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Relative Susceptibility of Peach Cultivars to Fungal Gummosis (*Botryosphaeria dothidea*)

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Abstract

Peach fungal gummosis, incited by *Botryosphaeria dothidea* (Moug.:Fr.) Ces. & De Not., significantly depresses growth and yield on susceptible peach [*Prunus persica* (L.) Batsch] cultivars. Little is known about the relative susceptibility of commercially important peach cultivars utilized in the southeastern United States. A trellis system equipped with an automated misting system was used to deliver inoculum from infected peach prunings to peach trees planted beneath the trellis. Peach prunings inoculated with *B. dothidea* were placed on the trellis wires above the newly planted trees. Intermittent misting of the trellis occurred during May and June of the first year, after which the inoculum source were removed. Disease severity was evaluated in November of the following growing season after visible symptoms developed. Significant variation in disease susceptibility was detected across the cultivars tested. Of the 25 cultivars tested, 'Summergold' was the most susceptible and 'Redskin' the least.

Introduction

Recent work has demonstrated that failure to control peach tree fungal gummosis, incited by *Botryosphaeria dothidea*, can cause yield reductions approaching 40% in mature trees of susceptible peach cultivars such as 'Summergold' (1). While chemical control appears to be technically feasible, the best material tested, captafol (Difolatan), is no longer registered for use on peach and requires an exorbitant application regime (up to 10 sprays per growing season) to achieve admittedly imperfect disease suppression. The current absence of a proven chemical or management control strategy makes genetic resistance a goal worth pursuing. This is especially so given the questionable cost-effectiveness and longevity of any chemical control program that requires a spray application frequency approaching that needed with captafol.

Information on the relative susceptibility of commercial peach cultivars to fungal gummosis would be immediately usable by growers to make decisions re. cultivar selection and disease management strategies appropriate to the disease pressure present on their site. Moreover, this information would be essential to breeders in guiding parent selection for the development of new cultivars with superior disease resistance. Advanced selections could be evaluated for specific disease resistance under uniform conditions using cultivars of known susceptibility as comparisons to eliminate highly susceptible selections.

Previous observations (5, 14, Reilly and Okie, unpublished) on disease susceptibility of peach cultivars were hampered by low inoculum pressure, environmental factors and inadequate replication of cultivars being evaluated. For example, side by side comparisons of cultivars, when conducted, were typically performed in cultivar blocks with only 1 to 4 trees of each cultivar and with trees not always of the same age. Meaningful comparisons are difficult to obtain under such circumstances due to the lack of replication and the influence of bark age on susceptibility (16). Low or nonuniform inoculum pressure and unfavorable weather conditions for disease development may also affect the observations. Moreover, many cultivars studied in early work were either 'exotic' lines or are of relatively minor importance today. The intent of this study was to determine the relative

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fungal gummosis susceptibility of current commercially important peach cultivars utilizing uniform, replicated material with a screening methodology demonstrated to provide high disease pressure (16).

Materials and Methods

Trellis Construction: A trellis system was established consisting of 4 rows, 45.7 m long, with 6.1 m middles. Support braces 1.9 m tall and 1.2 m wide (6 per row) were used to suspend 3 steel wires and steel fencing (5 cm x 10 cm cells x 1.2 m wide) the length of each trellis. A mist system, controlled by an electric timer, was placed on the wire with mist emitters (32.9 LPH) at 1.7 m intervals.

Preparation of Inoculum. The inoculum source was prepared in February, 2001 by collecting prunings (typically 1 to 1.5 m long with side branches intact) from peach orchards at Byron sufficient to cover the trellis wire (ca. 400 total). The prunings were placed on plastic sheets and 2.0L of inoculum of *Botryosphaeria dothidea (5 x 10^5* spores mL^{-1}) was applied with a compressed air hand sprayer. Isolate used was a known pathogenic strain collected from peach in Georgia, Bd-20 (14). The inoculated prunings were left undisturbed in partial shade at the edge of a wooded area until needed, then placed on the trellis (ca. 2 per m) and the mist system started.

