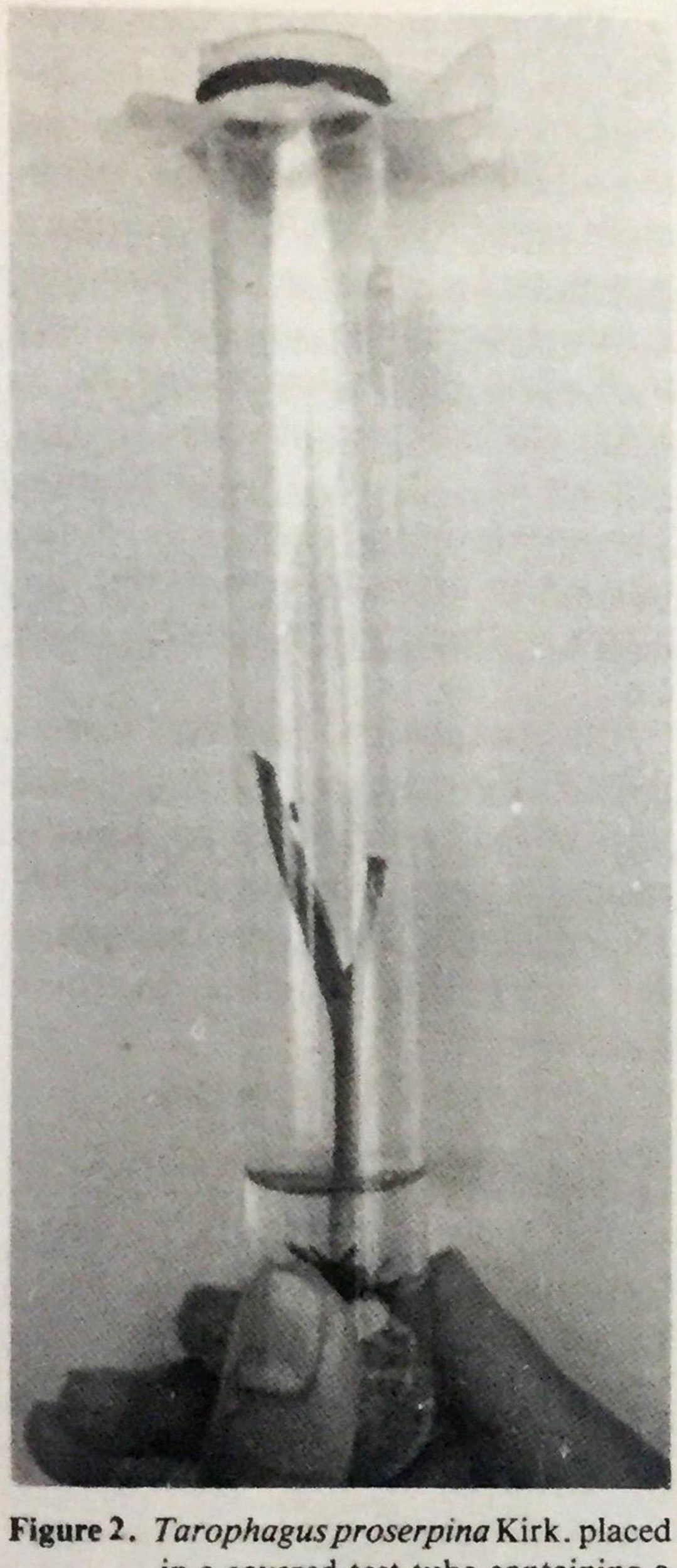

Figure 2. *Tarophagus proserpina* Kirk. placed in a covered test tube containing a taro seedling for taro feathery mosaic disease transmission experiment.

