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Influence of Mulch and Fumigation on Production of 'Sunny' Tomatoes

JAMES BROWN, TIM MOTIS, TED TYSON, JIMMY WITT,
CINDY CHANNELL-BUTCHER, LAURA SANDERS, AND ED SIKORA

Polyethylene mulch is commonly used in vegetable production to control weeds, conserve moisture and fertilizer levels, and to modify soil temperature, with resulting improvement in plant growth and development. An undesirable consequence of using conventional black plastic mulch is that it does not decompose and must be removed following harvest.

However, AAES research showed that a new mulch material known as Styrofan BN 1248 provides many of the same benefits as black plastic when used on tomato plants, but it can be plowed into the soil after harvest. Styrofan, a biodegradable polymer produced by BASF Corp., is sprayed on soil and dries to a film.

In field plots at the E.V. Smith Research Center in Shorter, irrigation tubing was laid in the center of 13.9-inch-high, 35.8-inch-wide, single-row pressed beds. Rows were spaced 59 inches from center to center. Mulch treatments included 1.25-mil black plastic, blue-black Styrofan sprayed over beds at a rate of 105.5 gallons per acre. In addition, four fumigant treatments were tested: Busan 1020 at 103 gallons per acre and Basamid at 300, 375, and 450 pounds per acre. These were compared to control plots where the herbicide Treflan was used without mulch. Busan 1020 was injected through the drip system to the plant beds. Basamid treatments were broadcast and incorporated into the upper surface of the soil beds. Treatments were applied and tomato plants were transplanted to the field in May.

With few exceptions, the total marketable tomato yield among treatments was similar (see table). Regardless of fumigants, weeds were 100% controlled on plots where black plastic mulch was used. On the control plots, percent weed population ranged from 1.5% on May 23 to 16% on June 22. This one-year study showed that the lowest rate of Basamid will produce tomato yields equal to the higher Basamid test rates with either mulch. Therefore, 300 gallons per acre of Basamid is the suggested application rate. Mulch selection would depend on site location and/or climatic conditions.

EFFECTS OF FUMIGANTS AND MULCH ON TOTAL MARKETABLE TOMATO YIELD AVERAGED OVER ALL DATES

Treatment	Total number	Total weight
	no./a.	*tons/a.*
Busan 1020 - 103 gal./a. with no mulch	21,360	4.64
Busan 1020 -103 gal./a. with Styrofan	22,860	4.83
Busan 1020 -103 gal./a. with plastic mulch	25,420	5.53
Basamid - 300 lb./a. with no mulch	19,310	4.29
Basamid - 300 lb./a. with Styrofan	24,660	5.83
Basamid - 300 lb./a. with plastic mulch	22,160	5.21
Basamid - 375 lb./a. with no mulch	23,800	5.62
Basamid - 375 lb./a. with Styrofan	20,230	4.71
Basamid - 375 lb./a. with plastic mulch	16,860	3.48
Basamid - 450 lb./a. with no mulch	20,310	4.89
Basamid - 450 lb./a. with Styrofan	18,350	4.67
Basamid - 450 lb./a. with plastic mulch	24,530	5.82
Treflan control	20,840	5.38

Evaluation of Transgenic Tomatoes in North Alabama

JOHN MURPHY, ED SIKORA, AND KARRIE LOVINS

Since 1992, viral diseases have devastated fresh market tomato production in some North Alabama counties. AAES studies identified five viruses in the area, but cucumber mosaic cucumovirus (CMV) is clearly the predominant pathogen. Unfortunately, there are no commercially acceptable tomato varieties able to resist CMV infection. And using insecticides to control aphids, which transmit CMV, is ineffective because only very brief insect contact is needed to spread the virus.

An AAES study in Blount County examined the use of genetically engineered, or transgenic, tomato plants with resistance to CMV. Such plants are created when a portion of viral genetic material is introduced into a single plant cell, and that cell is cultured into a fully developed plant. Every cell in the "regenerated" plant then has that portion of the viral genetic material, thus inhibiting subsequent infection by the virus. Transgenic plants in this study expressed the CMV coat protein gene. The CMV transgenic lines provided extremely good protection against CMV under conditions of high disease pressure.

Transgenic tomatoes consisted of three lines, one transformed with the coat protein gene of a CMV subgroup II isolate (designated CP-II), and two lines transformed with the coat protein gene from CMV subgroup I and II isolates (designated CP1-I+II, and CP2-I+II). These lines were compared to a susceptible control line, (-)CP, which was the same genotype as the transformed lines but did not contain CMV genetic material.

Plants were evaluated for CMV symptom development three times during the growing season. All three transgenic lines held up extremely well throughout the season. No CMV-like symptoms were observed in any of the transgenic lines at the first two evaluations. At the third, late-season rating period, four of 43 CP-II plants showed signs of CMV, but the two CP-I+II transgenic lines were still symptom-free. Seven of 48 control plants developed symptoms within one month of transplanting; by the third rating period, 46 of the plants were symptomatic.