Plant Materials and Management. Eight replicates of 25 commercially important peach cultivars were planted on March 19, 2001 at 0.9 m in-row spacing in a randomized complete block design with two replicates of each cultivar under each of the four trellises (Table 1). Trees were obtained from commercial sources. Trees were propagated on Guardian™ (BY520-9), Halford or Nemaguard peach seedlings. Observations in a previous peach rootstock trial demonstrated that there is no significant effect of peach seedling rootstocks on scion susceptibility to peach fungal gummosis (Beckman, unpublished data). Trees were planted into a raised bed of ca. 25 cm height (at planting). A raised bed was used because of concerns about the possible negative impact of the large amount of water that would be delivered through the mist system during the inoculation process. Trees were trained to 2 scaffold limbs each. Scaffolds were orientated perpendicular to long axis of trellis. Mist system was set to run for 15 min. every 2 hours for 20 days beginning on May 10, 2001, then the application frequency was decreased to 15 min. every 3 hours for an additional 20 days. No pesticides were applied to trees during the course of trial except for the use of herbicides to maintain a weed-free strip ca. 3 m wide centered on the tree row.

A research orchard consisting of 3 early season, 3 mid-season and 3 late season cultivars planted in randomized blocks by season, having 6 trees per replication, 6 replications per cultivar was established in January 2000 with a spacing of 6.1 m between trees and 6.1 m middles. The orchard is located 0.8 km from the trellis trial described in this report and isolated from other peach orchards. Four of the cultivars common to the trellis ('GaLa', 'Harvester', 'Redglobe' and 'Flameprince') were rated for gummosis during fall 2002 using the same rating scale as for the trellis experiment. Seasonal precipitation data, obtained from the USDA weather station at Byron, 0.7 km from the orchard are presented in Table 2.

Table 1. Peach cultivars evaluated for susceptibility to peach fungal gummosis (*B. dothida*) at (Byron. Ga., 2001-2002)

Cary Mac	Flameprince	Gulfprince	Redglobe	Summergold [z]
Coronet	Flordacrest	Harvester	Redhaven	Sunbrite
Cresthaven	Flordaking	June Gold	Redskin	Sunprince
Dixiland	GaLa	Juneprince	Springcrest	Surecrop
Empress	Goldprince	O'Henry	Springprince	Suwanee

[z] Summergold is known to be highly susceptible to fungal gummosis and serves as a standard for comparison.

Recovery of B. dothidea. In August, 2002 bark tissue was removed at the necrotic-healthy interface of several gumming lesions on each trellis tree. A small segment (2 mm x 8 mm) of tissue at the interface was removed, immersed in sodium hypochlorite (1.31%) for 2 minutes and rinsed twice with sterile deionized water. Specimens were placed onto Difco Potato Dextrose Agar (PDA) and incubated at 24°C under a 12 hour light-dark photoperiod. *B. dothidea* conidia that developed from the samples were identified microscopically after 14 days.

Data Collection: Disease severity on trunk and main scaffold limbs was rated in mid-November, 2002 using the following scale (Fig. 1):

0= no gumming
1= light, few gum spots mostly on trunk
2= medium, few-numerous gum spots on trunk and scaffold limbs
3= medium-heavy, many gum spots, some large, on trunk and scaffold limbs
4= heavy, many large gum spots on trunk and scaffold limbs
5= severe, gumming coalescing on trunk and scaffold limbs, tree or limbs dying.

Gummosis ratings were analyzed by the General Linear Models (GLM) program of the Statistical Analysis System for personal computer (SAS Institute, Cary, NC). Gummosis rating treatment means, error degrees of freedom and error mean square terms were used to perform a cluster analysis (8).

Results and Discussion

Fungal colonies consistent with *B. dothidea* were recovered from gumming lesions of every tree in this trial. The cultivars separated into 3 distinct classes for gummosis susceptibility (Table 3). 'Summergold' was the most susceptible to fungal gummosis confirming earlier observations (4, 16). 'Flameprince' and 'O'Henry' were grouped with 'Summergold' in the most susceptible class. These 3 cultivars represent ca. 5% of commercial southeastern peaches, including Alabama, Georgia, Louisiana, North Carolina, South Carolina, Tennessee and Texas growing areas (6, 7, 9, 10, 11, 12 and 13). The next most susceptible class (B) contains several very important cultivars that are widely planted in the Southeast including 'Redglobe', 'Harvester', 'Cresthaven', 'Redhaven', and 'Coronet'. Together the two most susceptible classes (A and B) represent ca. 35% of southeastern U.S. peach acreage. These first two classes developed significant symptoms

