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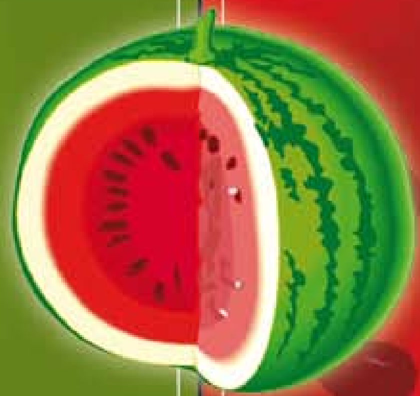

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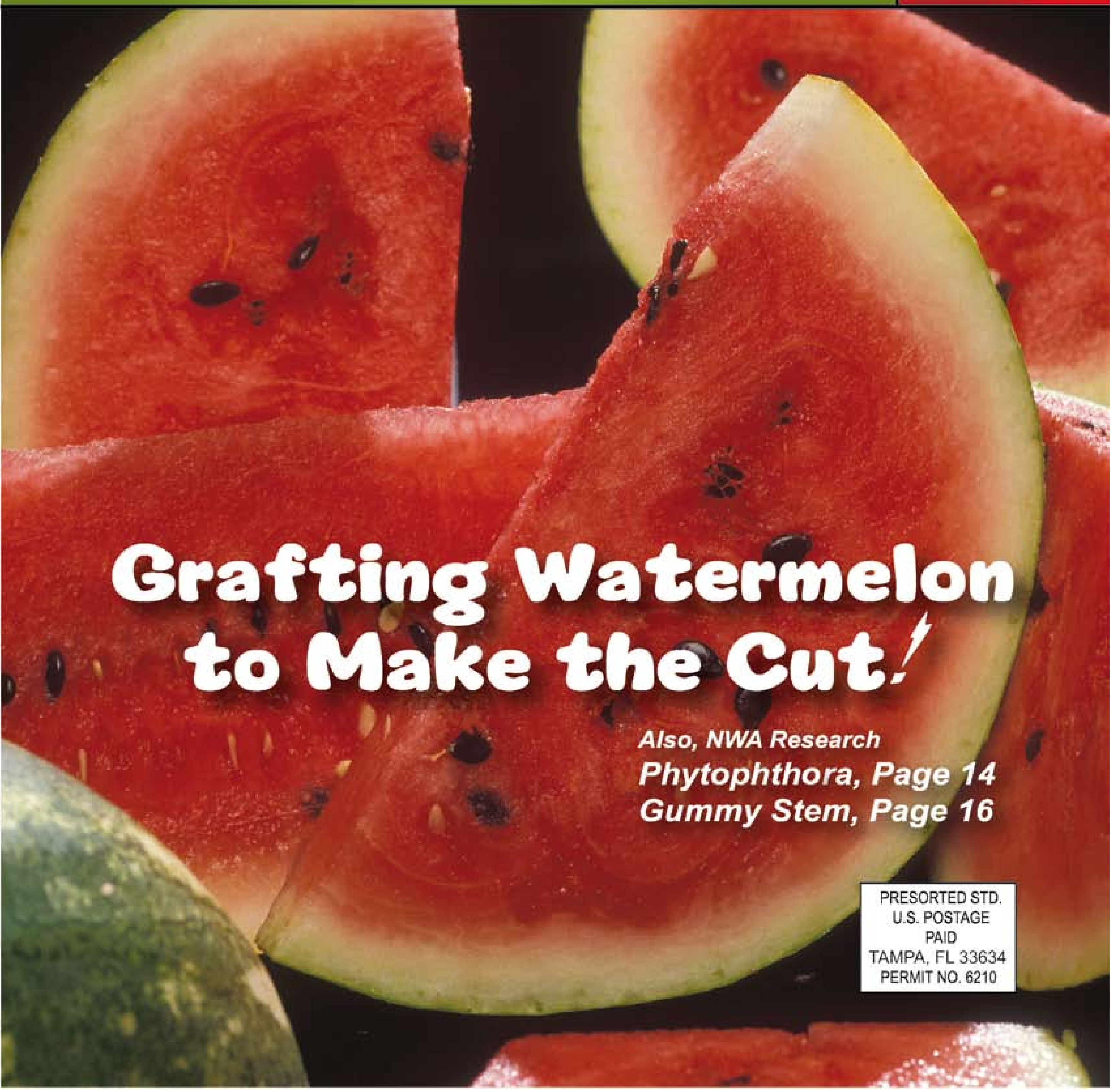

Grafting Watermelon to Make the Cut!