Plant samples were also analyzed by enzyme-linked immunosorbent assay (ELISA), yielding results that complemented the visual observations. A mid-season ELISA evaluation showed that almost all transgenic plants were free of CMV, but 100% of the susceptible control plants were highly infected with the virus. A late-season analysis revealed that transgenic tomato plants did become infected with CMV, but these plants prevented the virus from accumulating to the high levels seen in control plants.

These data indicate that transgenic plants resisted accumulation of CMV until later in the season, and the virus did accumulate in the transgenic plants to detectable, but low levels by the end of the season. Thus, it appears as though the transgenic plants provide a level of defense against infection, upon becoming infected resist accumulation of the virus, and as a result prevent or reduce the development of symptoms and losses in yield.

Evaluation of NS-83 for Control of Cucumber Mosaic Virus of Tomatoes

ED SIKORA, JOHN MURPHY, MARLIN HOLLINGSWORTH, AND ARNOLD CAYLOR

Since 1992, a series of virus epidemics has reduced Alabama tomato production by an estimated 20-25% per year. In a 1995 AAES study, a promising new biological control proved to be of little help in controlling this problem.

The experimental product, NS-83, was developed by researchers in China and is an organic product made from decomposed plant material. NS-83 reportedly controls a broad spectrum of viral diseases on a variety of vegetables. The test material, which is applied as a spray before and shortly after transplanting, induces a tolerance to mosaic-type viruses among treated plants.

Cucumber mosaic virus (CMV), an aphid-transmitted virus, appears to be responsible for the majority of Alabama's tomato damage. The virus was found in 90% of fields surveyed and in more than 70% of plants tested in 1992. Conventional methods for managing CMV include weed control, the use of reflective mulches, application of crop oils, use of barrier crops, and altering planting dates and sites to avoid periods and locations where aphid populations are high. Under high virus pressure, as has been experienced in North Alabama recently, these practices can be ineffective.

On-farm evaluations of NS-83 were established in Blount and St. Clair counties, and a third test was conducted at the North Alabama Horticulture Substation in Cullman. A processing tomato, "Hybrid 882," was grown in a greenhouse for four weeks, then transplanted to the field on June 21 in Cullman and June 22 in Blount and St. Clair counties.

Treatments consisted of NS-83 applied: (1) on June 16 (six days before transplanting) and June 26 (four days after transplanting); (2) on June 16 and 26 and July 13 (18 days after transplanting); or (3) on June 16 and 26 and July 13 and 25 (25 days after transplanting). These treatments were compared to control plots.

EVALUATION OF NS-83 FOR CONTROL OF CUCUMBER MOSAIC VIRUS OF TOMATO

Treatment[1]	Stand count	Plants with CMV symptoms		
		7/20	7/27	8/10
		pct.	pct.	pct.
1	48	27.0	66.6	83.3
2	53	52.8	67.9	98.1
3	54	40.7	70.3	94.4
Control	52	48.0	65.3	94.2

[1]Treatments are described in the text.

Each treatment consisted of a one row plot, 15 feet long, on 30-inch-wide and four-inch-high pressed beds. Tomatoes were grown on white plastic mulch at the Cullman and Blount county locations and on silver or black plastic mulch at the St. Clair county site. Fungicides were applied according to recommendations. Plants were observed weekly for the development of symptoms typical of CMV. Laboratory analysis of leaf tissue was conducted at the end of the experiment to substantiate field observations.

There was very low incidence of CMV at both the St. Clair and Cullman county locations. However, high CMV pressure occurred at the Blount County site throughout the season. Relatively high aphid populations were noted in the field only a few days after the tomatoes were transplanted. Symptoms of CMV were observed within a month after transplanting, and the presence of the virus was confirmed by laboratory examination. Incidence of CMV was extremely high (83-98%) six weeks after transplanting. There did not appear to be any beneficial effect of NS-83 for the control of CMV in this experiment.

Evaluation of Fungicides Using Fixed and Weather-timed Spray Programs for Blight Control in Tomatoes

ED SIKORA, ELLEN BAUSKE, AND MARLIN HOLLINGSWORTH

An AAES experiment was conducted to evaluate fungicides for control of fungal foliar diseases of tomato. Treatments included products currently labeled for tomato (Bravo 720, Manzate 200DF, and Bravo C/M), as well as the experimental compounds Bravo 825 and Dacobre 27/27DG.

These products were applied following the standard fixed, seven-day spray schedule. A weather-timed fungicide spray program known as TOM-CAST (Tomato Disease Forecaster) was also included in the test using Manzate 200DF. TOM-CAST uses two weather measurements, leaf wetness and air temperature, to assess disease risk and determine optimum fungicide spray intervals.

