New Natural Weed Hosts of *Sweet potato feathery mottle virus* in Syria

Ensaf Akel[1], Imad D. Ismail[1], Salah Al-Chaabi[2] and Segundo Fuentes[3]
(1) Faculty of Agriculture, Tishreen University, Lattakia, Syria, Email: ensafakel@hotmail.com;
(2) General Commission for Scientific Agricultural Research (GCSAR), Douma, Damascus, Syria;
(3) International Potato Center (CIP), Lima, Peru

Abstract

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A survey was conducted along the Syrian coastal area to identify natural weed hosts of *Sweet potato feathery mottle virus* (SPFMV, genus *Potyvirus*, family *Potyviridae*). Eight hundred sixty eight selected samples representing fifty six species (forty five genera, twenty three families) were collected from ten fields related to five regions (Zagrin, Sarsakia, Brgan, Ras Al-Aen, and Hreson) during 2006/2007 and 2007/2008 growing seasons. All samples were tested for *the presence of Sweet potato feathery mottle virus* by using tissue blot immunoassay and polyclonel antibodies. Results showed that nineteen species were naturally infected with *Sweet potato feathery mottle virus* including *Amaranthus retroflexus* L., *Atriplex hastate* L., *Brasica oleracea* var. capitata., *Calendula officinalis* L., *Capsicum annum* L., *Chenopodium* sp., *Chenopodium hybridum* L., *Chenopodium polyspermum* L., *Chenopodium vulvaria* L., *Convolvulus arvensis* L., *Cucurbit maxima* Dush., *Heliotropium europaeum* L., *Ipomoea violacea* L., *Malva neglecta* Wallr., *Mentha arvensis* L., *Phaseolus lanatus* L., *Sinapis arvensis* L., *Spinacea oleracea* L and *Traxacum officinale* Web belonging to twelve families and mostly to the families *Chenopodiaceae* and *Convolvulaceae*. All weed species were recorded for the first time in Syria as natural hosts of SPFMV.

Keywords: SPFMV, sweet potato, Syria, viruses, weed.

Introduction

Volunteer plants and weeds provide shelter and sources of nutrients for virus vectors. Other vegetative structures or contaminated weed seeds may also harbor viruses. Aside from facilitating the spread of disease as alternative source of inoculum, these plants sustain the viability of the virus between crop seasons (16). Numerous weeds that act as reservoirs for a virus and its vectors (6, 22), and certainly those of genus *Datura*, have been found to be important in the epidemiology of certain viral diseases (17, 20, 25). *Sweet potato feathery mottle virus* (SPFMV; genus *Potyvirus*; family *Potyviridae*) is the most common virus on sweet potatoes (*Ipomoea batatas* (L.) Lam) in Africa (24, 32, 33, 38) and elsewhere in the world (7, 9, 11, 26, 28, 30, 35) and causing variable symptoms and damage to the crop (11, 26, 28, 30). The first report of a SPFMV incidence was from Africa (15). Later it was reported from Italy (32), and recently in the Syrian coastal area (2, 21). SPFMV is transmitted by aphids, *Aphis gossypii, A. craccivora, Lipaphis erysimi, Myzus persicae,* in a nonpersistent manner (4, 5, 13, 18, 35). The virus can also be transmitted mechanically, and by grafting (2, 4, 8, 29). It is not transmitted by contact between plants, by seed, or by pollen (7). Many isolates and strains of SPFMV have been characterized in different parts of the world. Some strains of SPFMV cause economic losses by their effect on storage root quality (internal cork and russet crack) (19, 29). In the last few years, four strains of SPFMV (RC, O, C and EA) have been reported (34, 36). Two strains were found in North Carolina (31). Four strains of SPFMV were recorded in Syria based on their reaction on the indicator plants *I. setosa* and *I. nil* (3). In Japan, most of sweet potato cultivars were susceptible to a SPFMV-S strain, which causes serious production losses (39). An East African strain of SPFMV incited severe ‘sweetpotato virus disease’ in plants co-infected with *Sweet potato chlorotic stunt virus* and threatens subsistence sweetpotato production. However, little was known about its natural hosts and ecology, although SPFMV incidence was similar in annual and perennial species (37). The experimental host range of the virus is mainly restricted to the *Convolvulaceae* and *Chenopodiaceae* families, but a few SPFMV strains also infect species of the family *Solanaceae* of which *Nicotiana benthamiana* is a good propagation host for virus purification (12).