Also, NWA Research
Phytophthora, Page 14
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Grafting Watermelon Onto Squash or Gourd Rootstock Makes Firmer, Healthier Fruit

Grafting may have solved the problem of mushy fresh-cut **watermelon** once and for all!

Perhaps nothing is so aptly named as the watermelon. This fruit (technically, itís a vegetable, related to cucumbers, pumpkins, and squash) is actually 92 percent water. Once it is cut into chunks, watermelon can quickly become mushy. This presents a challenge to the fresh-cut market, which demands firm, attractive fruit. Thereís a growing consumer demand for fresh-cut produce in the United States and around the world. These value-added products are found in most grocery stores, and shoppers love the ready-to-eat convenience.

Benny Bruton, a plant pathologist with the ARS South Central Agricultural Research Laboratory, in Lane, Oklahoma, evaluated watermelon tops grafted onto gourd and squash rootstock and confirmed them to be resistant to *Fusarium* wilt, a widespread and costly plant fungus. And grafting may also have solved the problem of mushy fresh-cut watermelon once and for all.

Watching Profits Wilt Away

Fusarium fungi live in the soil and attack plants at all stages of growth. If growers continually plant watermelons in the same soil, eventually theyíll wind up with a disease problem called *Fusarium* wilt. Until now, U.S. watermelon growers have dealt with *Fusarium*-infested soil in three ways: rotate the fields, treat with methyl bromide to kill the fungus, or grow resistant cultivars.

The first two solutions are becoming less workable; land is becoming less available for rotations, and methyl bromide is being discontinued due to environmental concerns. Watermelon cultivars are available with varying resistance to only two races of *Fusarium,* but grafted watermelons have resistance to all three racesóand have the added benefit of firmness.

Grafting: An Old Practice With New Potential

In Japan, South Korea, and some European countries, watermelon producers havenít had the luxury of rotating their crops from one field to another because their land resources are very limited. So, to get around the *Fusarium* wilt dilemma for the past 50 years, growers there have grafted their watermelon plants onto rootstock of squash, pumpkin, and gourd.

Bruton says that the U.S. watermelon industry previously did not embrace this grafting technique because it was considered too expensive, and producers had enough land that they could rotate from one plot to another.

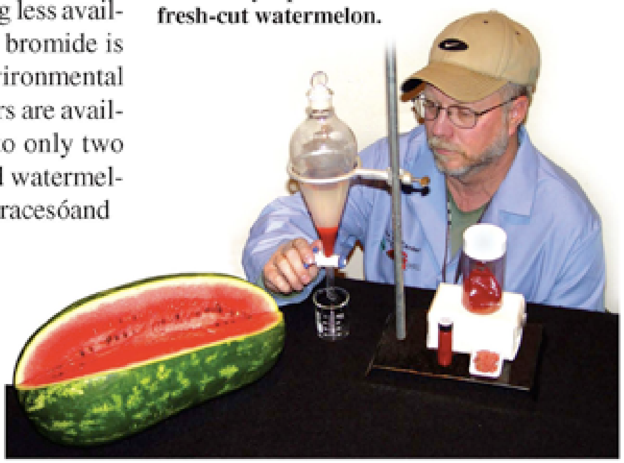
In cooperation with Abbott & Cobb Seed Company, a national leader in the industry, Bruton and his colleagues evaluated watermelon tops grafted onto squash and gourd rootstock. Both cultivar and rootstock were carefully selected for the ideal combination, he says. Another industry partner, Speedling, Inc., performed the actual grafts at their nursery in Alamo, Texas.

Fruit Quality Increased

Bruton says that grafting watermelon plants onto other rootstock has been reported to produce inferior-quality fruitó though in other cases, no such effects were reported. What Bruton and his colleaguesóW arren Roberts, a horticulturalist at Oklahoma State Universityís

BENNY BRUTON (D129-1)

Technician Rick Houser extracts lycopene from fresh-cut watermelon.



BENNY BRUTON (D131-1)

Watermelon grafted onto *Cucurbita* rootstock. The resulting watermelon plant will gain resistance to *Fusarium* wilt and enhanced fruit quality from the graft.