RESULTS AND DISCUSSION

Results showed percentages infection of 33.5 and 34.0% for adults and nymphs, respectively (Table 1). This suggests that adults and nymphs have the same efficiency in transmitting the pathogen. Varying numbers of insects differ in their ability to transmit the pathogen after a 24-hr infection feeding. A single insect could induce the disease in a healthy plant and percentage infection increased as the number of insects was also increased. Smith and Boncquet (1915) showed that sugar beet curly top disease could be transmitted by the leafhopper *Eutettix tenella* Baker, and that a single insect from an infected plant could induce the disease in a healthy one. A single *T. proserpina* has the same ability in transmitting taro feathery mosaic disease. Inoculation of plants with insects starved for 60, 120, and 360 min resulted in 40, 38 and 43% infection, respectively. This shows that most of the insects still fed and acquired the pathogen from diseased plants and induced the disease in healthy plants even if they were starved within 60 to 360 min. Percentage infection in test plants inoculated with insects starved for 480 min was low (3%). It is possible that after 8 hours of starvation, most of the insects were weakened, hence no longer active in acquiring the pathogen. As a result, many were unsuccessful in transmit-

Table 1. Summary of parameters measured to characterize the relationship between taro feathery mosaic disease and the taro planthopper.

Parameter	
Transmission efficiency	
Nymphs	34.0%
Adults	33.5%
Feeding period	
Minimum acquisition	5 min
Minimum inoculation	5 min
Optimum starvation period	1-6 hours
Minimum no. of insects for inoculation	1 individual
Pathogen retention	36 days[1]

[1] The longest time the viruliferous insect remained alive. Insects were infectious until death although transmission was intermittent.

ting the disease. No infection was observed in plants inoculated with insects starved for 30 min. The starvation time was probably so short that the insects were not ready to feed on the diseased plants. The insects must have made only short probes which were not sufficient for the acquisition of the pathogen. A similar observation was reported in the green leafhopper *(Nephotettix impicticeps* Ishihara) wherein no transmission of tungro virus of rice occurred after a one-minute acquisition feeding (Ling, 1966).

Feeding Period

Symptoms were observed on healthy plants exposed for at least 5 min to insects that previously acquired the pathogen and on healthy plants exposed to insects after an inoculation feeding of at least 5 min. In other words, the insects had minimum acquisition feeding and inoculation feeding periods of 5 min each. Hence, these results support the contention that the pathogen causing feathery mosaic in taro does not undergo multiplication because there is no definite incuba-

tion period in the body of the vector. There were no symptoms observed in plants exposed to an infective insect at 2 min inoculation feeding period. This should not be considered as incubation period but rather the period spent by the insects in adjusting to the new environment.

Serial Transmission

Figure 3 presents the retention and transmission pattern of taro feathery mosaic disease by *Tarophagus proserpina*. Most of the insects remained infective until death and most individuals transmitted the pathogen intermittently. Failure of the insect to transmit the disease during some of the serial transfers could be interpreted in terms of insect feeding behavior and variation in susceptibility of the host plants (Ling, 1966). It is possible that the concentration of the transmitted pathogen was too low that a long incubation period was needed for sufficient multiplication in the