In Louisiana, United states, the perennial wild plants of *I. trichocarpa* Ell. and some annual wild species such as *I. hederacea* Jacg., *I. hederifolia* L., *I. lacunose* L., and *I. wightii* (Wall) were infected with SPFMV in the field and may act as a natural reservoir of SPFMV which can then be transmitted to sweet potato (12). In East Africa, over 89 species of *Ipomoea* (40) and several species of other genera of Convolvulaceae were known to occur, including one species each of the genera *Hewittia* (Wight & Arn) and *Lepistemon* (Blume) (40). In central Uganda, *I. eriocarpa* R.Br., *I. hederifolia* L., and *I. tenuirostris* Chisy were reported to be infected with SPFMV (23, 24).

The main objective of this research is to identify the weeds which can host SPFMV under Syrian conditions.

Materials and Methods

Field Survey

Eight hundred and sixty eight selected foliar samples representing 56 weed species, 45 genera, and 23 families were collected from 10 sweet potato fields and from the surroundings area related to 5 regions covering Zagrin, Sarsakia, Brgan, Ras Al-Aen, and Hreson in Lattakia and Tartous governorates, during 2006/2007 and 2007/2008 growing seasons. Regions were selected on the basis of high incidence of sweet potato plants exhibiting characteristic symptoms of SPFMV. Samples were blotted on nitrocellulose membranes according to Makkouk and Kumari (27).

Detection of SPFMV

Tissue blot immunoassay (TBIA) was used for serological detection of SPFMV with polyclonal antibodies provided by the International Potato Center (CIP), Lima, Peru (10). The kit also contained NCM strips spotted with sap from SPFMV-positive and negative controls. Samples were also spotted on nitrocellulose membranes in Syria and processed at CIP to confirm results.

Results and Discussion

A large number of weed species with symptoms suggestive of virus infection were observed in sweet potato fields and their surroundings in Syrian coastal area during 2006/2007 and 2007/2008 growing seasons from April to October (Table 1). *Amaranthus retroflexus* L., *Convolvulus arvensis* L., *Chenopodium* sp. were common weed species in most surveyed fields. Mosaic and leaf malformation symptoms were the most common. Some collected samples showed mosaic, mottle, yellowing, chlorosis, stunting and necrotic spots, whereas other samples did not show any obvious symptoms.

Results of TBIA test showed that 19 weed species were infected with SPFMV (Table 1). SPFMV-infected wild host plants identified in this study belong to different families and not only to *Convoulvulaceae*. Individual SPFMV-infected wild plant could serve as a virus reservoir for many years, encompassing several sweet potato growing seasons. In Louisiana, the perennial weed *I. trichocarpa* is reported as a reservoir of SPFMV throughout sweet potato growing seasons (12). However, there are no studies to show whether isolates of SPFMV isolated from wild species play a role in the incidence of SPFMV in surrounding sweet potato fields. There is no similar study in literature aimed to survey the host species of SPFMV under natural infection conditions, but some previous studies aimed to search host range under artificial infection conditions (1, 8, 14). A study done by Tugume *et al.* (37) indicated that SPFMV was prevalent at different incidences in 22 *Ipomoea* species, and in *Hewittia sublobata*, *Lepistemon owariensis*, of which 19 species were new natural hosts for SPFMV. *I. eriocarpa*, *I. hederifolia*, *I. wightii*, and *I. tenuirostris*, previously were known as natural hosts of SPFMV in Uganda (23, 24). *I. hederifolia* and *I. wightii* were found infected with SPFMV also in Louisiana (12).

New sweet potato cultivations are established by taking cutting from vines of the previous crops for planting, which makes sweet potato a perennial plant in the local cropping system. Although farmers usually manage to select symptomless and SPFMV-free vines as source of cuttings (18), the subsistence sweet potato crops and especially the remaining plants from harvested crops and those grown in abandoned plots often are found infected with SPFMV (18). The actual interactions of the weed and wild species and sweet potato crops in relation to virus transmission require further study.