The experiment was conducted at the North Alabama Horticulture Substation in Cullman in 1994. Tomatoes were transplanted on May 12. Each of seven treatments consisted of one-row plots, 30 feet long, with plants spaced 20 inches apart. All treatments, with the exception of the TOM-CAST treatment and the unsprayed control, received fungicide applications at seven-day intervals beginning three days after transplanting and continuing through harvest.

A Campbell Scientific CR10 module located on the substation was used to obtain leaf wetness and temperature measurements necessary for determining TOM-CAST applications. Disease severity was assessed weekly. Tomatoes were harvested on July 19. Total yield (number and weight) was calculated.

Weather conditions were relatively cool and wet for most of the experiment. Early blight was first observed in early July. Late blight became a significant problem and resulted in only one harvest. Significantly less disease was observed on the Bravo 825, Bravo C/M, Dacobre 27/27DG, and TOM-CAST-Manzate 200DF treatments. There were few significant differences in yield among treatments, but all were greater then the control. Bravo 825, Dacobre 27/27DG, and the TOM-CAST-Manzate 200DF treatments produced more than 10,000 pounds of tomatoes per acre.

The TOM-CAST treatment required only seven fungicide applications, compared to 11 for the fixed spray treatments. At $20 per acre per application, a grower following the TOM-CAST program would have saved $80 per acre during the season.

EVALUATION OF FUNGICIDES FOR CONTROL OF FOLIAR DISEASES OF TOMATOES

Treatment[1]	Foliar blight			Total fruit
	July 8	July 14	July 21	
rate/a.	*pct.*	*pct.*	*pct.*	*lb./a.*
Manzate 200 DF (3 lb., fix)	9.4	11.4	31.0	7,626
Manzate 200 DF (3.0 lb., TC)	4.6	4.6	15.0	10,237
Bravo 720 (2 pt., fix)	9.8	12.2	25.6	8,494
Bravo 825 (1.82 lb., fix)	5.0	6.2	16.4	10,905
Bravo C/M (5.6 lb., fix)	4.0	4.2	12.2	8,611
Dacobre 27/27DG (5.6 lb., fix)	5.0	5.8	14.0	10,224
Control	61.2	74.0	80.2	1,970

[1]Fix = seven-day spray schedule; TC = TOM-CAST weather-timed program.

Evaluation of TOM-CAST for Early Blight Control on Tomatoes

ED SIKORA, ELLEN BAUSKE, AND JIM PITTS

Alabama tomato growers may make 10 or more fungicide applications on a tomato crop to control early blight, a fungal disease that prefers warm, wet conditions and can cause severe defoliation and reduced yields. Growers often apply these treatments on a fixed, seven-day schedule beginning shortly after transplanting and continuing through harvest, regardless of the prevailing weather conditions. This practice can waste a grower's time and money if fungicides are applied when the disease is not present or active.

Each fungicide application costs approximately $20 per acre. An AAES study showed that a weather-timed fungicide spray program known as TOM-CAST (Tomato Disease Forecaster) can cut the number of applications required to control early blight by almost two-thirds. TOM-CAST is currently being used in California and the north-central regions of the U.S., as well as in Canada and Mexico.

Related studies since 1992 have shown repeatedly that growers using TOM-CAST can significantly reduce the number of fungicides applied to a tomato crop in a season without resulting in a reduction in yield or fruit quality. Continuing the earlier research , AAES researchers in 1994 evaluated Bravo 720 and Manzate 200DF fungicides for control of early blight using both TOM-CAST and the fixed, seven-day spray schedule.

At the Chilton Area Horticulture Substation in Clanton, tomatoes were transplanted to the field on July 20. Manzate 200 DF at three pounds per acre and Bravo 720 at two pints per acre were applied according to TOM-CAST or at seven-day intervals beginning three days after transplanting and continuing through harvest. TOM-CAST uses two weather measurements: leaf wetness and air temperature to assess disease risk and determine optimum fungicide spray intervals. Leaf wetness and temperature measurements were obtained from the fully automated weather station located on the substation (Alabama Mesonet). Early blight severity was assessed weekly. Tomatoes were harvested on Sept. 20 and 26, and Oct. 3, 11, and 18. Total yield (number and weight) was calculated.

Significantly more disease was observed on the unsprayed control during the last two rating periods. No significant difference was observed in total fruit number or weight among treatments. The TOM-CAST treatments, however, required only five fungicide sprays, compared to 14 for the fixed spray treatments. This more efficient spraying schedule would have saved a grower $180 per acre.