Table 2. Rainfall by month in millimeters (2000-2002) and the thirty-year average at Byron, Georgia

Month	2000	2001	2002	30-Year Average
January	138	41	56	136
February	8	24	57	94
March	98	243	117	124
April	30	64	79	69
May	19	123	60	58
June	99	141	129	107
July	96	62	150	118
August	52	55	97	96
September	200	54	82	76
October	9	8	103	79
November	26	58	101	82
December	9	33	49	76
Total	783	905	1080	1114

Table 3. Relative fungal gummosis susceptibility of 25 commercial peach cultivars (Byron, Ga., 2001-2002).

Class A [z] High Susceptibility		Class B Moderate Susceptibility		Class C Low Susceptibility	
Cultivar	Rating [y]	Cultivar	Rating	Cultivar	Rating
Summergold	3.94	GaLa	2.75	Juneprince	2.06
Flameprince	3.43	Redglobe	2.69	June Gold	1.87
O'Henry	3.00	Coronet	2.69	Cary Mac	1.87
		Surecrop	2.63	Goldprince	1.87
		Redhaven	2.56	Gulfprince	1.69
		Sunbrite	2.56	Flordaking	1.63
		Flordacrest	2.50	Springcrest	1.63
		Dixiland	2.50	Sunprince	1.56
		Cresthaven	2.44	Redskin	1.37
		Empress	2.44		
		Springprince	2.19		
		Suwanee	2.19		
		Harvester	2.14		
Mean:	3.46		2.48		1.73
Range:	(3.93 – 3.00)		(2.75 – 2.14)		(2.06 – 1.37)

[z] Significance of class separations: AB<0.0014 and BC<0.0048.

and most likely would experience significant yield reductions if this disease were not managed. The least susceptible class (C) contains several important commercial cultivars, including 'Juneprince', 'June Gold', 'Flordaking', and 'Goldprince'. This class represents ca. 18% of southeastern U.S. peach acreage. This class might not experience significant disease symptoms and yield reduction under low inoculum pressure and optimal management.

Comparing the gummosis rating (mean per cultivar) of 'GaLa' (1.0), 'Redglobe' (1.1), 'Harvester' (1.0) and 'Flameprince' (1.0) from the 3-year-old orchard to that from the trellis experiment (Table 3) illustrates the problem with disease comparison if unfavorable conditions such as low inoculum pressure and erratic rainfall occur. Rainfall was 331, 209, and 34 mm below the 30-year average for 2000, 2001, and 2002, respectively (Table 2). We believe that the drought conditions and isolated location resulted in the low disease incidence.

Our ratings roughly agree with those of Daniell and Chandler (5), though only 5 cultivars are common to both studies and different rating scales were used. As in this study, Daniell and Chandler rated 'Redskin' as having some degree of resistance. However, they regarded 'Suwanee', 'Springcrest', 'Redglobe' and 'Dixiland' as susceptible. In this study, there appeared to be significant differences in these 4 cultivars. 'Redglobe', 'Dixiland' and 'Suwanee' were grouped in the moderately susceptible class but 'Springcrest' exhibited some resistance. No cultivar tested appeared to be immune.

Current management options are limited primarily to inoculum reduction and include pruning of diseased wood followed by either its removal from the orchard or flail mowing to speed decomposition of the infected prunings (3). At this time, there are no fungicides registered for control of fungal gummosis on peach. Most fungicides currently registered

