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MODERATE RESISTANCE TO *TOMATO LEAF CURL VIRUS* AMONG COMMERCIAL TOMATO CULTIVARS IN NORTHERN NIGERIA

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Abstract: Sixteen tomato cultivars obtained from the collections of the Institute for Agricultural Research (IAR) Samaru, Nigeria were screened for resistance to local strains of *Tomato leaf curl virus* at Samaru, Northern Guinea Savanna, over a two year period, 1998/1999 and 1999/2000 dry seasons. Five cultivars were moderately resistant, nine were moderately susceptible, while two were highly susceptible. Most of the cultivars were high yielding (46–55 t/ha) and had good fruit size (4.8–6.0 cm x 2.8–4.1 cm). They will be further evaluated on-farm at different locations after which they will be introduced to farmers to replace the low yielding and TLCV-susceptible cultivars currently in use in most parts of the Savanna ecological zones of the country.

Key words: tomato cultivars, *Tomato leaf curl virus*, resistance, susceptibility

INTRODUCTION

Tomato leaf curl virus (TLCV) Genus *Begomovirus* is a very devastating and economically significant pathogen of cultivated tomatoes in tropical and sub-tropical regions (Brunt et al. 1996; Novo-Womdim et al. 1996; Brown 1994; Lapidot et al. 2001). The virus has long been known in the Middle East, North, Central, East and West Africa, South East Asia, and Southern Europe (Alegbejo 1995; Antignus 2003; Czosnek et al. 1990; Navas-Castello et al. 1999; Moriones and Navas-Castello 2000; Muniyappa et al. 2000; Ladipot et al. 2001; Kashina et al. 2002; Rybicki et al. 2000). It has also been reported in the Caribean region (Nakhla et al. 1994), Mexico (Momol et al. 1999; Valverde et al. 2001). It is the most limiting factor in tomato production between January and May in the Northern states of Nigeria (Alegbejo 1995; Alegbejo and Ogunlana 1995).

The virus is spread mainly by whitefly, *Bemisia tabaci* Genn. (Butter 1976; Butter and Rataul 1977; Sanchez-Campos et al. 2000). TLCV epidemics tend to be associated with high populations of the whitefly vector (Cohen and Antignus 1994). Infected plants are stunted, flower shedding may occur and few harvestable fruits of small size are produced (Kisha 1981), leaves are rolled upwards and inwards, internodes are shortened and proliferation of lateral branches occurs (Moustafa 1991). Yield losses of 23, 50, 63, and 100% have been reported in Nigeria, Sudan, Lebanon, and the Mediteranean, respectively (Yassin and Abu 1972; Makkouk et al. 1976; Alegbejo and Ogunlana 1995; Lapidot et al. 2001).

Chemical control of the vector was only partially successful (Uvah et al. 1990; Cohen et al. 1992). And there are concerns that they may have deleterious effect on the environment. In Nigeria, the only resistant cultivars available are semi-wild accessions whose resistant genes need to be transferred into tomato cultivars with desirable agronomic characteristics (Alegbejo 1995). Hence sixteen tomato cultivars, some of which are commonly grown by farmers in northern Nigeria and with some desirable agronomic characteristics, such as a high yield and good fruit size, were screened for resistance to TLCV at Samaru, using TI106 or Roma VF as a check.

MATERIALS AND METHODS

The two-year trial was conducted at the Institute for Agricultural Research (IAR) irrigation farm at Samaru (latitude 11 11″N, longitude 07 38″E, altitude 686 m) during the 1998/99 and 1999/2000 dry seasons. Sixteen tomato cultivars including TI106 or Roma VF were used. Seeds were sown on heat-sterilized soil in an insect-proof screenhouse in December 1998 and 1999, and twice daily watered. The screenhouse interior was sprayed with Uppercott (dimethoate + cypermethrin) at the rate of 1.2 g a.i./litre of water to control *B. tabaci*, vector of TLCV and other insect pests. Seedlings were fertilized with NPK (15:15:15). In late January of 1999 and 2000, five-week old seedlings were transplanted at 45 cm apart in sunken bed (plots) 4.5 x 3.0 m separated by a 60 cm gap. There were twenty plants per bed. The trial was laid out in three replicates in a randomized block design. One row of ten TLCV-infected tomato plants infested with ten *B. tabaci* were transplanted between adjacent accessions to serve as source of inoculum. The field was hoe-weeded four times at 3, 5, 7 and 9 weeks after transplanting (WAT) and fertilized 2 and 6 WAT with NPK (20:10:10) at the rate of 200 kg/ha on each occasion. Agronomic and other cultural practices used were as recommended for tomato (Anon 1976). Disease incidence and severity were recorded weekly starting from 1 WAT till the end of the growing season (mid-April). Disease severity was rated on individual plants using a visual scale of 1–7 (Alegbejo 1995), where: 1 = no visible disease symptom; 3 = top leaves curled and slight stunting of plant; 5 = all leaves curled and slight stunting of plant; 7 = severe curling of leaves, stunting of plant and proliferation of axillary branches.