Table 1. Weed and natural hosts of SPFMV recorded in Syria. in Sweet potato fields and their surroundings in 2006/2007 and 2007/2008 growing seasons. Letter with underlines refer to symptoms gives positive reaction with SPFMV antiserum

Family Weed species	External symptoms	No. of infected samples/ No. of tested samples
Amaranthaceae		
Amaranthus hybridus L.	SNS	0/4
A. retroflexus L.	Mm, Vby, M+Mo, Nsy, Y, Ch, Vby +YSS, St+SNS, MO, St+Vby, My+Ldi, My, Mm	16/172
Apiaceae		
Scandixpecten-veneris L.	M	0/8
Asteraceae		
Calendula officinalis L.	YSS, Ch	1/8
Xanthium strumarium L	My	0/4
Boraginaceae		
Heliotropium europaeum L.	Nsy	0/28
Anchus officinalis L.	Nsy	0/12
Brassicaceae		
Brasica oleracea var Capitata	Vby	0/4
Raphanus raphanistrum L	My, Mo	0/8
Sinapis arvensis L.	Nsy, Mo	0/8
Caryophyllaceae		
Cerastium arvense L.	Vby	0/12
Chenopodiaceae		
Atriplex hastate L.	Ldi	1/4
Chenopodium sp.	My, Nsy, YSS	4/32
C. amaranticolor L.	Nsy	0/24
C. quinoa Willd.	Nsy	0/8
C. hybridum L.	Nsy	1/4
C. polyspermum L.	Nsy	1/4
C. vulvaria L.	M	1/4
Spinacea oleracea L.	YSS, Y, Mm, Nsy	2/16
Compositae		
Artemisia vulgaris L.	Nsy	0/4
Bidens pilosa L.	SNS, Nsy, Mo	0/16
Lactuca sativa L.	M+Ldi, Y	0/8
Sonchus oleraceus L.	YSS, Nsy	0/16
Traxacum officinale Web.	M, Nsy, Ch, Mo, Y	2/32
Convolvulaceae		
Convolvulus arvensis L.	SNS, YSS, Mo, Vby, St, M, Nsy	8/124
Ipomoea violacea L.	Lc+Vy, Ldi+Vy	2/8
Cucurbitaceae		
Cucurbita maximx Dush.	Mm	1/8
C. pepo L.	Mo	0/4
Cucumis melo L.	M	0/4
C. sativus L.	M	0/8
Luffa cylindrical L.	M	0/8
Citrullus vulgaris L. (thunb)	Nsy, Ch	0/8
Euphorbiaceae		
Euphorbia heterophylla L.	Vby, Nsy, SNS	0/24
E. helioscopia L.	Nsy	0/8
E. peplus L.	Nsy	0/4
Graminae		
Digitaria sanguinalis L.	Nsy	0/16
Synodon dactylon pers	Nsy	0/8

Table 1 (Cont.)

Family Weed species	External symptoms	No. of infected samples/ No. of tested samples
Labiatae		
Mentha arvensis L.	Ldi	1/4
Leguminaceae		
Phaseolus lanatus L.	M+Ldi, M, Y	1/12
Ph. vulgaris L.	M, Ldi	0/8
Malvaceae		
Althaea officinales L.	My	0/8
Hibiscus trionum L.	Nsy	0/4
Malva neglecta Wallr.	Y, Vby, St, Nsy	4/28
Papaveraceae		
Papaver rhoeas L.	Nsy	0/4
Pedaliaceae		
*Sesamum indicum*L.	Mo	0/4
Polygalaceae		
Rumix crispus L.	SNS	0/4
Portulacaceae		
Portulaca oleracea L.	Nsy	0/8
Primulaceae		
Anagallis arvensis L.	Nsy	0/4
Solanaceae		
Capsicum annum L.	M+Ldi, MO, M	4/16
Datura stramonium L.	M.	0/4
Hyoscyanus niger L.	Nsy	0/4
Lycopersicom esculentum Miller	St+My, St+Ldi, Y, Mo, Vby, St, M	0/36
Nicotiana tabacum L.	M, Nsy, My, YSS	0/12
Solanum nigrum L	Mm, Mo, Nsy	0/20
Sycrophulariaceae		
Veronica persica Poir.	Nsy	0/4
Tiliceae		
Corchorus olitorius L.	Vby, Mo, YSS	0/12

* Ldi= leaf malformation; Nsy= No-symptoms; Mo= mottling; SNS= Necroses spot; M= Mosaic; MMO= Mild mosaic; Vby= Yellow between vein; Vy= Vein-clearing; YSS= Yellow small spot; Y= Yellow; My= Yellowing Mild; St= Stunting; Ch= Chloroses; Lc= Leaf curl, Mm= Mild mottling.

