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A Review of a Yellowing and Stunting disorder of Cucurbits in the United Arab Emirates

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ABSTRACT

A yellowing and stunting disorder of cucurbit crops occurred in epidemic proportions in U.A.E. since 1985 and is currently endemic on melon (Cucumis melo) and atermelon (citrullus lanatus). Symptoms of the disorder include bright interveinal chlorosis of the older leaves. Hassen (1986) rejected inanimate factors as casual agents , indicated the virological nature of the disorder, and suggested lettuce infectious yellows virus (LIYV) as the most probable causal agent. Long flexuous filamentous virus like particles were observed in most affected samples examined by Lecoq (1986), and were suspected to be the causal agent of the disorder. Symptoms failed to develop on melon plants covered for 35 days from seeding with a spun-pounded polyster material (Agryl P17)which prevented the tobacco whitefly (Bemisia tabaci) from feeding on the plants (Minist Agr.& Fish.,1987). Based on serological tests of over 150 samples, and field observations of known hosts of LIYV, it is concluded that the causal agent of YSD differs from LIYV in serological affinities and probably in host range. It should probably be considered a new virus of the closterovirus-like group similar to LIYV.

Key words: Cucurbits, Cucumis melo, Cucumis sativus, Citrullus lanatus , yellowing and stunting .

INTRODUCTION

Cucurbits are the most important vegetables in U.A.E. Recently, they have been subject to a widespread occurrence of a yellowing and stunting disorde (YSD) which seriously threatens their production and has received considerable attention from both agricultural circles and the public. Several reports have been written about the problem, but not scientific papers have been published . The objective of this review is to describe the YSD of cucurbits and document observations and investigations made thus for on its epidemiology, etiology and control.

EPIDEMIOLOGY

There is a general agreement that the YSD was observed for the first time on some melon and watermelon plantings in Ras Al-Khaimah in 1982. The disorder spread steadily in subsequent years until it reached epidemic proportions in 1985 and has are susceptilbe. They include melon(Cucumis melo L.) , watermelon (Citrullus lanatus (Thunb) Mansf.), cucumber (Cucumis sativus L.), summer squash (Cucurbita pepo L.) , snake melon (Cucamis melo L var. flexuosus) and bottle gour (Lagenaria sicerari (Molina)Standl). The disorder is however , most severe on melon , watermelon and greenhouse cucumber .other crops suffer less damage .

SYMPTOMATOLOGY

The earliest symptoms appear 4-5 weeks after planting as slight interveinal light green mottling on

the older leaves. Gradually, the mottled areas become chlorotic, coalesce and change into a bright yellow color, while the main veins remian green (Fig. 1). Meanwhile, symptoms acropetally develop on other leaves. All stages of symptoms development may be seen on the same plant on older and intermediate leaves, while young mature leaves remain symptomless or show only pin-point chlorotic spotting . Also, older leaves become thick and brittle. In watermelon, the chlorotic areas may become necrotic, and the youngest leaves remain small and become thicker and slightly curled (Fig.2). Sometimes, black patches develop on the older leaves of melon plants, particularly at the margins. Plants remain stunted and age prematurely. Yield and quality reductions depend on the stage of plant growth at which symptoms develop. Symptom development on 4-5 week-old plants means crop failure, while fields continued thereafter. All cucurbits grown in U.A.E. which show symptoms 10 weeks after planting can produce a satisfactory crop: Cucurbits other than melon suffer less because they produce yield before the plants are severely damaged .

ETIOLOGY

Several invited experts and agricultural personnel have indicated their view points concerning the nature of the causal agent(s) of the YSD. A number of animate and inanimate factors have been suggested. Fungi, bacteria, nematodes and insects were quickly excluded at an early stage. According to Minist. Agri. & Fish. report (1987), P. Jones (Rothamsted Exp. Sta., U.K.) did not find any virus

Fig. 1. Symptoms of the yellowing and stunting disorder on melon (Cucumis melo) plants.

