Evaluation of Watermelon and Related Germ Plasm for Resistance to Zucchini Yellow Mosaic Virus

GEORGE BOYHAN, Senior Research Associate, Department of Horticulture, JOSEPH D. NORTON, Professor, Department of Horticulture, BARRY J. JACOBSEN, Professor, Department of Plant Pathology, and BRUCE R. ABRAHAMS, Technician, Department of Horticulture, Alabama Agricultural Experiment Station, Auburn University 36849

ABSTRACT

Boyhan, G., Norton, J. D., Jacobsen, B. J., and Abrahams, B. R. 1992. Evaluation of watermelon and related germ plasm for resistance to zucchini yellow mosaic virus. Plant Dis. 76:251-252.

Of 153 plant introductions (PI), breeding lines, and commercial cultivars tested by mechanical inoculations in the greenhouse, only PI 482261-1, Egun, PI 494528, PI 386026, and PI 386025 showed any resistance to the Florida strain of zucchini yellow mosaic virus. PI 482261-1 and Egun are *Citrullus lanatus*, the others are citron types (*Citrullus colocynthis*). This is the first report of resistance in PI 386026, PI 386025, and the cultivar Egun.

Zucchini yellow mosaic virus (ZYMV) is a potyvirus that was first described in 1981 from squash in Northern Italy (1). This virus can cause severe economic losses in many cucurbits, including squash, muskmelon, and watermelon (3). Several strains of the virus have been described (2). Three strains have been identified on the basis of reactions in muskmelon PI 414723 (2). Provvidenti et al (6) reported the occurrence of Connecticut (CT) and Florida (FL) strains of ZYMV, with the FL strain occurring more widely in the United States. Sources of resistance to the FL and CT strains have been found in *Citrullus colocynthis* (L.) Schrader cultivars Nigeria Local and Egusi and in PIs 494528 and 494532 and to the FL strain in *C. lanatus* (Thunb.) Matsum. & Nakai PI 482261-1 (4,5). PI 482261-1 is described as resistant only to ZYMV-FL, and this resistance is controlled by a single recessive gene (4,5).

The identification of additional sources of resistance to ZYMV and the incorporation of this resistance into commercial cultivars is highly desirable. This research was undertaken to screen watermelon and related germ plasm for potential sources of resistance, as well as to evaluate resistance presently available in commercial watermelon cultivars.

This work supported by AAES Project 842. AAES Journal 18-913004P.

Accepted for publication 1 October 1991 (submitted for electronic processing).

MATERIALS AND METHODS

Experiments were conducted in the greenhouse in May and August of 1990. The first involved a completely random-

Table 1. Evaluation of watermelon and related germplasm for ZYMV resistance

Entry	Total observations	Mean disease rating[y]
PI 482261-1	36	0.44 a[z]
Egun	25	0.52 a
PI 494528	25	0.96 a
PI 386026	24	1.25 a
PI 386025	21	1.29 a
PI 494529	32	1.41 ab
AU-Producer	29	3.24 bc
AU-Jubilant	32	4.34 c

[y] Disease index: 0–5 scale: 0 = no visible signs of infection; 1 = slight leaf discoloration; 2 = increased leaf discoloration; 3 = leaf discoloration with some mottling of the tissue, leaves of normal shape; 4 = mottled leaves with some distortion of shape; and 5 = severe mottling with shoestringing of leaf tissue.

[z] Means followed by the same letter are not significantly different ($P = 0.05$) according to Duncan's multiple range test.

ized block design with three replications, each entry consisting of five plants. Eight entries were planted in each 28- × 53-cm flat filled with Metromix 300 (Cambridge, MA). The second experiment involved four plants of each entry, with four entries planted per flat.