Resistance level was determined using the scale outlined below (Alegbejo 1995):

Rating	Percentage infection	Disease severity
Resistant	1.0–15.9	1.0–2.9
Moderately resistant	16.0–25.9	3.0–4.9
Moderately susceptible	26.0–36.9	5.0–6.9
Highly susceptible	37.0 and above	7.0

Ripe fruits from each plot were harvested weekly at the onset of ripening, recorded and yield per hectare estimated. Each years data were subjected to the two way analysis of variance. Differences between treatments were determined by the standard error of difference (SED) at 5 percent level probability. Samples of the Samaru isolate of TLCV had earlier been confirmed to be serologically related to the Israeli isolate of *Tomato yellow leaf curl virus* (TYLCV) (Czosnek and Laterrot 1997).

RESULTS

Results of the 1998/99 trial are shown in Table 1. None of the sixteen tomato cultivars was resistant to TLCV. However, five cultivars were moderately resistant, nine were moderately susceptible, while two were highly susceptible. The moderately resistant cultivars were also high yielding and had good fruit size. There were significant differences (p = 0.05) in the level of resistance among some of the cultivars. Leaves of infected plants were curled and the plant stunted compared with healthy plants which were uniformly green and showed no visible symptoms or malformations. Symptoms began two weeks after transplanting but did not occur at the same time in all the cultivars. Time of symptom expression varied from two to ten weeks after transplanting.

Table 1. Reaction of tomato cultivars screened for resistance to *Tomato leaf curl virus* (TLCV) at Samaru in the 1998/1999 dry season

Tomato cultivar	TLCV – infected plants [%]	Disease Severity [1–7]	Resistance category	Yield [t/ha]
TI20	24.50	4.30	MR	53.10
TI12	34.71	5.81	MS	50.36
TI13	20.92	3.82	MR	49.21
TI7	26.00	5.50	MR	52.53
TI38	24.54	5.31	MR	54.01
TI24	31.10	6.10	MS	50.82
TI106 (check)	29.61	6.21	MS	54.79
TI22	30.12	6.0	MS	51.00
TI85	35.26	6.01	MS	50.1
TI3	41.30	6.72	HS	48.32
TI10	40.93	6.81	HS	47.01
TI31	23.01	4.10	MR	53.10
TI204	26.00	5.10	MS	52.52
TI205	29.54	6.10	MS	48.12
TI206	32.01	6.21	MS	46.70
TI539	30.12	4.90	MS	51.06
SED (p=0.05)	2.2	0.70		1.40

The performance of the cultivar in the 1999/2000 dry season were similar to those of the previous year (Table 2). No cultivar was resistant. Again, five cultivars were

moderately resistant, nine were moderately susceptible while two were highly susceptible. The check TI106 was again moderately susceptible. There were significant differences (p = 0.05) in the level of resistance between some of the cultivars.

Table 2. Reaction of tomato cultivars screened for resistance to TLCV at Samaru in the 1999/2000 dry season

Tomato cultivar	TLCV – infected plants [%]	Disease severity [1–7]	Resistance category	Yield [t/ha]
TI20	25.00	4.32	MR	52.10
TI12	36.10	5.90	MS	51.40
TI13	22.02	3.93	MR	49.72
TI7	26.13	5.61	MR	53.60
TI38	25.10	5.46	MR	53.91
TI24	30.20	6.21	MS	50.61
TI106 (check)	30.01	6.30	MS	55.06
TI22	29.51	6.01	MS	50.25
TI85	35.10	6.42	MS	50.10
TI3	40.21	6.94	HS	48.12
TI10	41.21	6.90	HS	46.20
TI31	23.50	4.21	MR	53.41
TI204	26.02	5.21	MS	47.01
TI205	30.53	6.03	MS	47.01
TI206	31.36	6.41	MS	46.22
TI539	29.03	5.03	MS	50.01
SED (p=0.05)	2.3	0.72		1.30

DISCUSSION

The reaction of the sixteen tomato cultivars to TLCV were similar in the two-years trial. Five of them combined moderate TLCV-resistance with a high yield, an acceptable fruit size (5 x 2.5 cm) and red colour. The infector rows served as source of inoculum for the virus and the host for the vector, *B. tabaci*. Therefore, the chances of disease escape were nullified.

Nariani and Vasudeva (1963) were not able to find TLCV resistance in the 98 tomato cultivars they tested for 12 years. Also, Kisha (1981) did not find TLCV resistance in any of the tomato cultivars grown in Sudan. They had to resort to other means of control. The resistant cultivars reported by Karsrawi et al. (1988) and Alegbejo (1995) were semi-wild and were therefore not acceptable by consumers. The breeding line LC104 reported by Alegbejo (1995) had medium sized fruits, and was also not acceptable by consumers but needed to be breed further.

In conclusion, the confirmation of the moderate resistance in five of the cultivars used in the current study is a major break through in TLCV research in northern Nigeria. It is hoped that these cultivars will go on-farm along side farmers cultivars in different locations after which they will be recommended to growers to use in com-

bination with other control measures to minimize the chances of their break down. It is intended that steps will be taken to incorporate heat stress tolerance into these cultivars in order to arrest the other constraint to tomato production during the hot period (February–May) in Northern Nigeria. This will reduce the cost of tomato production.