Fig. 2. Symptoms of the yellowing and stunting disorder on watermelon (Citrullus lanatus) plants.

particles in affected melon samples sent to him in 1984, while M. Verhogen (La Faculte des Sciences Agronomiques de Louvain La Neuve, Belgium) rejected any relationship between the YSD and any of the known mosaic type viruses of cucurbits. Verhogen suggested the possibility that this could be similar to squash leaf curl virus (SLCV), a whitefly-transmitted virus. SLCV symptoms (Flock and Mayhew,1981;Duffus and Flock,1982) are, however, distinctively different than the YSD.

Among the inanimate factors which were suggested as inducing the disorder were cultivars, weather conditions, soil type and excessive use of pesticides. Other factors suggested were S and Mg deficiency (Khogly,1985), soil decline, soil hard pans, poor soil aeration, high soil salinity, high water salinity, high carbonates in irrigation water, excessive irrigation, excessive fertilization and low precipitation (khogly,1986). Furthermore, soil and water salinity were also considered by jones (1986) to be a serious problem that could account for the disorder.

In a lengthy report, Hassan (1986) rejected all inanimate factors as causal agents. This argument was based on the epidemiological nature of the disorder, its geographical distribution, host range , and the lack of any scientific evidence that factors mentioned above could induce similar symptoms in their entirety. Also, Al-Dolaimi (1986) measured salinity in soil and water samples taken from healthy and affected fields in various parts of the country and found no relationship between salinity and

the YSD .

Upon observing affected fields in April, 1986, Hassan (1986) strongly indicated that the YSD of cucurbits is a virus problem , and suggested that lettuce infections yellows virus (LIYV) a whitefly-transmitted virus which induces similar symptoms in cucurbits in California (Duffus, et al.,1986) the most likely virus to be responsible for it . His conclusion was based on the infectious nature of the disorder, details of its symptoms on cucurbits, and the extremely large population of tobacco whiteflies, Bemisia tabaci (Gennadius)associated with the disease. Immediately thereafter, Jones (1986) , based on field observations and laboratory analysis, indicated that viruses were probably not associated with the disorder . In the course of his analyses he identified three viruses in some leaf samples. viz., watermelon mosaic virus-1 (WMV-1), cucumuber mosaic virus (CMV) and squash mosaic virus (SMV) or a similar virus. Jones further indicated that their incidence and importance was slight, and that WMV-1 was the most widespread virus found . On the contrary, Lecoq (1986), also based on field observations and laboratory analysis , confirmed the virological nature of the problem. He found particles of SMV and cucumber vein yellowing virus (CVYV) in some leaf samples, but the most common virus-like particles were long, flexuous, filamentous often broken and appareently very labile. These particles were morphologically similar to LIYV which was reported from California (Duffus et al. , 1986). The particles were found by Lecoq in 15 out of 16 samples showing yellowing, and were occassionally

very slightly decorated with LIYV antiserum (prepared by Duffus) in immuno-electron-microscopy, while SMV and CVYV particles were not decorated. Locoq indicated that in previous analysis of samples sent to him earlier in the same year, the same type of virus particles was observed, and that some of them were clearly or only slightly decorated with LIYV antiserum. He did not know whether this heterogenity was due to the experimental conditions or to a virus serological variability. Jones in 1987 isolated filamentous virus particles from affected melon, watermelon and squash leaves. he suggested that they may be transmitted by the whitefly, but he indicated that they probably were not LIYV (cited from Minis. Agr. & Fish., 1987). Soon afterwards, Makkouk (1987) , suggested upon his visit to the country that the widespread YSD on cucurbits was probably caused by a virus similar to cucumbur yellow virus (CYV) which is transmitted by the greenhouse whitefly , Trialeurodes vaporariorum (Westwood) . He also reported on the widespread occurrence of CVYV which is transmitted mechanically and by the tobacco whitefly B. tabaci .

