HELIA, **15**, Nr. 17, p.p. 65-68 (1992)

STUDIES ON INSECT TRANSMISSION OF SUNFLOWER MOSAIC DISEASE

M.Sreehari, N.Govinda Rao and K.S.Sastry

Department of Plant Pathology, Andhra Pradesh Agril. University, Rajendranagar, Hyderabad–500 030,
Directorate of Oilseeds Research, Rajendranagar, Hyderabad–500 030, (A.P.) India,

SUMMARY

A mosaic disease of sunflower (*Helianthus annuus* L.) was reported by Venugopal Rao *et al.* (1987) and etiological agent was found to be cucumber mosaic virus. Three species of aphids, *Aphis gossypii* Glov.; *Aphis craccivora* Koch, and *Rhopalosiphum maddis* Fitch. were found to be vectors of the virus. Further investigations were carried out to find out the other possible vectors and on the relationship of causal virus with the aphid *A.gossypii* which was proved to be the most efficient vector and the results of these studies are being reported herein.

Key words: Mosaic disease of sunflower, cucumber mosaic virus, aphids, vectors.

MATERIAL AND METHODS

The culture of the virus isolated by Venugopal Rao *et al.* (1987) was continuosuly maintained by periodically inoculating young sunflower plants in the insect – proof glass house. Virus free colonies of *A. gossypii, A. craccivora, R. maidis, Myzus persicae* and *Uroleucon compositae* were collected from cotton (*Gossypium herbacium*), groundnut (*Arachis hypogaea*), jowar (*Sorghum biocolor*), brinjal (*Solanum melongena*) and saf-flower (*Carthamus tinctorius*). Healthy colonies of the said aphid species were raised from single aphid and maintained on their respective hosts before using them in transmission studies. Unless mentioned otherwise only adult wingless individuals numbering 10 per plant and 10 plants for each treatment were used in all the tests. For all the experiments the sunflower hybrid BSH–1 was used both as virus source and as test plant and each treatment was replicated twice. During test feeding, the plants were covered with insect--proof nets. At the end of test feeding, the insects were killed by spraying Dimethoate (0.02 per cent) on the test plants. Standard procedures were followed for virus–vector relationship studies as described by Noordam (1973).

RESULTS

Transmission tests with different aphids: The apterous adults of the five aphid species viz., *A. gossypii, A. craccivora, U. compositae, M. persicae, and R. maidis* were starved for one hour before feeding on the virus source for 10 minutes and then put in groups of 10 aphids on each test plant for 24 hourse. The results showed that *A. gossypii* was the most

efficient vector with 60% virus transmission followed by 45% with *A. craccivora*. The transmission percentages with the other three aphid species viz., *M. persicae, R. maidis,* and *U. compositae*, were 30.30 and 20, respectively.

VIRUS VECTOR RELATIONSHIP WITH RESPECT TO THE APHID *APHIS GOSSYPII*

I. *Effect of pre–acquisition and post–acquisition starvation on transmission*: The pre–acquisition starvation increased the efficiency of the vectors and maximum (60%) efficiency of the vector was obtained with one hour pre–acquisition starvation period. As the starvation period was increased to two hours the efficiency dacreased (30%). With further increase, there was an inverse relationship between the length of post–acquisition starvation and efficiency of the vector. Post acquisition starvation of the aphids for 30 minutes, one hour and two hours resulted in decreased transmission of 35,30, and 0 per cent respectively. Without post acquisition starvation treatment, the maximum transmission achieved was 60%.

II *Effect of acquisition and inoculation feeding period on transmission of the virus*: The efficiency of the vector to transmit the virus increased with an increase in the access period on the disease source. The efficiency was maximum (60%) at 10 minutes access period and it began to decrease (5–40%) when the access period exceeded 10 minutes. The data also showed that 1 minute access to healthy test plants was enough for viruliferous aphids to initiate infection (10%) but maximum infection (60%) was obtained with 10 minutes access to the helathy test plant. With inoculation feeding period beyond 10 minutes the virus transmission was decreased. It was observed that even 1 or 2 min. inoculation period was sufficient to transmit the virus, but the transmission percentage is to the tune of 10–15%.

III. *Effect of number of viruliferous aphids on virus transmission:* Even though a single viruliferous aphid was capable of initiating infection to the tune of 20%, the maximum percentage (60%) of infection was obtained when 10 aphids per test plant were used. It was also recorded that with five aphids the virus transmission was 35%.

IV. *Effect of alate and apterate forms of A. gossypii on transmission of the virus*: The virus was transmitted up to the 3rd plant in a series of 10 plants. Therefore it was clear that virus was held by the vector for not more than 30 minutes indicating a non–persistent virus–vector relationship.