Two weeks after planting, all but one seedling of each entry were mechanically inoculated by rubbing carborundum-dusted cotyledons and first true leaves with sap from Yellow Crookneck squash infected with ZYMV-FL (supplied by R. Provvidenti, Cornell University, Geneva, NY). Virus inoculum was prepared by macerating infected squash leaves with 0.05 M KPO_4 buffer, pH 7.5. Control plants were dusted and then rubbed with buffer only. All plants were reinoculated 1 wk later using the same procedure to insure infection. Plants were rated for disease symptoms 4 wk after inoculation using a 0–5 scale, where 0 = no visible signs of infection; 1 = slight leaf discoloration; 2 = increased leaf discoloration; 3 = leaf discoloration with some mottling of the tissue, leaves of normal shape; 4 = mottled leaves with some distortion of leaf shape; and 5 = severe mottling with shoestringing of leaf tissue. Ratings were made on leaves at the second and fourth nodes in the first experiment, and on whole plants in the second experiment.

To assure homogeneity of variances, data were analyzed using a modified arcsine transformation, where each rating value was divided by 5 and the arcsine computed.

RESULTS AND DISCUSSION

The combined results of two experiments with 153 PIs, cultivars, and Auburn University breeding lines were compared by dividing the sum of the rating products (rating class × number of observations) by the total number of observations. Mean disease rating data demonstrated that 37 of the 82 PIs tested had ratings greater than 3.0. Commercial cultivars with mean disease ratings 1.0–2.0 include Jubilant Select 88 and Parker; 2.0–3.0 includes Tendersweet Orange Flesh, Minilee, Crimson Sweet, Crimson Tide, Yellow Crimson, Charlee, and Sweet Charlie; and 3.0–4.9 includes Sugar Baby, Sugarlee, Sunsweet, AU-Producer, Charleston Gray, Willhites Tendergold, Cardinal, Carmen F1, Sangria, Charleston Elite, Bush Jubilee, Jubilee, Dixielee, Mirage LS, and Jubilee II. A complete list of PIs tested can be obtained by writing to the authors. It should be noted that some entries had inoculated plants classed from 0 to 5. It is not known if these were escapes or the results of heterogenous populations. This is more likely the case for PIs.

In addition to the previous analysis, Duncan's multiple range test was performed on the data from the 25 entries showing the lowest mean disease ratings (most resistant) and for which there were at least 20 observations. AU-Producer and AU-Jubilant were included as susceptible entries. These data are given in Table 1.

PI 482261-1 had the highest level of resistance in our test, followed closely by Egun, PI 494528, PI 386026, and PI 386025. The reaction in PI 482261-1 and PI 494528 confirms previous reports indicating resistance to ZYMV-FL (5). PI 494532 from Nigeria, also previously reported as resistant to ZYMV (5), appeared to be quite susceptible in our tests; however, this resistance reportedly is temperature dependent and is best expressed at high temperatures (5). Greenhouse temperatures in our tests ranged from 20 to 35 C.

PI 482261-1, a *C. lanatus* species from Zimbabwe with a mottled green oblong fruit and yellow flesh, appears to be a good source of resistance to ZYMV-FL. Egun is described as an edible seeded *C. lanatus* var. *citroides* from Nigeria with resistance to watermelon mosaic virus 2 (7), but it has not been previously reported with resistance to ZYMV (4). Unlike that of PI 482261-1, resistance in PI 494528 is not restricted to ZYMV-FL, but it is also better expressed at higher temperatures (4). PI 386026 and 386025 are both *C. colocynthis* from Iran and have not been previously reported as being resistant. These PIs may prove to be significant new sources of resistance, especially since their origin is Iran rather than Africa.

Other material that may have potential as sources of resistance includes PI 512350 and PI 512361, both of which are *C. lanatus* from Spain; PI 525083 and PI 525081, which are *C. colocynthis* from Egypt; NF19-3N and NF24-4E, two short-internode breeding lines from the University of Florida (Central Florida Research and Education Center, Leesburg); and Jubilant Select '88, a selection of AU-Jubilant. However, because of low numbers of observations, these lines require further testing.

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