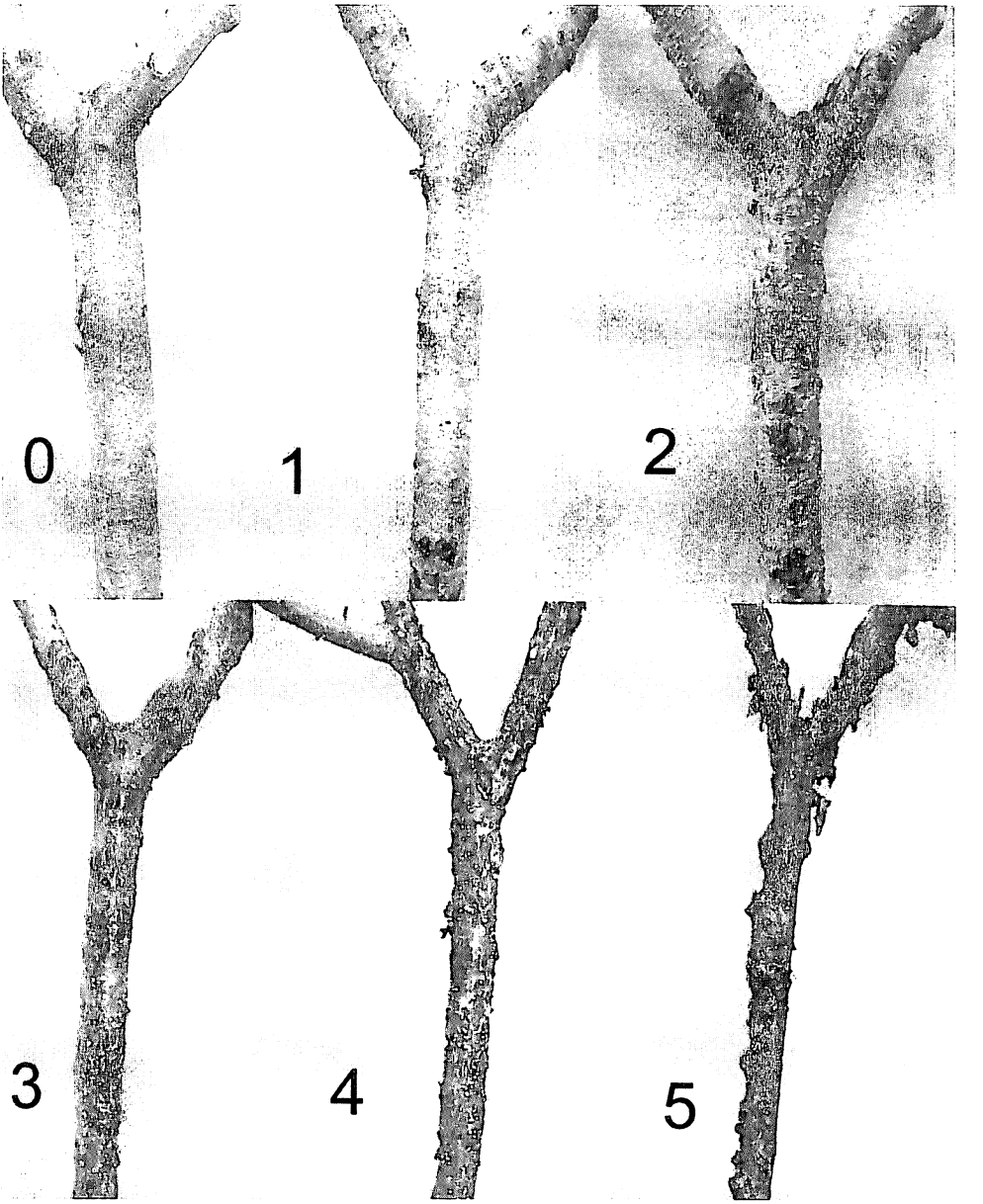

Figure 1. Fungal gummosis rating scale for trunk and scaffold limbs of 2-year old peach trees: 0 = none, 1 = light, 2 = medium-heavy, 4 = heavy, and 5 = severe

for control of other diseases on peach do not have much useful effect on fungal gummosis under field conditions (1, 2, 17 and Beckman and Reilly, unpublished data). However, Taylor and Sherman (18) demonstrated the efficacy of phosphorous acids in providing at least partial suppression of gummosis under field conditions. At this time the best strategy may be to refrain from planting highly susceptible cultivars on sites with high inoculum pressure and to further reduce inoculum through proper pruning and orchard floor management practices. High inoculum pressure is likely to be encountered when replanting individual trees into orchards already heavily infected or planting new blocks adjacent to infected orchards. Stress has been shown to be an important factor influencing disease severity, in particular drought stress during the post-harvest period (15). The judicious use of irrigation on susceptible cultivars may lessen disease severity.

