STUDIES ON POTATO VIRUSES Y AND A

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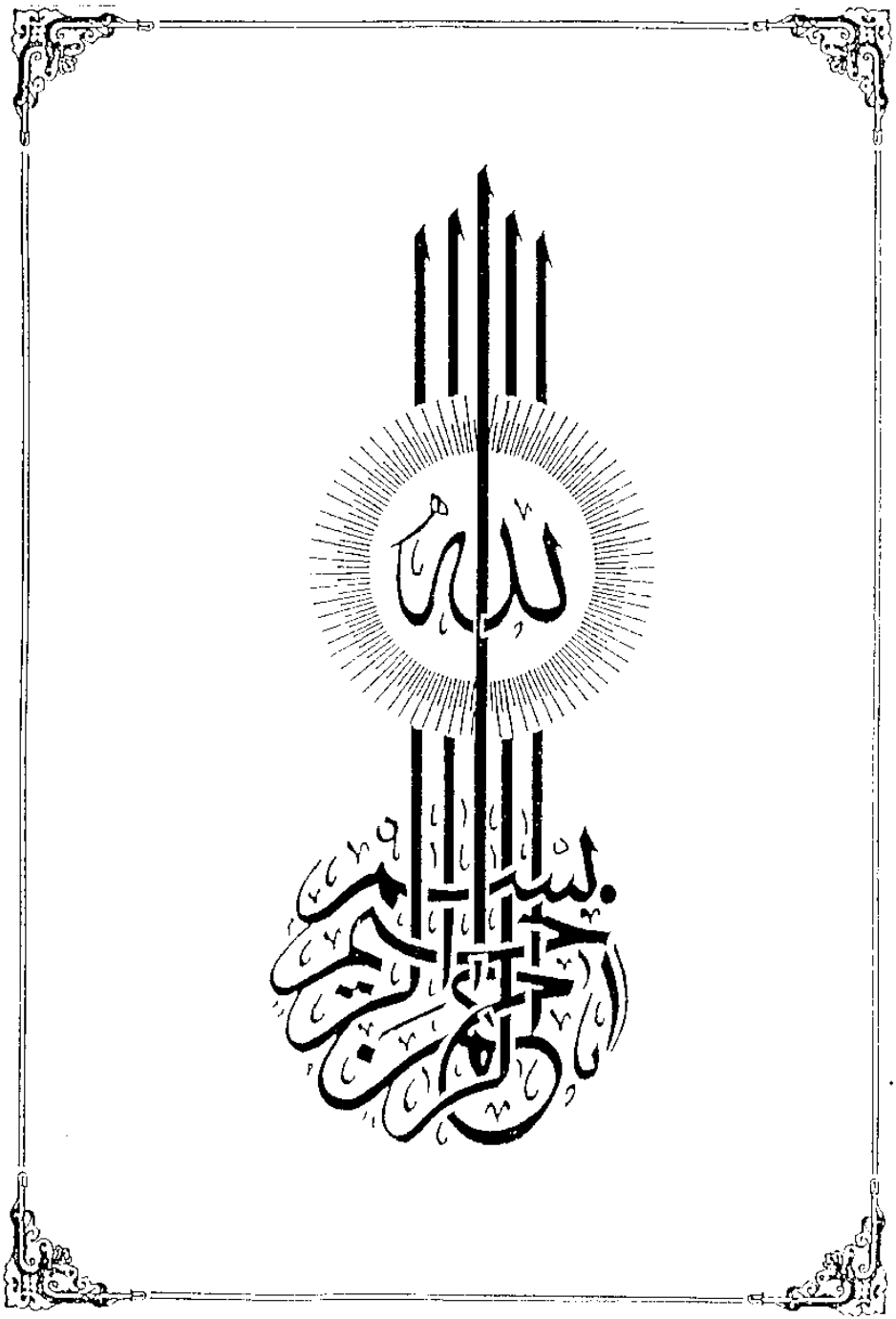

C O N T E N T S

INTRODUCTION

Several of the potato diseases are known to be due to virus infection. Martyn 1968 lists 33 types of virus, not counting the many strains within each type, however not all of these are proven viruses. Some may turn out to be mycoplasmas (DE Bokx, 1972).

Viruses known to infect potatoes may conveniently be classified into two general categories, (a) those that normally caused distinct foliar, or in certain instance, tuber symptoms, for example potato leaf roll virus, potato virus Y, etc., (b) those that frequently do not produce consistent foliar or tuber symptoms, for example potato S and M viruses (Shepared & Claflin, 1975) and potato virus A (Beemster, 1960).

Potato virus Y has long been studied by different workers and from different parts of the world. It is still a major potato virus, because it spreads easily and so much reduce yield. Arenz & Hunnius (1959) estimated the losses brought out by tobacco veinal necrosis, a strain of PVY, and found a yield reduction of about 14 percent in masked infection and of about 20 percent in visible infection. Crop losses due to potato virus Y infection in Egypt amounted to 54% (Omar et al., 1969).