All plants in the fields are subject to attack by numerous pests (11, 28). In this regard, the plants/samples which showed symptoms and gave positive reaction with SPFMV are listed in Table 1. The observed symptoms are not necessarily caused only by SPFMV infection. On the other hand, all plants/samples which exhibited external symptoms and gave negative reaction with SPFM, cannot be considered as non-hosts for the virus. It could well be that at the time of the survey, such species were not exposed to SPFMV infection. In addition, such hosts can be favorable to the insect vectors. *Chenopodium amaranticolor* L and *C. quinoa* Willd were SPFMV free under natural infection conditions (Table 1) but they are reported as SPFMV host under laboratory conditions (1, 8, 14). To confirm our results, weed species which did not react positively for SPFMV presence in TBIA test should be tested again under artificial inoculation conditions and then tested serologically. Perennial plant species infected with SPFMV were found more important as alternative hosts of the virus, because its ability to play the role of source of inoculum, for the neighbouring plants in the field or other neighbouring fields, for many years.

SPFMV is not known to be seed transmitted in sweet potato. Presuming that this also holds true for the wild species, a hypothesis which needs to further investigation.

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الملخص

عاقل، إنصاف حسن، عماد اسماعيل، صلاح الشعبي، وسيجوندو فوينتس. 2010. العوائل العشبية الطبيعية لفيروس التبرقش الريشي للبطاطا الحلوة في سورية. مجلة وقاية النبات العربية، 28: 96-100.

أجري مسح حقلي للتعرف على العوائل العشبية الطبيعية لفيروس التبرقش الريشي للبطاطا الحلوة في الساحل السوري. جمع خلاله 868 عينة نباتية فردية من 56 نوعٍ نباتي (45 جنساً، و23عائلة) وذلك من 10 حقول عائدة لــ 5 مناطق رئيسية لزراعة البطاطا الحلوة (زغرين- الــسرسكية- البرجــان- رأس العين- حريصون)، خلال موسمي 2007/2006 و2008/2007. اختبرت جميع العينات باستخدام بصمة النسيج النباتي المناعية والمــصل المــضاد لفيــروس التبرقش الريشي متعدد الكلون. أكدت النتائج الإصابة الطبيعية بفيروس التبرقش الريشي لــ 19 نوعٍ من العينات العشبية والمحصولية المختبرة (*Amaranthus* ،*retroflexus* L. ،*Atriplex hastate* L. ،*Brasica oleracea* var. capitata. ،*Calendula officinalis* L. ،*Capsicum annum* L. ،*Chenopodium* sp. ،*Chenopodium hybridum* L. ،*Chenopodium polyspermum* L. ،*Chenopodium vulvaria* L. ،*Convolvulus arvensis* L. ،*Cucurbita maxima* Dush. ،*Heliotropium europaeum* L. ،*Ipomoea violacea* L. ،*Malva neglecta* Wallr. ،*Mentha arvensis* L. ،*Phaseolus lanatus* L. ،*Sinapis arvensis* L. *Spinacea oleracea* L. و *Traxacum officinale* Web.)، وهذه الأنواع عائدة لــ 12 عائلة نباتية مختلفة، وقد وجد أن معظم العينات المصابة بالفيروس تنتمي إلى عائلتي *Convolvulaceae* و *Chenopodiaceae*، ويعدّ اكتشاف هذه الأنواع النباتية المصابة بفيروس التبرقش الريشي التسجيل الأول للإصابة الطبيعية في سورية باستثناء البطاطا الحلوة العائل الرئيس لهذا الفيروس.

كلمات مفتاحية: SPFMV، بطاطا حلوة، سورية، فيروسات، أعشاب.

عنوان المراسلة: انصاف عاقل، كلية الزراعة، جامعة تشرين، اللاذقية، سورية، البريد الالكتروني: ensafakel@hotmail.com

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