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POLISH SUMMARY

UMIARKOWANA ODPORNOŚĆ POMIDORA NA WIRUSA KĘDZIERZAWKI LIŚCI WŚRÓD KOMERCYJNYCH ODMIAN POMIDORA W PÓŁNOCNEJ NIGERII

W okresie dwóch lat, w suchych sezonach wegetacyjnych 1998/1999 i 1999/2000 prowadzono atestację odporności 16 odmian pomidora z kolekcji Badawczego Instytutu Rolniczego (IAR) w Samaru, Nigeria, na lokalne szczepy wirusa kędzierzawki liści pomidora (TLCV) z Samary Północna Gwinea Savanna. Pięć odmian wykazywało umiarkowaną odporność, dziewięć odmian umiarkowaną wrażliwość, natomiast dwie były bardzo wrażliwe. Większość odmian dawała wysokie plony (46–55 t/ha) i miała dobrą wielkość owoców (4,8–6,0 cm x 2,8–4,1 cm). Odmiany te będą następnie oceniane w polu w różnych lokalizacjach, po czym zostaną wprowadzone do uprawy w gospodarstwach, aby zastąpić nisko plonujące i wrażliwe na wirusa TLCV, wykorzystywane obecnie w przeważającej części ekologicznych stref Savanna w kraju.

BOOK REVIEW

Regnault-Roger C., Philogene B.J.J., Vincent C., (Eds.). 2005. Biopesticides of Plant Origin. Lavoisier & Intercept, Ltd., Paris and Andover. 313 pp. ISBN 2-7430-0675-7; ISBN 1-898298-97-1.

For centuries only natural pesticides of plant origin were used by man for control of medical, household and agricultural pests. Indeed, hundreds of plant species contain in their juice and tissues various chemical compounds that are repellent or toxic to insects and other arthropods. With the development of chemical and physical sciences and technologies it was possible to prepare extracts or powders from such insecticidal plants or even synthesize compounds being the analogues of natural chemicals. The most striking example of such endeavors is development of synthetic pyrethroids being the analogues of pyrethrins naturally occurring in some plants.

As stated in the „Foreword" (p. VII–VIII) this book aims in the seventeen chapters to „...report on the status of technological, analytical, and scientific advances in the field to meet the needs expressed by crop protection practitioners, students, researchers, and professionals". Indeed, this goal is very well accomplished.

In chap. 1 „Botanicals: yesterday's and today's promises" (p. 1–15) B. J. R. Philogenete at al. (p. 1–15) review three topics: (a) the first generation of insecticidal plant compounds (nicotine, rotenone, pyrethrum); (b) the advent of synthetic organic insecticides, (c) the second generation of insecticidal compounds of plant origin (pyrethroids, azadirachtin).

In chap. 2 „New insecticides of plant origin for the third millennium" (p. 17–35) C. Regnault-Roger reviews polyphenols, monoterpenes and essential oils toxic to insects.

In chap. 3 „Phytochemical discovery of new botanical insecticides" (37–46), J. T. Arnason, T. Durst and B.J.R. Philogene introduce compounds extracted from plants belonging to families *Meliaceae* and *Piperaceae.*

In chap. 4. „Organic chemistry's contribution to the understanding of biopesticide activity of natural products from higher plants" (p. 47–58) P.-H. Ducrot reviews antifungal oligostilbens isolated from *Cyphostemma crotalariodes* and antifeedant properties of agrofurans isolated from plants belonging to *Celestraceae* family.

In chap. 4 „Plant natural products as synergists" (p. 59–67) B.J.R. Philogene discusses synergistic effects of lignans isolated from plant species belonging to families of *Asteraceae* and *Umbelliferae*.

In chap. 6 „Sulfur compounds derived from *Allium* and crucifers and their potential applications in crop protection" (p. 69–86) J. Auger and E. Thibout discuss insecticidal, acaricidal, herbicidal, nematicidal, fungicidal and bactericidal activity of various sulfur compounds against various insects, pathogens and weeds.

In chap. 7 „The role of phytoecdysteroids in the control of phytophagous insects" (p. 87–103) F. Marion-Poll et al. present many interesting facts on the effect of plant compounds e.g. ecdysone or cyasterone on the physiology and development of insects.

In chap. 8 "Idioblast oil cells as a source of new botanical products with biological activity" (105–121) C.R. Rodriguez-Saona et al. indicate that oil extracted from avocado (*Liriodendron tulipifera*) tissues has insecticidal properties against several plant pests.

In chap. 9 "Use of secondary plant products to protect the seeds of a legume, cowpea. Effects on insect pests and their parasitoids" (p. 123–137) J. Huignard et al. indicate that terrenes, sulfur compounds and alkaloids are toxic to noxious beetle *Callosobruchus maculatus* and its parasitoid *Dinarmus basalis.*

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