Potato virus A (Murphy and McKey , 1932) another of the important viruses affecting potato reduces yield by up to 40 percent (Bartels, 1971).

Potato viruses Y and A particles are indistinguishable by electron microscopy, and are difficult to differentiate on the symptoms they incite in various test plants, However, they may be distinguished serelogically using a special technique (Fribourg & DE Zoeten,1970) and biologically on specific test plants (Bartels, 1971).

In general, most of the viral or mycoplasmal diseases are nearly always diagnosed on the basis of symptoms visible in the field, except for potato viruses Y and A, where, the routine laboratory testing is necessary (Shepard & Claflin, 1975).

Biological tests used to detect infected tubers are time consuming and laborious. Suitable laboratory methods such as biochemical diagnosis would no doubt minimize such difficulties to a large extent.

The object of this investigation is to differentiate between PVY and PVA, present in the Egyptian fields, to study the effect of the two most predominant PVA strains, viz. tobacco veinal necrosis, and tobacco vein-banding on the solute contents of potato and tobacco hosts and to conduct some comparative biochemical color test to detect the infected potato tubers.

REVIEW OF LITERATURE

Part I- Identification

It was suggested by Clinch & Laughnane (1933) that the virus of potato mosaic group should be divided into an X , and a Y groups with virus A being included in the Y group. Bawden (1936) belived that there was little justification for this classification since virus A and Y were not related in the same way as were the strains of virus X, although they produced similar symptoms on tobacco and both were transmitted by Myzus persicae Sulz. Hansen (1937) reported that virus A reacted with Y antiserum, but Bawden (1944) was not able to confirm those results. According to Bartels 1963; 1964 different degrees of relationships exist between potato viruses Y and A (Brunds & Berks 1965) Fribourg and LE Loeten (1970) produced an antiserum against PVA with a homologous titer of 1/512 and heterologus titer against an PVY isolate of 1/64. Gregor (1958) reported that necrotic response to virus Y in Solanum demissum Lindl. is always accompanied by a necrotic reaction to virus A. He added that the relationships established between the genes and the viruses suggested that virus Y and Virus A are related. In general PVA shows similarity

with PVY, but the differences between them justify the nomenclature as different viruses (Beenster and Rozendaal, 1972).

A: Potato virus Y:

1- Strains:

Rugose mosaic of potato was first described in(1923) by Schultz & Folsom. The virus nature of the disease was not fully demonstrated until the same authors (1925) transmitted the infective entity to potato both by mechanical and aphid inoculations.

The identity and nature of the components of rugose mosaic was given by Smith (1931). His experimental data proved that the rugose mosaic disease of potato is caused by 2 viruses, one was transmissible by sap as well as by aphids, which he named potato virus 1, and the other was transmissible by sap and not by aphid which he called potato virus X.

Since the discovery of the duel nature of potato rugose mosaic, it has been shown that virus Y is not composed of uniform entities, but it consists of several strains (Bawden & Sheffield, 1944; Bawden & Kassanis, 1947, Darby et al , 1951).

Easten et al.,(1958) divided 16 isolates of PVY obtained from Brazil, Ecuador, Halland, Germany, Irland, and the U.S.A., on the basis of severity of symptoms produced on some potato varieties into 3 groups viz. severe isolates, medium isolates, and erratic isolates. Munro (1955) tried to differentiate PVY strains that can not be clearly distinguished on potato using Physalis floridana Rydb. He concluded that the strains causing mild symptoms on potato induce severe symptoms on P.floridana and Vice versa. On the basis of serological relationship between PVY strains, Bartles 1964 , divided PVY strains into common, necrotic, and anomalous strains(De Bokx (1964). DE Bokx (1964) mentioned that Bartles classification does not include the strain of potato stipple streak. Therefore, he divided the strains of this virus into 3 groups: Y^{o} (common strains), Y^{N} (tobacco veinal necrosis strains) and Y^{C} (Potato stipple streak strains). In Southeastern United States Bedding and Tolin (1970) grouped PVY strains isolated from Solanaceous crops on the basis of the reaction of root-knot nematode-susceptible and resistant varieties of flue-cured tobacco into three strains viz. , $M^{S}M^{R}$ (caused mild symptoms in both root-knot nematode susceptible and resistant varieties), $M^{S}M^{R}$ (caused mild symptoms in root-knot nematode resistant varieties), and

$N^{S}N^{R}$ (caused necrotic symptoms in both root-knot nematode susceptible and resistant varieties).

2- Host range and differential hosts:

Many strains or rather groups of strains are known that can be distinguished according to the severity of systemic symptoms on potato, tobacco or other hosts.

Easton et al (1958) mentioned that the severe isolates of PVY are characterized by local necrotic lesions, leaf dropping, severe mosaic, rugosity, chlorosis, and stem streaking in potato. The medium isolates produce a moderate rugose and leaf dropping. The erratic isolates which includes TVN strains failed to produce symptom on 14 potato varieties. Silbersehmidt (1960) confirmed the difficulty in transmitting the necrotic strains of this virus to potato plants, whereas Richardson (1956) reported that these strains infect potato plants as readily as did the typical strains.