Extremely large whitefly populations were always associated with the disorder. Prevention of the whitefly feeding on melon and watermelon plants by covering them with the polyster material Agryl P17 for 35 days from seeding prevented development of the disorder during the experimental period which lasted for 65 days from seeding . In contrast, unprotected control plants developed symptoms typical of the disorder. Symptoms appeard also on plants which were exposed to naturally

occuring populations of whitefly during the seeding stage and then completely protected from the insect during subsequent growth stages (Minist. Agr. &Fish, 1987). Similar results were obtained with melon plants using different polyster and polypropylene covers (M.A.Al-Idrisis, Director, Agr. Dept.& Animal Prod., Al-Ain, personal communication).

Duffus in a visit to the agricultural regions of U.A.E. during October and November of 1988 confirmed the almost identical symptom syndrome of YSD on cucurbits to the LIY disease as it occurs in California .

Additional field observations on plant species known to be hosts of LIYV such as sowbane (Chenopodium murale L.) and sunflower, Helianthus annuus L. that under California conditions show highly visible symptoms of LIYV infection, indicated no evidence of infection under high disease and vector pressure.

Over 150 samples from various squash , snake melon, bottle gourd, malva (Malva parviflora L.), lettuce (Lactuca sativa L.), and turnip (Brassica rapa L.) were collected from a wide geographic range of the area. These samples were prepared for enzyme-linked immunosorbent assays (ELISA) by the double antibody sandwich method described by Clark and Adams (1977). The plates were coated with globulin at 1 ug/ml in California and the suspect samples prepared and placed in the wells and washed in U.A.E. Upon return to the USA, virus infected and virus free control samples were placed in wells

reserved for that purpose.

The ELISA tests indicated no serological relationship of the YSD agent to LIYV. The control samples reacted to LIYV- infected lettuce and melon tissue indicating the handling of the coated globulin and virus samples had not affected the sensitivity of the ELISA system over the three week period.

All of the above results indicated that whiteflies serve as a vector for the causal agent of YSD. The agent has long flexuous, filamentous virus-like particles (Lecoq, 1986). The symptom syndrome on cucurbits appears identical to those induced by other whitefly-transmitted closterovirus-like viruses such as beet pseudo yellows virus (BPYV), LIYV, CYV and muskmelon yellows virus (MYV) . Three of the viruses are transmitted by the greenhouse I. vaporariorum . Recent evidence (Zenbayashi et al., 1988) indicates the insect transmission and host range characteristics of CYV are identical to BPYV. So this virus reported from Japan should probably be considered as BPYV and the name CYV no longer used. MYV was reported to infect cucurbits only, but this work and insect relationships have not been confirmed .

All attempts to identify whitefly species in the U.A.E have failed to detect any species other than B. tabaci (M.A. Al-Idrisi, personal communication). Thus the causal virus of YSD appears to be closer in affinities to LIYV than the greenhouse whitefly - transmitted entities. It differs however in serological affinities and probably in host range.

Pending further characterization it should probably be considered a new virus of the closterovirus-like group similar to LIYV.

CONTROL

All attempts made locally to control the disorder through the control of whiteflies by insecticides failed. This had been also the case with LIYV in California (Natwick and Durazo, 1985) . It was possible to achieve good control of the whitefly as a pest, but not as a virus vector.

Several control methods have been suggested for the control of whitefly-transmitted viruses . The use of chemicals in protected environments is generally fairly effective. Thus in the case of YSD in nursery production or crops in greenhouses, effective screening and the use of pesticides should be an effective control.

However, under field conditions where viruliferous vectors move into the crop, pesticides have shown little value. Technical control measures such as straw mulches to delay infection and reduce whitefly populations have shown some promise with tomato yellow leaf curl virus (Cohen and Berlinger, 1986).

The best potential for the control of the YSD would seem to be cultural practices to eliminate or reduce virus sources and genetic manipulation. The most obvious starting point would be the isolation of nursery and transplanting stock to protected

environments with adequate insect control. The planting stock material should probably also be isolated geographically from the production fields. A greater understanding of the host range and epidemiological characteristics of the YSD causal agent is necessary before the value of crop plant free zones is understood. However, until the role of ornamental and wild plants in the epidemiology of YSD is known, the isolation of newly planted crops from older diseased ones should be attempted. It would be expected that these cucurbit free zones should be whole growing regions and be at least two weeks in duration before young plants are sown in those zones .

