BIOLOGICAL STUDIES ON POTATO LEAF ROLL VIRUS DISEASE

BY

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INTRODUCTION

Potato Leaf roll virus (PLRV) is of historical interest as well as of economic importance. It is first described and named by Orton in his bulletin of 1914. While Quanjer, in 1916, was the first to demonstrate the infectious nature of the disease.

Potato leaf roll virus disease is one of the most important virus disease in Egypt because of its widespread and its depressing effect on potato yield.

Properties of the virus causing potato leaf roll disease is not well known. It is not sap transmissible. All attempts made to prepare antiserum specific to this virus failed.

Many attempts were made to detect diseased potato tubers and plants for the presence of PLRV using different methods. The use of most of these methods did not prove to be too promising. At the present time, reproduction of the specific symptoms of the disease by grafting or by aphid transmission is the only sure means of distinguishing it, but it is worth mention that indexing programmes using

plant hosts are extremely time - consuming and also very expensive.

The use of suitable laboratory indexing methods could eleminate such difficulties.

The present work was undertaken to study :

I- Transmission and Host Range of PLRV.

II- Diagnosis of the Virus in potato plants and tubers.

III- Effect of the virus on the yield and chemical constituents in potato leaves and tubers.

transmission is essential in studies concern this virus Sapkar (1963) found that PLRV was transmitted to a portion of Potato Clone by top-grafting with scions of Physelis floridana carrying the virus. Cupertino & Costa (1967) mentioned that in grafting 60 - 70 day old potato stems on 40 days old Datura stramonium seedling rootstocks, symptoms appeared 30 - 40 days later, and he found that the method can be used on a large scale. Williams (1957) found that the percentage of transmission by Cuscuta subinclusa was increased by heavy shading of the test plants and pruning of the bridging dodder.

Potato leaf roll virus spreads within potato fields mainly by aphids. The chief insect vector for PLRV is the green Peach aphid Myzus persicae sulz. (Smith 1929, Stegwee 1960 and others).

Other species of aphids can also transmit the virus:

These are Ascalonicus doncaster (Heinze, 1951) cited from Smith (1957). Myzus circumflexus Buckt. (Whitehead, 1930, 31; Smith, 1930; Dykstra & Whitaker, 1938.). Myzus ornatus (Loughnane,1939; MacCarthy, 1954). Macrosiphum solanifolii Ashm, M. pseudosolani (Murphy &

Mckay 1929, Reddick, 1936) and Macrosiphum solanifolii Ashm (Kirkpatrick & Frankross, 1952, Peddick, 1936). M.pseudosolani (Ossialnnilsson, 1944). Macrosiphum convoluli Kirkpatrick & Frankross (1952)., Macrosiphum euphorbiae (Day, 1955; Daiber, 1962; Murayama, KoJima, 1965, Makinnon, 1969).

Elze (1932) found that Aphis rhamni, Aphis Fabae, Psylloides affinis can also transmit the virus. Heinza(1959) mentioned that a new vector of PLRV is Myzotoxoptera tulipaella.

Results obtained by several workers studied the green Peach aphid-Potato leaf roll virus relationship were widely different. Oortwijn Botjes (1920) demonstrated in greenhouse experiments that the disease could be transmitted by the aphid M. persicae. He correctly assumed that this also occurred in the field Schultz & Folsom (1921)reported similar results with the aphid M. persicae.

Elze (1927) reported that Aphids (Myzus persicae) fed upon infected potatoes for 14 hours were able to infect healthy potatoes when they had 24 hours test feeding period but not during a - 10 hours feeding time.

Smith (1931) found that aphids can acquire PLRV from an infected potato plant after 6 hours infection period,

and they are capable to transmit it to a healthy potato plant after 2 hours inoculation feeding period. Bawden , (1951) demonstrated that aphids fed for two (2) hours on infected D. tatula plants became infective, but could not transmit the virus during the succeeding 24 hours. While aphids which had fed on infected plants for several days could infect healthy plants within 15 minutes.

Kassanis (1952) reported that Aphids transmitted leaf roll virus after 2 hr. for both infection and test feeding periods. The number of plants infected by aphids increased when the feeding time on both infected and test plants were elongated to 4 hours. The inoculation feeding period was not more than 30 min.

The time of inoculation feeding can be roduced to 10 - 15 min, when very infective aphids are used. This period was determined by Roberts (1940) as the minimum period required for the aphids stylets to reach the phleom, and this may be interpreted that PLRV has to be introduced the phloem for infection to occur.

Webb, Larson and Walker 1952 reported that a 6 hours feeding period on the source of inoculum was shown to be sufficient for aphids to acquire the virus and after

Mangercats (1956). Williams, Liewelyn, and Frank ross(1957) reported that the minimum time required for acquisition of leafroll virus by Myzus persicae from infected Physalis floridana or Datura stramonium was half an hour. They found also that aphids reared on infected D. stramonium transmitted the virus to D. stramonium and P. floridana in 10 and 30 minutes respectively. Such aphids transmitted the virus with equal facility to 2 species during test feeding of 15 - 30 minutes.

Stegwee (1960) mentioned that at least about ten minutes feeding are required for the aphids to pick up the virus. Oshima et al (1966) in Japan found that Myzus persicae sulz. fed on infected Physalis floridana Rydb. for 30 and 60 minutes were unable to infect healthy P. floridana seedlings within 3 hours after leaving the source plants, but fifty percent infection occurred when 24 - 48 hours inoculation feeding period were used. They reported also that the aphid vectors reared on infected Datura stramonium L. were able to transmit the virus to Physalis floridana within 5 minutes.

an interval or latent period of 30 hours can transmit the virus to healthy plants. Once the aphids become viruliferous, only a 2 hours feeding period was required for them to transmit the virus.

Kirkpatrick & Ross, (1952) reported that three of the 10 aphids allowed to feed on the infected plant for 30 minutes became infective. As the feeding period increased, up to about 24 hours, the number of aphids that become infective also increased. He found also that the shortest inoculation period was 30 minutes.

MacCarthy, (1954) mentioned that the acquisition threshold period was found to be 2 hours.; the inoculation threshold period was found to be 30 minutes, and the transmission threshold period was found to be 12 hours in comparison with 4 hours acquisition and 8 hours inoculation.

In experiments at the phytopathological Research institute, Wageningen, Holland it was found that an acquisition period of 15 minutes on Physalis floridana infected by potato leaf roll virus followed by 15 minutes inoculation feeding period on the same host, sufficed for the transmission of the virus by groups of Five initially virus-free, non-fasting Myzus persicae. DeMeester &

Loughnane (1941) has divided certain potato varieties into three groups on the basis of their susceptibility to leafroll.

Group I : Most susceptible: Arran cairn, up to-date, Arran signet.

Group II : Intermediate : Arran pilot, British Queen, Kerr's pink, Gladstone, Arqan peak, Arran victory, Dumbar yeoman, Ulster Monarch, May queen, President, Great scot, Arran crest, Epicure, Redskin, Dunbar standard.

Group III: Least susceptible : Flourball, Arran banner, Majestic.

Salaman and Wortly (1939) reported that leaf roll virus was successfully transmitted to Campanula , to Matthiola, and turnip by grafting and to Brussels sprouts by means of Aphids.

Quanjer (1923) reported that plants of Nicotiana tabaccum L., Atropa belladona L., Datura stramonium L., Hyoscyamus niger L., Solanum nigrum L., and S. dulcamara L., can be infected by means of aphids or grafts.

In 1933 Dykstra transmitted the leaf roll virus to some solanaceous plants, viz, Datura stramonium. L.,