Wes Watkins Agricultural Research and Extension Center (WWAREC) in Lane, and Wayne W. Fish, an ARS biochemist in Laneóhave found, however, is that the fruit that comes from certain grafted plants is at least 25 to 30 percent firmer.

ìAnd it has the added advantage of disease resistance to many soilborne pathogens as well as *Fusarium* wilt,î Bruton says.

Other ARS scientists have found that watermelon contains more of the health-promoting compound lycopene per serving than any other fresh fruit or vegetable. Lycopene gives watermelon and tomatoes their red color and is thought to act as a powerful antioxidant that may help to reduce the risk of age-related diseases.

Fish evaluated lycopene and sugar levels and says that the grafting technique doesnít harm those characteristics. Firmer fruit could be a big plus for growers, because the fastest-growing niche market for watermelon (and cantaloupe) is the fresh-cut market. The fresh-cut industry is predicting that fresh-cut watermelon and cantaloupe will ultimately be an even bigger market than fresh-cut salads and vegetables. ìFarmers should receive a high premium in return for a superior product,î Bruton says.

ìGrafting isnít going to be for everyone,î Bruton explains. ìProducers have to evaluate their situation and see what will work best for them. Our evidence so far indicates we have a much firmer fruit, and firmness is one of the more important qualities for customer satisfaction.î

Economic Impact of Grafting

Growers recently spent as much as $350 per acre on methyl bromide treatments for *Fusarium* wilt control. WWAREC director and economist Merritt J. Taylor says that grafted transplants should be an affordable option for many producers once that cost is eliminated. Early results indicate that farmers may require fewer grafted plants per acre to produce the same yields and may need less fertilizer per acre, which should help control production costs.

Any new direction in agricultural production will require adjustments in practices. If grafting becomes popular in the United States, Roberts says, there will be a market for people who can perform the grafting operations under controlled environments and then ship the plants throughout the United States. He adds that there are many combinations of watermelon and squash, gourd, or pumpkin rootstock that still need to be evaluated for yield and quality.óBy **Jim Core,** ARS.

This research is part of Plant Diseases (#303) and Quality and Utilization of Agricultural Products (#306), two ARS National Programs described on the World Wide Web at www.nps.ars.usda.gov.

Benny Bruton is with the USDA-ARS South Central Agricultural Research Laboratory, Hwy. 3 West, Lane, OK 74555-0159; phone (580) 889-7395, fax (580) 889-5783, e-mail bbruton-usda@lane-ag.org. ✷

BENNY BRUTON (D130-1)

OSU technician Wyatt O'Hern prepares watermelon chunks for a ìfr esh-cutî study , as ARS technician Diann Baze analyzes samples for sugar concentration.

Phytophthora Fruit Rot-

An ugly profit-robbing disease reared its head in 2003 on the east coast of the United States. The Eastern North Carolina watermelon production region experienced unusually high rainfall in the months of June, July and August. The rains were frequent and the ground had very little time to dry out. Over 2,000 acres of watermelon were affected by Phytophthora fruit rot. Watermelon growers in Eastern NC who raised pepper and squash knew the ravages of the disease, caused by Phytophthora capsici, and were surprised to find another crop on its list of victims.

Diseases caused by Phytophthora capsici are not new. This fungus was first described on pepper in New Mexico in 1922. At least 49 economic species can be infected. Among the major hosts of this organism are cucurbits (watermelon, cantaloupe, honeydew melon, cucumber, squash, gourd, etc.) and solanaceous vegetables (pepper, tomato and eggplant).

Watermelon fruit rot caused by P. capsici is not a new problem to North Carolina either. We have seen this disease repeatedly with increasing severity over the last twenty years. In watermelon the disease only affects the fruit and has not been observed on roots, crowns, stems or leaves. The disease often starts on the lower part of the melon where fruit makes contact with soil. The fruit rot stage can occur anytime from fruit set through harvest. Splashing water, either from rain or overhead irrigation, disperses the pathogen and can result in numerous infections on the upper fruit surface. Infected fruit can rot after harvest, during transit or in storage.

Watermelon fruit rot begins as one or numerous small water-soaked depressed lesions, often on the bottom of the fruit (Fig 1.). The lesions spread and coalesce; eventually the fruit is covered with a white, yeast-like growth that contains great masses of spores (Fig. 2). Lesions often show a concentric ring pattern at the margin. The infected fruit soon collapse and disintegrate, and in the process produce fungal spores for another round of infections..