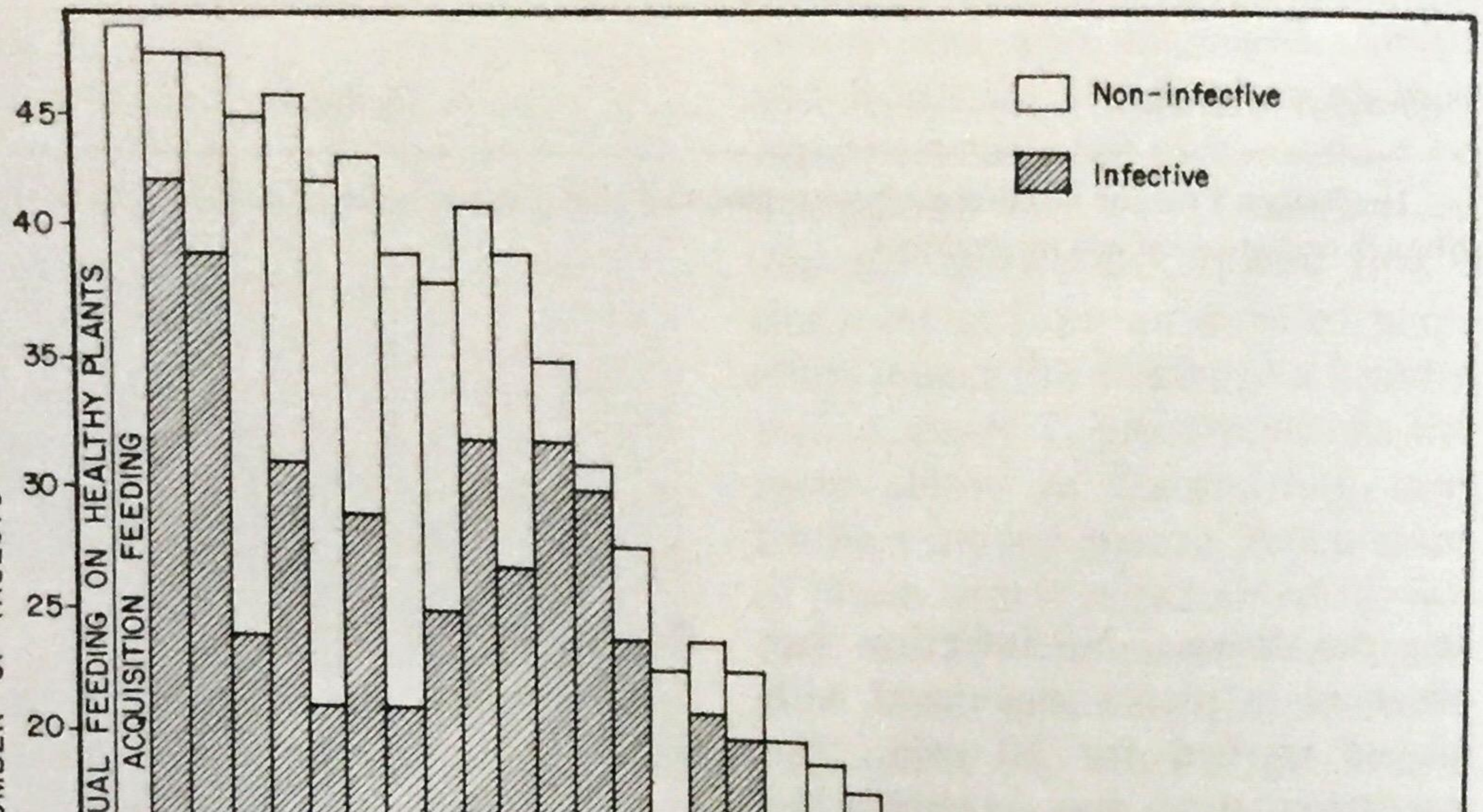

Figure 3. Taro feathery mosaic disease retention and transmission pattern by its vector, *Tarophagus proserpina* Kirk.

host plant before symptom initiation. This may also be the reason for the variation in TFM disease symptom from severe to slight feathery mosaic pattern on leaves of test plants as observed by Palomar et al. (1983).

The capacity of the insects to remain infective until death shows that the pathogen has a long retention period in the insect. Long retention periods may indicate multiplication of the pathogen in the vector, ability of the pathogen to remain active in the body of the insects for a long period, and slow rate of pathogen loss from the vector (Bennet and Wallace, 1938 as cited by Ling, 1969). Ling (1969) stated that if the pathogen (virus) does not multiply in the insect, the infective capacity of an insect is affected by the initial charge of the virus. Rivera and Ou (1965) concluded that for tungro virus, the percentage of infective insects was increased by prolonging the acquisition period. Hence, it is surmised that the long retention period of the pathogen in *T. proserpina* was not due to multiplication. The 24-hr acquisition period probably enabled the nymphs to acquire a greater dose of the pathogen, thus giving them a high probability of remaining infective until death.

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