

Research Updates

Evaluation of Precocious Yellow Gene Squash Cultivars for Tolerance to Watermelon Mosaic Virus

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Summary. Yellow squash (*Cucurbita pepo* L.) planted after early spring in Mississippi have a strong likelihood of developing green streaks and blotches on the fruit—symptoms of watermelon mosaic virus strain 2. Cultivars with the relatively new precocious yellow gene (PYG) tend to show such symptoms less prominently, and in some cases not at all, when infected. Field trials were conducted at two locations to evaluate several PYG cultivars and compare their WMV-2

symptoms to those of standard, non-PYG types. In both cases, the PYG cultivars had fewer unmarketable fruit due to WMV-2 symptoms, although they were not entirely immune to the virus.

Squash producers in the southeastern United States who attempt to produce a mid- or late-season crop of yellow straightneck or crookneck squash often find that watermelon mosaic virus strain 2 (WMV-2) causes a high percentage of nonmarketable fruit. Because yellow squash generally commands a premium price during this season, economic losses can be severe for some producers. Other cucurbit crops grown in the state, including zucchini squash, pumpkin, cucumber, watermelon, muskmelon, and gourds, also are susceptible to WMV-2, but disease incidence has been sporadic. Fruit symptoms in yellow squash caused by WMV-2 include mild to severe fruit distortion and varying degrees of green discoloration of normally yellow fruit (McGuire and Wickizer, 1982; Petoseed, 1988; Sherf and Macnab, 1986). Yield reductions of 50% to 100% as a result of the green fruit phase of the disease are not uncommon in fields planted after the middle of June in Mississippi.

Watermelon mosaic virus infection of squash plants occurs after acquisition of the virus by aphids from WMV-2-infected weed hosts along the borders of fields of spring-planted crops. Viruliferous aphids (primarily winged forms) feed on leaves and stems of squash, and symptoms appear on foliage 1 to 2 weeks following inoculation. Foliage symptoms range from a faint green to a severe chlorotic mottle and frequent malformation. Infected

plants produce a high percentage of WMV2 symptomatic fruit. Secondary cycles develop from virus carried by aphids from infected plants in the primary cycle. Other means of WMV spread are not known.

Control of WMV-2 has been difficult to achieve. Insecticide applications for control of the aphid vector do not prevent plant infection because aphids must feed on sprayed foliage for the insecticide to be effective; at this point, infection has already occurred. Other control strategies have included stylet oils to prevent introduction of virus particles into host tissue during aphid feeding (Drye et al., 1980; Sherf and Macnab, 1986). Reflective mulches also have been used on the plant beds or row middles as aphid repellents (Chalfant et al., 1977; Lamont et al., 1990).

However, in the past few years, several precocious yellow gene (PYG) yellow squash cultivars have been developed to overcome the greening effect of WMV-2. This work was pioneered with gourds and other cucurbits by O. Shifriss of Rutgers Univ. (Shifriss, 1949) and continued by other researchers (Schaffer, 1982). Seed companies [Harris Moran Seed Company (Rochester, N.Y.) and Asgrow Seed Company (Kalamazoo, Mich.)] continued progress on PYG breeding in an attempt to bring cultivars to the market. Such cultivars are now available and offer several advantages:

- Fruits turn yellow earlier. This makes them more suitable for baby vegetable markets because fruit will not have the greenish cast typical of other cultivars at this immature stage.
- Fruit have a tendency to retain the yellow color when infected with WMV-2 (or several other viruses) when compared to non-PYG cultivars. The plants are not resistant; the gene merely masks the green symptoms typically induced by the virus.
- The precocious yellow gene also may increase the number of female flowers, thereby increasing yield.

One disadvantage of the PYG cultivars is that they all have a yellow peduncle (fruit stem), rather than the usual green one. This is sometimes a problem in marketing.

In view of the market demand for late-season summer squash, we evaluated several of the PYG types for toler-

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ance to WMV-2, and compared them to non-PYG types. The cultivars were evaluated at two locations: Smith County in south-central Mississippi and Itawamba County in northeastern Mississippi. Recommended production practices and pest management were followed (Harris and Webrew, 1990; Nagel, 1990). The PYG cultivars Multipik and Supersett were used at both locations. The PYG cultivars Superpik and XPH1636, as well as the susceptible cultivar Lemondrop, were included in the Smith County trial, while the susceptible cultivar Pavo was used in Itawamba County for comparison. 'Multipik' and 'Superpik' are straight-neck yellow squash cultivars, while 'Supersett' is a semi-crookneck type. All three PYG cultivars are from Harris Moran Seed Co. XPH1636 is a crook-neck PYG yellow squash breeding line from Asgrow Seed Co. 'Lemondrop' and 'Pave' are both non-PYG cultivars.

In Itawamba County, plots were 12 ft (3.7 m) long with 38 inches (97 cm) between rows, replicated four times. Seed were planted on 1 Aug. 1990 and thinned to 18 inches (45 cm) within the row. All fruit from four plants selected at random were harvested and rated on 12 Sept. In Smith County, plots were 25 feet (7.6 m) long with 42 inches (107 cm) between rows, replicated three times. In addition, there was one additional non-replicated plot of 'Superpik'. Seeds were planted 20 Aug. 1990, and thinned to 18 inches (45 cm). Insect and disease control were as recommended for commercial squash production in Mississippi (Harris and Killebrew, 1990). All fruit larger than 1 inch (2.5 cm) were harvested and rated on 29 Oct. Harvested fruit were separated into the following groups: all green, $\geq 50\%$ green, light green, and totally yellow. Only all-yellow fruit are considered marketable.

Data were analyzed using SAS (SAS Institute, 1985) to calculate analysis of variance. Means separation, when the treatment effect was significant, was by least significant difference.