Fig. 2. Large Phytophthora blight lesion covered with spores. Note the concentric rings at the margin.

The disease can develop between a wide range of temperatures (52-95F). Generally the disease is more destructive during the higher temperatures of July and August.

Rot-

A Menace to Watermelon Production

Bill Jester, Horticultural Science Department
and Gerald Holmes, Department of Plant Pathology,
North Carolina State University

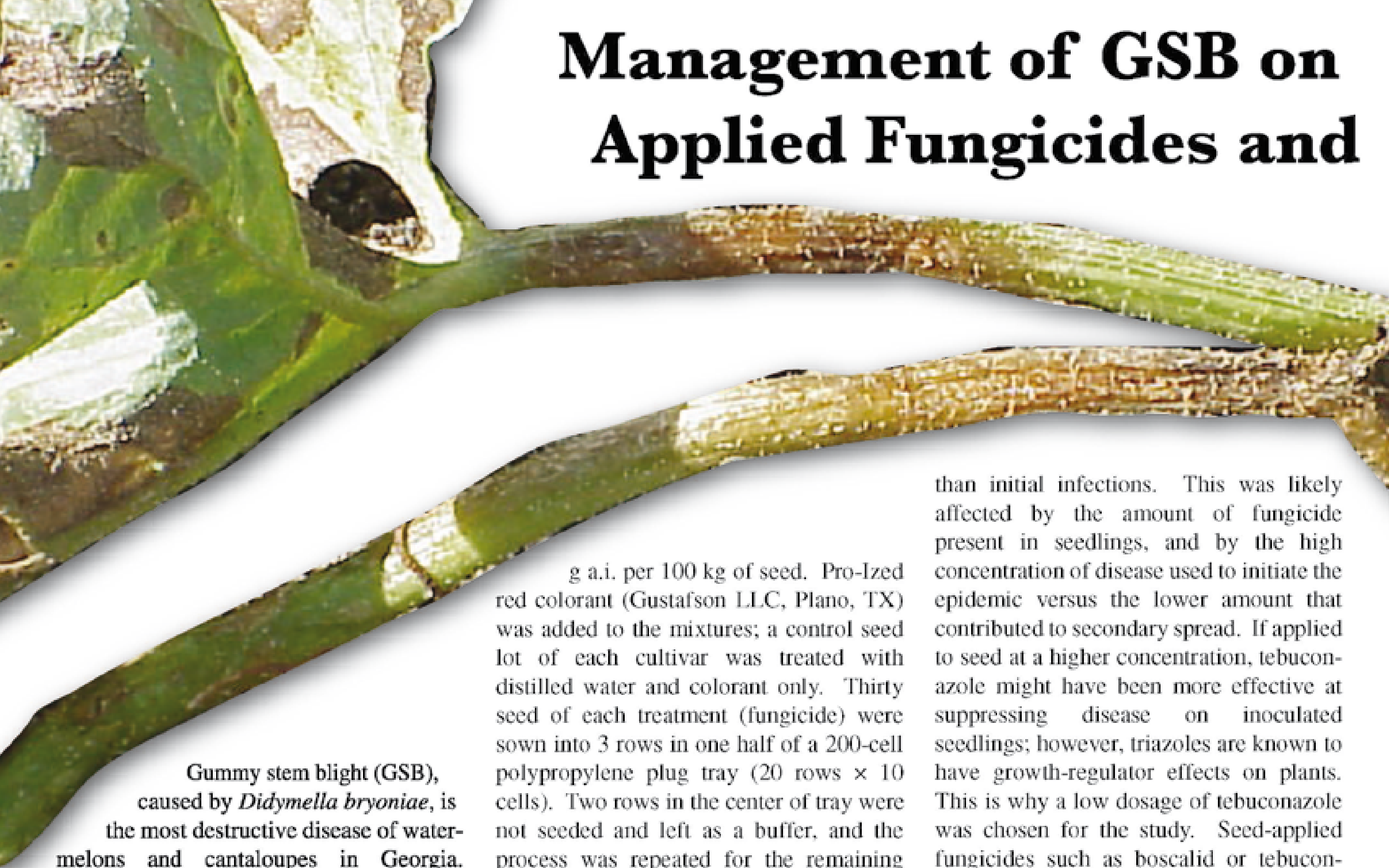
Fig. 1. Early symptom of Phytophthora blight in watermelon: water soaked lesion where fruit contacts soil.