Preliminary experiments conducted by the Minist. Agr. & Fish., (1987) and the Dept. Agr. & Animal Prod. (M.A.Al-Idrisi, personal communication) on the use of spunponded polysters and polypropylene plant covers for about 35 days (until flowerring) were promising. The economics of this practice are still being investigated. This method was highly effective in preventing infection of squash plants with SLCV and LIYV in California (Natwick and Duraza, 1985).

A few hundred commercial melon, watermelon, cucumber and squash cvs were screened for resistance to the disorder in separate trials conducted by the Minist. Agr. & Fish., Dept. Agr. & Animal Prod. at Al-Ain and Fac. Agr. Sci., U.A.E. Univ. None of the cvs tested was found resistant , but the Dept. Agr. & Animal Prod. (Salih, 1988) reported only slight symptom development in five melon cvs, viz.,

Maskotaly , Maggar Kings, Caribe F1, Rocky Sweet F1 and Midstar F1 .

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استعراض لآراء الخبراء والدراسات التى أجريت على ظاهرة الاصفرار والتقزم فى القرعيات فى دولة الامارات العربية المتحدة

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ملخص

تحتل القرعيات المرتبة الأولى بين محاصيل الخضر فى دولة الامارات العربية المتحدة ، وقد تعرضت منذ عام ١٩٨٥ للاصابة بوباء اطلق عليه اسم الاصفرار والتقزم نال اهتماما كبيرا من قبل كافة المسئولين في الدولة نظرا لما سببه من خسائر جسيمة للمزارعين خاصة في محصول البطيخ (الجح) ، والشمام (البطيخ الاصفر) . وأهم أعراض الظاهرة هي ظهور لون أصفر زاه بين العروق في الاوراق القديمة ، وتبرقش جزئي بين العروق فى الأوراق الوسطية بينما تبقى الأوراق العلوية خالية من الاعراض ، أو يظهر بها نقط صغيرة صفراء اللون . كان Hassan (١٩٨٦) قد أكد على الطبيعة الفيرسية لهذه الظاهرة ، وأشار الى أن الفيرس المسئول عنها هو علي الأرجح فيرس اصفرار الخس المعدى . وكان لوكوك (Lecoq ١٩٨٦) أول من قدم دليلا عمليا عن مسبب الظاهرة باكتشافه وجود أجسام خيطية شبيهة بالفيروسات لدى فحص عدد من العينات النباتية المصابة . وتبين من دراسات وزارة الزراعة والثروة السمكيه (Minist. Agr. & Fish ١٩٨٧) أن أعراض الظاهرة لم تتكشف على نباتات البطيخ والشمام التى حجبت عن الذبابة البيضاء بغطاء من البوليستر لمدة ٣٥ يوما من الزراعة وذلك خلال فترة الدراسة التى دامت ٦٥ يوما . وبناء على ما تقدم ، ونتائج دراسة سيرولوجية أجريت على ١٥٠ عينة مصابة من عدة أنواع نباتية، والملاحظات الحقلية على العوائل المعروفة لفيرس أصفرار الخس المعدى ، فقد استدل على أن مسبب الظاهرة يختلف عن فيرس اصفرار الخس فى خصائصه

السيرولوجية وربما فى مدى العوائل ، وربما كان فيرسا جديدا من مجموعة الفيروسات الخيطية شبيه بفيرس اصفرار الخس المعدى .

وقد تبين اثناء البحث عن مسبب هذه الظاهرة وجود عدد من فيروسات القرعيات الاخرى في دولة الامارات هي فيرس تبرقش الخيار ، وفيرس تبرقش البطيخ (Jones ١٩٨٦) وفيرس تبرقش الكوسا ، وفيرس اصفرار عروق الخيار (Lecoq١٩٨٦) كما لاحظ Makkouk (١٩٨٧) أن الفيرس الاخير كان أكثر الفيروسات انتشارا فى القرعيات بعد الفيرس المسئول عن الظاهرة .

كلمات مفتاحية : القرعيات ، البطيخ ، الشمام ، الاصفرار والتقزم