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TRANSMISSION STUDIES OF WATERMELON MOSAIC VIRUS BY APHIDS

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Comparative efficiency of four species of aphids as vectors of watermelon mosaic virus revealed *Aphis gossypii* as most efficient vector. *Lipaphis pseudobrassicae* and *Aphis nerii* are reported as additional vectors of watermelon mosaic virus. A detailed study of virus-vector relationship was made using *Aphis gossypii*. Transmission of the virus was apparently non-persistent.

INTRODUCTION

Watermelon mosaic virus is more prevalent than any other cucurbit viruses in areas of Eastern Uttar-Pradesh. It infects several cucurbits and causes a heavy loss by reducing the quantity and quality of its fruits. BHARGAVA & TEWARI (1970) and BHARGAVA *et al.* (1975) found that watermelon mosaic virus perpetuates on a number of cucurbits throughout the year and the vectors *Myzus persicae* and *Aphis gossypii* play an important role in its transmission in nature. RAZVI & KHURANA (1968) found that *Aphis gossypii* constitutes a major component of the vector population in Gorakhpur. In the present investigation detailed studies were undertaken to find out the virus-vector relationships of watermelon mosaic virus with its most efficient vector *Aphis gossypii*.

MATERIALS AND METHODS

All the experiments were carried out in an insect-proof chamber which was regularly fumigated to keep it free from insects. Cultures of watermelon moasic virus originally collected by BHARGAVA & TEWARI (1960) was maintained on *Cucurbita pepo* L. Var. *caserta* plant by mechanical inoculation. Test plants *Cucurbita pepo* L. Var. *caserta* were grown in 22 5 cm earthen-pots. The condition of insect and the methods of culturing and handling of the insects were the same as those described by WATSON & ROBERTS (1939). The test aphids were collected from various host plants in the field and placed in a collecting cage until used. The insects were transferred from collecting cages to 15 cm petri dishes by means of a camel hair brush. Only full grown apterous aphids were used. Unless otherwise stated the aphids were given four hours preacquisition fasting, two minutes acquisition feeding and twenty four hours infection feeding time. Five infective aphids were used in each test. During the acquisition feeding insects were watched through a magnifying lens to see when they took up a feeding position and the time was recorded from them. At the time of post acquisition feeding the test plants were covered with glass chimneys. These insects were killed at the end of experiments by spraying 3% Folidol E 605 solution. The plants were kept for one month under observation. The symptoms of infection produced by infective aphids appeared after 10 to 12 days.

RESULTS

Comparative efficiency of four vectors to transmit watermelon mosaic virus

Results in Table 1 indicate that of four aphids tested, *Aphis gossypii* is more efficient vector of watermelon mosaic virus which is followed by *Myzus persicae*, *Lipaphis pseudobrassicae* and *Aphis nerii*. Therefore, *Aphis gossypii* was selected for detailed examination of virus - vector relationships.

TABLE 1. Comparative efficiency of four aphids as vectors of watermelon mosaic virus

Aphid vector	Host plant	Number of plants infected out of 30	Percentage of infection
Aphis gossypii	*Lagenaria vulgaris* SCHARD.	26	86. 6
Myzus persicae	*Raphanus sativus* L.	24	80. 00
Lipaphis pseudo-brassicae	*Brassica compestris* L.	18	60. 00
Aphis nerii	*Calotropis procers* L.	15	50. 00

Virus-vector relationships of watermelon mosaic virus and Aphis gossypii

1. *Effect of preliminary fasting on the transmission*

Results in Table 2 indicate that aphids can acquire the virus even without preliminary fasting but the efficiency increased when they were given a fast upto four hours. This, however, decreased when the preliminary fasting period was increased.

TABLE 2. Effect of preliminary fasting on transmission

Preliminary fasting time (hours)	Number of plants infected out of 15 treated	Percentage of infection
0	4	26.6
2	6	40.0
4	8	53.3
6	5	33.3

2. *Influence of number of aphids on the infection*

Results obtained (Table 3) showed that a single aphid was capable of transmitting the virus, although percentage of transmission was very low. The optimum percentage of transmission was obtained with a group of five aphids.

TABLE 3. Infection transmitted by different number of aphids

Number of aphids transferred / plant	Plants infected out of 15 treated	Percentage nfection
1	5	33.33
5	10	66.6
10	9	60.0
15	9	60.0

3. *Effect of acquisition feeding time on transmission*

Results in Table 4 show that the optimum acquisition feeding time is 2 minutes. This also shows that with higher acquisition feeding time, there was a corresponding decrease in the incidence of virus transmission.