Results shown in Tables 1 and 2 are percentage of fruit (by number) in each grading category. Data from Itawamba County (Table 1) were not significantly different at $P \leq 0.05$. However, data from Smith County (Table 2) were significantly different in all categories. 'Multipik' had the

Table 1. Percentage of fruit in each grading category in precocious yellow gene squash evaluation trial in Itawamba County, Miss.^a

Grading category	Cultivar and percentage fruit by number in each category ^b			
	Multipik	Supersett	Pavo ^c	P value
Percent marketable	40	33	15	0.6172
Percent light green	9	19	43	0.4075
Percent $\geq 50\%$ green	28	31	24	0.9613
Percent green	22	17	18	0.9584

^aBill Rogers Farm, Itawamba County, northeastern Mississippi.

^bThere were no significant differences by analysis of variance at $P \leq 0.05$.

^cSusceptible to WMV-2.

Table 2. Percentage of fruit in each grading category in precocious yellow gene squash evaluation trial in Smith County, Miss.^a

Grading category	Cultivar and percentage fruit by number in each category					
	Multipik	Supersett	Superpik ^b	XPH1636 ^c	Lemondrop ^d	P value
Percent marketable	98 a ^e	92 ab	93	82 b	16 c	0.0001
Percent light green	2 c	5 bc	0	17 b	35 a	0.0024
Percent $\geq 50\%$ green	0 b	3 b	8	1 b	13 a	0.0429
Percent green	0 b	0 b	0	0 b	35 a	0.0115

^aJames Ford Farm, Smith County, south-central Mississippi.

^bMeans within a row followed by the same letter are not significantly different at $P \leq 0.05$; mean separation by LSD.

^cNonreplicated.

^dExperimental line from Asgrow Seed Company; development has been discontinued.

^eSusceptible to WMV-2.

most marketable fruit (totally yellow), followed by 'Supersett' and then XPH1636. 'Lemondrop', the non-PYG comparison, had only 16% marketable fruit.

In the non-marketable categories, 'Lemondrop' had the most light green (35%), $\geq 50\%$ green (13%), and totally green (35%) fruit compared to the other cultivars. 'Multipik' had the least light-green fruit of all cultivars. Differences between the three PYG cultivars were not significant for the

totally green or $\geq 50\%$ green categories.

Data from 'Multipik' and 'Superpik' at the two sites were pooled to calculate average percentage symptomatic fruit in each of the rating categories (Fig. 1). Data from other cultivars were averaged from each site. Generally, all PYG cultivars produced higher percentages of non-symptomatic fruit. In Itawamba County, PYG cultivars tended to be $>30\%$ marketable (all yellow), compared with only 15% mar-

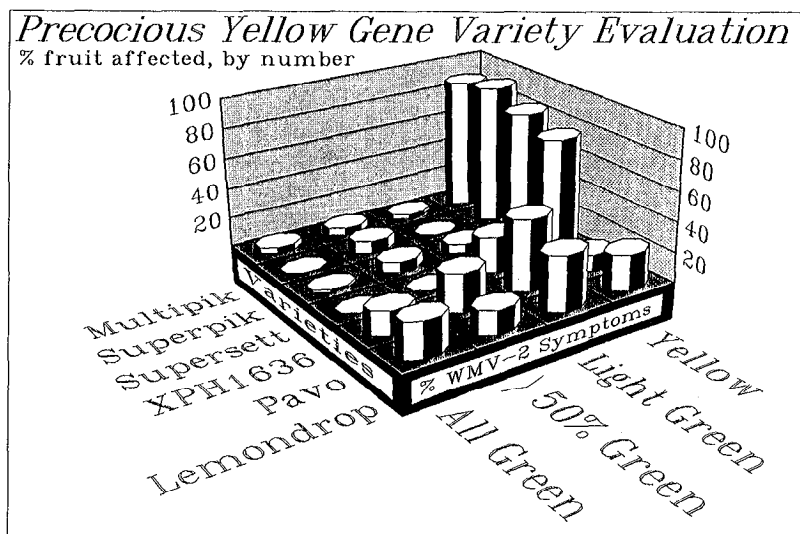


Fig. 1. Percentage of yellow squash fruit (by number) of PYG and non-PYG cultivars in each rating category with symptoms of WMV-2; data pooled between sites.

marketable for the non-PYG 'Pavo', although the differences were not statistically significant. At Smith County, all PYG types were >80% marketable, while the non-PYG 'Lemondrop' was only 16% marketable, a highly significant ($P = 0.0001$) difference.

Variability in reaction to WMV-2 at the two sites may be due to differences in the amount of virus inoculum at each location. At the Itawamba County location, the trial was surrounded by a field of 'Dixie', a susceptible cultivar, where an estimated 60% to 75% of the plants were infected. At the Smith County location, the only susceptible cultivar in the vicinity was 'Lemondrop', which was included as part of this trial. However, nearby weed hosts apparently were sufficiently infected with WMV-2 to permit virus spread to this test plot and cause disease symptoms in 83% of the fruit harvested from this cultivar. In contrast, at this location, >90% of the fruit were rated as marketable on the PYG cultivars Multipik, Supersett, and Superpik.

The results obtained in Smith County are more representative of what producers could expect if planting precautions are observed. It is important to realize that currently available PYG squash cultivars are only tolerant to WMV-2, and if interplanted in a field with a susceptible cultivar (e.g., 'Lemondrop', 'Dixie', or 'Pavo'), a low percentage of marketable fruit, such as obtained at the Itawamba County location, could result. In areas where WMV-2 has been a problem, squash growers could realize a substantial improvement in marketable yield by selecting a PYG cultivar. They should, however, investigate the potential acceptability of fruit with a yellow peduncle in their usual markets prior to planting.

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