P. capsici loves water. Soil moisture conditions are the most important factor for disease development. Spores form when the soil is at field capacity for 24 hours. Another spore type (a swimming spore) is released when soil is saturated for only six hours. The disease is usually associated with heavy rainfall, excessive-irrigation, or poorly drained soil. Over irrigation increases the incidence of the disease.

Control is difficult and usually involves using a number of practices. One practice is to select fields without a history of Phytophthora blight. Rotation for three years or more with nonhost crops may be beneficial. Perhaps the most important control strategy is water management (i.e., preventing extended periods of high soil moisture). Growers' selection of well-drained fields is imperative. Low-lying areas prone to flooding should not be planted. Avoid spreading the pathogen to uninfested fields by cleaning farm equipment of soil before moves. It is important to avoid irrigation water that is contaminated with water from infested fields. Scout fields for fruit with symptoms of Phytophthora blight and destroy these areas to prevent the spread of the disease.

Work is underway at North Carolina State University with the support of the National Watermelon Growers Association to assess the effectiveness of control using various fungicide treatments in different cultural regimes. Fungicide effectiveness against Phytophthora blight of watermelon has not been tested before. Because the disease primarily attacks fruit, controlling it may be simpler in watermelon than in pepper or squash where the entire plant is susceptible.

Management of GSB on Applied Fungicides and



Gummy stem blight (GSB), caused by *Didymella bryoniae*, is the most destructive disease of watermelons and cantaloupes in Georgia. Losses to GSB are high each year, and the disease has proven difficult to control with fungicides and cultural practices. Management options for control of GSB in the field are rotation, deep turning diseased tissue, avoiding irrigating that prolongs leaf wetness, and preventive fungicide applications. Of these management options, preventive fungicide applications is the most effective. In recent field experiments, Pristine (boscalid + pyraclostrobin) has proven itself to be the most effective fungicide for suppressing losses to GSB. Our experiments focused on using the boscalid component of Pristine as a seed treatment fungicide for suppressing greenhouse disease spread and developing spray programs that maximized the efficacy of and other effective compounds while practicing good fungicide resistance management.

Seed treatment test. Experiments were conducted in transplant production houses at Lewis Taylor Farms in Tifton, GA. Untreated seed of watermelon cultivars 'Mardi Gras' (diploid) and 'Tri-X 313' (triploid), along with the cantaloupe cultivar 'Athena', were treated with boscalid (Endura 70WG) at a rate of 25 g of active ingredient (a.i.) per 100 kg of seed, or tebuconazole (Folicur 3.6F) at 2.5 g a.i. per 100 kg of seed. Pro-Ized red colorant (Gustafson LLC, Plano, TX) was added to the mixtures; a control seed lot of each cultivar was treated with distilled water and colorant only. Thirty seed of each treatment (fungicide) were sown into 3 rows in one half of a 200-cell polypropylene plug tray (20 rows × 10 cells). Two rows in the center of tray were not seeded and left as a buffer, and the process was repeated for the remaining half of the tray. All seed in a given tray were of the same cultivar of watermelon or cantaloupe. At the appearance of the first true leaf, GSB was injected into the crown of each of three adjacent seedlings located in the center of the three rows planted to each treatment. This process was performed on seedlings in one half of the 200-cell tray; the seedlings in the remaining half were left uninoculated for the purposes of evaluating secondary spread of disease. The severity of GSB was evaluated on inoculated and non-inoculated seedlings one week after inoculation using a 0-10 scale were 0=no symptoms, 1=trace symptoms, and 10=complete death of seedling. Boscalid significantly reduced the severity of GSB on inoculated 'Athena' cantaloupe and 'Tri-X 313' watermelon, while the tebuconazole seed treatment did not differ from the untreated control. However, secondary spread (movement from inoculated to non-inoculated seedlings) was reduced ~89% on 'Athena', ~75% on 'Mardi Gras', and ~55% by boscalid (Fig. 1b). Tebuconazole reduced secondary spread of GSB by ~27% on 'Athena' and ~70% on 'Mardi Gras' seedlings. Boscalid applied as a seed treatment was more effective in preventing secondary spread of GSB on transplants than initial infections. This was likely affected by the amount of fungicide present in seedlings, and by the high concentration of disease used to initiate the epidemic versus the lower amount that contributed to secondary spread. If applied to seed at a higher concentration, tebuconazole might have been more effective at suppressing disease on inoculated seedlings; however, triazoles are known to have growth-regulator effects on plants. This is why a low dosage of tebuconazole was chosen for the study. Seed-applied fungicides such as boscalid or tebuconazole have the potential to be used as part of a program to manage GSB in the production of watermelon and cantaloupe transplants. Successful management of GSB on seedlings would reduce significant losses to producers of transplants, and would also reduce a source of initial inoculum that contributes to epidemics of GSB in the field. Because fungicides such as boscalid and tebuconazole target specific metabolic pathways in fungi, the risk of resistance development in populations GSB is high. Further work is needed to define ideal rates of application to seed for these compounds, and to assess the potential for resistance to boscalid and tebuconazole in GSB.