Beemster and Rozendaal (1972), described the reaction of Dutch potato varieties infected with PVY strains. They mentioned that mild mosaic and rugose occur in certain varieties with certain strains, and other varieties react with crinkle. Any one variety may reacts differently to

different strains. he added that sensitive varieties react with necrosis which may affect only some veins on the lower surface of the leaves or may form severe necrosis on leaves or stems. Such severe necrosis may ultimately causes older leaves to collapse and either drop from the plants (called leaf drop streak) or remain hanging (called palm tree type).

On tobacco, the normal strains of PVY are known to produce vein-banding symptoms (Dykstra, 1936; Klinkowski & Schmelzer, 1960). Nicotiana tabacum L. vars. White Burley and Samsun used by several authors as differential hosts for the necrotic strains of this virus (Smith and Dennis, 1940; Neberg & Silberschmidt, 1944; Klinkowski & Schmelzer, 1960; DE bokx, 1961; Kahn & Monroe, 1963; Brilova-Yongulova, 1965 and Lockhart & Fischer, 1976 b).

On the other hand, various local lesion host viz., P. floridana (Ross, 1953, Munro, 1955; De bokx, 1961); detached hybrid A6 leaves (Kohler, 1953, DE bokx, 1961, 1964); Chenopodium amaranticolor Costel & Reyn (Fontis & Foldman, 1963 , Ch. quinoa L.(Delgado- Sanchez & Grogan, 1966) , and Nicandra physaloides (L.) Gaertn. (Silberschmidt & Rostom, 1955) have been used.

The following hosts have been recorded as systemic hosts: Lycopersicon spp. (Sturgess, 1956, Silberschmidt, 1956; Pontis & Feldman, 1963), Capsicum annum L. (Silberschmidt 1956; Cook & Anderson, 1960; Pontis & Feldman, 1963), Nicotina glutinosa L., Nicotiana rustica L., Petunia hybrida vilm. (Sakimura, 1953; Pantis & Feldman, 1963); Solanum restoratum Dual.; Nicotiana sylvestris Spegas & Comes (Pontis & Feldman, 1963); Nicotiana debneyi Domin. (Macbinnon & Bagnall, 1972, and Datura ferox and D. metel L. (Van Der Plank & O'Conner1952).

3- Cross-protection between PVY strains:

The vein-banding and C strains of PVY have been reported to protect potato as well as tobacco against manifestation of the severe symptoms ordinarily incited by the more virulent strains (Dykstra, 1939; Salman, 1937; Bawden & Sheffield, 1944 and Darby et al., 1951). However, Bawden and Kassanis (1951) found no such correlation with strains of potato virus Y. Tobacco veinal necrosis, potato virus Y, and potato virus C are all closely related serologically, but whereas potato virus C and Y protect plant against each other, they do not protect plants against veinal necrosis virus. The interaction between strains

of potato virus Y was investigated by several workers and their results made the original observation even more interesting. They confirmed that plants infected with some strains of potato virus Y were not protected against infection by tobacco veinal necrosis, but found other strains which affect partial protection (Munro, 1955; Richardson, 1958; Easton et al,1958, Klinkowski & Schmelzer, 1960; Todd, 1961; and Horvath, 1969). Munro (1955) working with a strain of TVN found that a mild strains of PVY failed entirely to protect tobacco plants against the necrotic strain, however, it caused only a delay in the development of symptoms and decreased the symptoms severity. Todd (1961) working with strains of potato virus Y that partially protected against veinal necrosis virus, found that protection was increased by inoculating leaves of a certain position on the plant and by avoiding "swamping" the plants with inoculum of the challenging virus. In (1964), Gamez & Gonzalez found that the normal strain decreased the severity of symptoms of TVN on tobacco, but they failed to obtain similar results in N.rustica. Horvath (1969) reported that strain C protected tobacco plants against the normal strain, but not against TVN or the anomalous strains. His data

indicated that the TVN and the anomalous strains did not protect against any other strain of PVY. When he carried out a simultaneous inoculation with mild and severe strain of either C or normal strain he observed milder symptoms than inoculation with severe isolate alone.

In Japan Tomarue & Udegawa (1968) isolated a new strain of PVY causing yellow ring spot on White Burley tobacco and found a complete cross-protection between this strain and the ordinary strain, whereas in Morocco Lockhart & Fischer (1976a) found no cross-protection between a necrotic strain caused calico symptoms on tobacco and the ordinary one.

4- Physical properties:

Darby et al (1951) determined the physical properties of various PVY strains collected from the U.S.A., England, and New-Zealand. They found that none of the isolates were infectious after heating for 10 minutes at 62 °C., whereas all survived after 10 minutes at 54°C. All isolates remained infectious after 6 days storage in vitro at 20-22°C., but were inactivated after 18 days. Inactivation by dilution ranged from 1: 10,000 to 1:100,000.