TABLE 4. Infection transmitted by the aphid with varying acquisition feeding time

Acquisition feeding time	Number of plants infected out of 15 treated	Percentage of infection
30 seconds	2	13.33
1 minute	8	53.3
2 ,,	10	66.6
5 ,,	8	53.3
10 ,,	5	33.3
15 ,,	5	33.3

4. *Effect of infection feeding time on transmission*

The result in Table 5 indicate that maximum percentage can be obtained at 24 hours infection feeding time.

TABLE 5. Effect of infection feeding time on transmission

Infection feeding time	Number of plants infected out of 15 treated	Percentage infection
2	5	33.3
12	7	46.6
24	10	66.6
48	8	53.3

5. *Effect of postacquisition fasting on infection*

Results (Table 6) show that the maximum infection occurred when the aphids were not starved after acquisition feeding. It decreased with increase in starvation period and the infection was completely lost after one hour.

TABLE 6. Effect of post acquisition fasting on infection

Postacquisition fasting time	Plant infected out of 15 treated	Percentage of infection
0 minute	10	66.6
5 ,,	8	53.3
15 ,,	4	26.6
30 ,,	2	13.3
60 ,,	0	0
2 hours	0	0

6. *Effect of transferring an aphid to a series of healthy test plants after acquisition feeding*

An experiment was carried out to find out the extent of plants to which an individual viruliferous aphid could infect after acquisition feeding. Results (Table 7) show that first three aphids caused infection to first plant and the 1st and 3rd aphid could also infect second plant but not the third.

TABLE 7. Number of successive plants infected by each aphid

Number of plants	Aphids				
	1	2	3	4	5
1st	+	+	+	—	—
2nd	+	—	+	—	—
3rd	—	—	—	—	—
4th	—	—	—	—	—
5th	—	—	—	—	—

DISCUSSION

Observations made in this study show that all the four aphid vectors transmitted the virus. This also shows the comparative efficiency of these four aphids as vectors and *Aphis gossypii* has been found as most efficient vector of watermelon mosaic virus. Observations made by earlier workers have indicated *Myzus persicae* to be the most efficient vector of watermelon mosaic virus (CAUDRIET, 1962; TOBA, 1963). The ability of an aphid species to transmit the same virus in different areas is affected by the aphid's physiological specialization and vector specificity of the virus isolates (ROCHOW, 1960). In the present investigation too, *Myzus persicae* and *Aphis gossypii* are important vectors, but *Aphis gossypii* is comparatively more efficient to transmit the virus than *Myzus persicae*. The efficiency of this vector is also suggested by findings of BHARGAVA *et al.* (1975) who found *Aphis gossypii* constituting the major component of vector population in areas of Eastern Uttar-Pradesh.

The aphids *Lipaphis pseudobrassicae* and *Aphis nerri* are being reported for the first time as vectors of watermelon mosaic virus.

Studies on virus-vector relationships of watermelon mosaic virus and *Aphis gossypii* show that a single aphid can transmit the virus although, the optimum percentage of infection was obtained by a group of 5 aphids.

Preacquisition fasting up to 4 hours increases the efficiency of vector to virus uptake though transmission was obtained even without fasting. The maximum acquisition of virus was obtained in two minutes, subsequently becoming reduced. These findings support the views (BRADLEY, 1952) that in the acquisition of nonpersistent viruses, primary or initial probes within 10 seconds to 1 minute are important. The preliminary fasting time given to *Aphis gossypii* increased the efficiency of the aphids

only when short feeding periods were given. Similar observations have been made by BHARGAVA (1951) and MILLER (1952). After 1 hour of post acquisition fasting the aphids failed to transmit the virus. The decrease in the capacity to produce infection with an increase of post-acquisition fasting period is characteristic property of non-persistent virus (WATSON & ROBERTS, 1939). The vector virus relationships under study shows that the virus is non-persistent in nature. This is further proved by serial transfers of aphid to healthy plants where the aphid ceases to be infective very soon while feeding on a series of test plants.

The prevalence of this aphid on wild and cultivated cucurbits and non-persistent nature of the virus are responsible factors for wide occurrence of this disease in areas of Eastern Uttar-Pradesh.

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