Field tests. Field plots at Reidsville, Crisp Co., and Attapulgus, GA were chosen for testing fungicide programs. All plots were 30 ft long, were bordered on either side by non-treated border rows, and were replicated 5 times. Plots were sprayed weekly with a sprayer calibrated to deliver 40 GPA at 80 psi using TX-18 hollowcone nozzles. At Reidsville, Dry conditions during May and Jun followed by wetter-than-average conditions in late Jun and Jul resulted in late onset of disease in the trial. In general, all fungicide programs were effective in reducing the

Watermelon Transplants with Seed Field Fungicide Programs Involving Pristine

Dr. Kenneth Seebold[1] and Dr. David Langston[2],
[1]University of Kentucky at Lexington and [2]University of Georgia at Tifton

severity of GSB compared to non-treated plots. Alternating Bravo with Switch or Vanguard did not result in improved suppression of GSB compared to Bravo alone. Bravo alternated with Pristine had significantly less disease at the end of the season than Bravo alone, Bravo alternated with Vanguard or Bravo alternated with Vanguard and Quadris. Yields for all fungicide treatments were significantly higher than the untreated control. No differences in yield were observed between any of the fungicide programs and Bravo alone. At the Attapulgus location, wetter than normal conditions in June resulted in early disease onset and high severity of gummy stem blight in the trial. All fungicide programs significantly reduced the severity of GSB, in terms of area under the disease progress curve (AUDPC), compared to non-treated plots and Bravo alone. Severity of GSB at the end of the season was also lower for all fungicide programs (except Bravo applied twice followed by an alternation of Bravo and Pristine) compared to the untreated control or Bravo only. The timing of the initial application of Pristine in a given program had no significant effect on overall severity of GSB, as determined by AUDPC; neither did the number of applications of Pristine. Fruit weight per acre was higher in plots treated with Bravo alternated with Pristine; Bravo applied 2-3 times followed by an alternation of Pristine and Topsin tank-mixed with Dithane; or Bravo applied twice followed by an alternation of Pristine and Folicur as compared to Bravo alone or the untreated control. Topsin tank-mixed with Dithane (or any mancozeb product) was effective for the management of GSB in watermelon and for enhancing yield when used as a late-season rotation partner for Pristine. In Crisp Co., wetter than normal conditions and warm temperatures created favorable conditions for development of anthracnose in the trial. Severity of anthracnose at the end of the season, as well as season-long severity AUDPC, was significantly reduced by all fungicide programs compared to the untreated control. Anthracnose severity at the final evaluation of disease was significantly lower for Bravo applied 2-3 times followed by an alternation of Pristine and Topsin tank-mixed with Penncozeb compared to Bravo applied 3 times followed by an alternation of Pristine and Topsin, or Bravo applied twice and then alternated with Pristine and Folicur. None of the fungicide programs performed better against anthracnose than Bravo alone; however, these programs would likely be effective where other diseases, such as gummy stem blight or downy mildew, are present.

In general, results from 2004 indicate that Topsin tank-mixed with mancozeb is an excellent rotational combination to use with Pristine to manage foliar diseases of watermelons. Folicur (although not labeled) is also an excellent material to rotate with Pristine, especially for gummy stem blight suppression. All of these materials are safe alternatives to use late in the season and do not cause phytotoxicity to watermelon rinds. Pristine at the 12.5 oz/acre rate appears to be marginally effective against anthracnose and higher rates are warranted as per label instructions.