Evaluating cultivars for tolerance to peach fungal gummosis has been difficult because cultivar orchards are expensive to establish and maintain. Such orchards are typically limited to very few trees of each cultivar thus reducing replication. Disease pressure may not be uniform throughout the orchards and weather conditions may be unfavorable for disease development. Establishing a trellis system that maintains favorable conditions for disease development and provides high inoculum pressure on a large number of replications provides an optimum methodology for evaluating peach fungal gummosis susceptibility. This approach can be used to determine relative susceptibility of materials already commercially available or to aid breeders in identifying superior parents and to screen selections for resistance. This work should serve as a baseline for judging the peach fungal gummosis susceptibility of new cultivars and selections in breeding programs.

Literature Cited

1. Beckman, T.G., P.L. Pusey and P.F. Bertrand. 2003. Impact of fungal gummosis on peach trees. HortScience 38:1141-1143.
2. Britton, K.O. and F.F. Hendrix. 1985. Studies of the biology and control of peach gummosis. p. 161-163. In: C.L. Wilson and R. Scorza (eds.). 1984 Stone Fruit Tree Decline Workshop Proc., Oct. 30-Nov. 1, 1984, Appalachian Fruit Res. Sta., Kearneysville, WV.
3. Britton, K.O. and F.F. Hendrix. 1989. Fungal gummosis. p. 105-108. In: S.F. Myers (ed.) Peach production handbook. Coop. Ext. Service, Univ. of Georgia, Athens, GA.
4. Britton, K.O., F.F. Hendrix, P.L. Pusey, W.R. Okie, C.C. Reilly and J.W. Daniell. 1990. Evaluating the reaction of peach cultivars to infection by three *Botryosphaeria* species. HortScience 25:468-470.
5. Daniell, J.W. and W.A. Chandler. 1982. Field resistance of peach cultivars to gummosis disease. HortScience 17:375-376.
6. Findley, D.S. 1994. Texas peach tree inventory survey – 1994. Texas Agric. Statistics Service, Austin, Texas, 2 pp.
7. Frank, A.D. 1994. Louisiana peach tree survey. Louisiana. Dept. of Agriculture and Forestry, Baton Rouge, La. 21 pp.
8. Gates, C.E. and J.D. Bilbro. 1978. Illustration of a cluster analysis method for mean separation. Agronomy J. 70:462-465.
9. Graham, R.A. and S. Pavlasek, Jr. 1996. South Carolina Fruit Tree Survey. http://cherokee.agecon.clemson.edu/fb_all.pdf
10. Guinn, B., M. Harris, M. Kelsey and S. Thompson. 1993. Tennessee – Commercial apple and peach tree inventory. Tennessee Agric. Statistics Service, Nashville, Tenn., 18 pp.
11. Hubbard, E.E., W.J. Florkowski, T.A. Park and H.J. Witt. 1998. Commercial peach tree inventory and prospectus, Georgia 1995. http://www.ces.uga.edu/pubs/PDF/RR-650.PDF
12. Kleweno, D. 1993. Alabama peach tree survey. Alabama Agric. Statistics Service, Montgomery, Ala., 4 pp.
13. Murphy, B. 1997. 1997. North Carolina commercial fruit tree inventory survey. http://www.ncagr.com/stats/fruit/survey/
14. Okie, W.R. and C.C. Reilly. 1983. Reaction of peach and nectarine cultivars and selections to infection by *Botryosphaeria dothidea*. J. Amer. Soc. Hort. Sci. 108:176-179.
15. Pusey, P.L. 1989. Influence of water stress on susceptibility of nonwounded peach bark to *Botryosphaeria dothidea*. Plant Dis. 73:1000-1003.
16. Pusey, P.L. and W.R. Okie. 1992. Update on peach tree fungal gummosis in the Southeast. p. 49-58. In: A.P. Nyczepir (ed.). Stone Fruit Tree Decline, Sixth Workshop Proc., Oct. 26-28, 1992, Fort Valley, Ga.
17. Pusey, P.L., C.C. Reilly, and W.R. Okie. 1985. Peach tree fungal gummosis. p. 151-160. In: C.L. Wilson and R. Scorza (eds.). 1984 Stone Fruit Tree Decline Workshop Proc., Oct. 30-Nov. 1, 1984, Appalachian Fruit Res. Stat., Kearneysville, WV.
18. Taylor, J.B. and W.B. Sherman. 1997. Foliar applied phosphorous fertilizers inhibit peach gummosis. Proc. Fla. State Hort. Soc. 110:182-183.