DISCUSSION

In addition to the three aphid vectors reported earlier (Venugopal Rao *et al.,* 1987), *Myzus persicae* and *Uroleucon compositae* were also found to transmit the mosaic disease of sunflower. It was found that pre–acquisition starvation greatly increased the efficiency of the vector and maximum efficiency was obtained with one hour starvation. With further increase in pre–acquisition starvation, the efficiency of the vector to transmit the virus has decreased. The post–acquisition starvation on the contrary decreased the efficiency of the vector indicating a non–persistent relationship between virus and the vector. Similar results were reported by Singh *et al.* (1975). Joshi (1977) and Suter *et al.*

(1985).

In the present studies minimum acquisition and inoculation feeding periods for the vector were one minute each. However, maximum efficiency was obtained with 10 minutes of each, acquisition feeding and inoculation feeding periods. With further increase in acquisition and inoculation feeding periods the efficiency of the vector was decreased. The results are in conformity with the findings of Sharma and Yadav (1985) and Shreni *et al.* (1985).

It has been observed that increase in the number of aphids up to 10 per plant has increased the efficiency of the vector. This may be due to the increased probability of transmission merely by increasing the choice of including more viruliferous individuals in the total as reported by Singh *et al.* (1975) and by Joshi (1977).

The differences in transmission efficiency of alate and apterate forms of the vector reported herein are in confimity with the findings of Azad *et al.* (1963) and Ranga Raju and Chenulu (1968). The present results also indicated the non–persistent relationship between the virus and the vector as the vector could hold the virus for more than 30 minutes and the present findings are similar to the findings of Thangamani *et al.* (1970); Singh *et al.* (1975) and Shreni *et al.* (1985).

A non–persistent virus is one which is easily acquired by the vector, i.e., by short acquisition feeding period and is easily transmitted by the vector with short inoculation feeding period. The viruliferous aphid vector loses its transmissibility within a short period after acquisition. Longer acquisition feeding periods make the vector to lose its transmissibility. All these characters are true with the virus and the vector under investigation. Since results of our present studies almost coincide with the typical characteric features of non–persistent viruses described herein, it can be inferred that the virus–vector relationship of sunflower mosaic virus with *A.gossypii* is non–persistent type.

CONCLUSIONS

Safflower aphid, *Uroleucon compositae* Theob, has been found to be the additional vector of mosaic disease of sunflower. Detailed investigations on the virus–vector relationship with regard to the aphid vector, *Aphis gossypii* Glov., and sunflower mosaic disease, carried out indicated that pre–acquisition starvation increases the efficiency of the vector. Maximum efficiency has been obtained with 1 hour starvation. Optimum access period for acquisition as well as for inoculation of the virus is 10 minutes. Post–acquisition starvation decreases the efficiency of the vector. Percentage of transmission increases with increase in number of viruliferous aphids per plant. Apterate adults have been found to be more efficient than alate adults. The virus is not retained for more than 30 minutes in the vector. Based on the present studies, it is inferred that the virus–vector relationship of sunflower mosaic disease with *A.gossypii* is non–persistent type.

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ESTUDIOS SOBRE TRANSMISION DEL MOSAICO DE GIRASOL

RESUMEN

El afido de cártamo, *Uroleucon compositae* ha resultado ser un vector adicional del mosaico del girasol. Investigaciones detalladas llevadas a cabo sobre la relación virus–vector en relación al vector, *Aphis gossypii* glow y el mosaico del girasol indicaron que el estrés previo a la presencia del vector incrementa la eficiencia del vector. La eficiencia máxima se obtuvo con 1 hora de estrés. El periodo óptimo de acceso para la presencia así como la inoculación del virus es de 10 minutos. El estres posterior decrece la eficiencia del vector. El porcentaje de transmision incrementa con el aumento del número de afidos viruliferos por planta. Los adultos no alados fueron encontrados mas eficientes que los alados. El virus no es retenido por mas de 30 minutos en el vector. Basados en el estudio presente se infiere que la relación virus–vector del mosaico del girasol con *A. gossypii* es del tipo no persistente.

ETUDE DE LA TRANSMISSION ENTOMOPHILE DE LA MOSAÏQUE DU TOURNESOL

RÉSUMÉ:

Nous avons trouvé que le puceron du carthame *Uroleucon compositae* Theob est un vecteur additionnel de la mosaïque du tournesol. Des recherches détaillées effectuées sur les relations virus vecteur concernant le puceron *Aphis gossypii* Glov et la mosaïque du tournesol montre qu'une diète de pré–acquisition augmente l'efficacité du vecteur. Le maximun d'efficacité a été obtenu avec une diète d'une heure. La durée optimale pour le passage aussi bien au moment de l'acquisition que pour l'inoculation est de 10 minutes. La diète de post–acquisition diminue l'efficacité du vecteur. Le pourcentage de transmission augmente avec le nombre de pucerons virulifères par plante. Les adultes aptères se sont révélés être plus efficaces que les adultes ailés. Le virus n'est pas retenu plus de trente minutes dans le vecteur. Il peut être conclu, d'aprés cette étude, que les relations virus – vecteur chez la mosaïque du tournesol avec *A.gossypii* sont de type non–persistant.