EVALUATION OF TOM-CAST AND A FIXED FUNGICIDE SPRAY PROGRAM WITH BRAVO 720 AND MANZATE 200DF FOR EARLY BLIGHT CONTROL ON TOMATOES

Treatment[1]	Foliar blight			Total no.	Total yield
	Sept. 13	Sept. 30	Oct. 7		
	pct.	*pct.*	*pct.*	*no./a.*	*lb./a.*
Control	4.6	40.2	90.6	2,815	7,045
Manzate 200 DF (Fix)	3.0	9.8	23.4	41,672	22,207
Manzate 200 DF (TC)	4.2	15.4	32.6	49,368	25,357
Bravo 720 (Fix)	2.8	8.6	27.0	35,719	17,722
Bravo 720 (TC)	3.6	13.0	27.8	32,815	17,805

[1]Fix = seven-day spray schedule; TC = TOM-CAST weather-timed program.

Double-cropping on Black Polyethylene Mulch: Fall Collards Following Spring Tomatoes

JOE KEMBLE AND JIMMY WITT

Despite the potential for greater yields of high quality produce, many Alabama growers have expressed concern over the high costs of producing vegetables on polyethylene mulch with drip irrigation (plasticulture). Polyethylene mulch and drip irrigation lend themselves to double-cropping. In this way, material and labor costs associated with plasticulture are spread over two growing seasons.

An AAES study at the E.V. Smith Research Center in Shorter is examining the effect of mulch types and varying fertility regimes (before and after planting) on growth and yield of double-cropped tomatoes and collards. This three-year project also seeks to determine the economic returns and production costs for the various double-crop systems. Presently, there are no commercial recommendations for double-cropping vegetables in Alabama.

Treatments are evaluated based on plant growth and development, fruit set, vine cover, and product quality and quantity. Yield was determined by weight, quality, and/or fruit number of each marketable grade.

In the spring tomato trial, five fertility levels (0, 60, 120, 180, 240 pounds of N per acre) on black plastic were compared to the conventional treatment for tomatoes (120 pounds of N per acre on bare ground). Bare ground plots received additional nutrients via sidedressing, while black plastic plots received nutrients via fertigation. Control plots received 50% of all N and K, and 100% of required P preplant. Black plastic plots received 30% of all N, 100% of required P (based on soil test results), and 30% of all K required (based on soil test results) preplant.

Proper weed, insect, and disease control was maintained. Fertilizer was injected weekly beginning the week of transplanting and continuing through final harvest. Moisture levels were monitored via switching tensiometers placed in a representative plot of each treatment. After final harvest, tomato plants are sprayed with the herbicide glyphosate, allowed to die back, and then removed.

Fertility for collards was based on soil test results and desired level of fertility, so total amount injected or sidedressed was determined after soil test results were returned. Bare ground plots received preplant nutrients via sidedressing, while black plastic plots received nutrients via fertigation. In September, collards transplants were placed into previously punched holes. Proper weed, insect, and disease control was maintained. As in the spring test, irrigation was monitored via switching tensiometers.

Presently, this study is still underway. A complete update will be available in the next Fruit and Vegetable Research Report.

Double-cropping on Black Polyethylene Mulch: Trellised Cucumbers Following Tomatoes

JOE KEMBLE AND JIMMY WITT

Double-cropping is the production of two consecutive crops on the same land area in a successive growing season. This practice can increase efficiency by spreading costs for materials and labor across two growing seasons. Trellised cucumbers return higher yields and quality, but the process of staking and tying is labor- and cost-intensive, limiting the number of growers using this system. This study examined the potential of double-cropping trellised cucumbers following staked, fresh-market tomatoes in Alabama.

After the final harvest of tomatoes, plants were sprayed with the herbicide glyphosate. Care was taken to prevent the spray from coming in contact with the plastic mulch. After the tomato plants died back, 30 pounds of N per acre from 20-20-20 were injected through the drip system. Thereafter, five pounds of N per acre were injected weekly -- alternately from 20-20-20 and potassium nitrate (13-0-44) -- continuing throughout the final harvest of cucumbers. Instead of providing new support for growing cucumbers, the cucumbers used the dead tomato plants along with the attached strings and states for support.

Two weeks after the herbicide was applied, holes were punched through the plastic eight inches apart. Then, two to three seeds of three cucumber cultivars ('Centurion,' 'Hustler,' and 'Slice King') were sown to a depth of one inch. Following emergence, plants were thinned to one per hill. Proper weed, insect, and disease control were maintained. Cucumbers were harvested every two to three days, and fruit were graded according to USDA standards.

Results indicate that this is a potential system for tomato and cucumber production in Alabama. Overall, 'Slice King' and 'Centurion' performed similarly, each producing more and better marketable fruit than 'Hustler'. However, 'Slice King' produced more U.S. Fancy grade fruit than the other two cultivars. Vine cover, plant growth, and overall vigor of 'Slice King' was also better than that of 'Hustler' and 'Centurion,' and thus appeared to be more adapted to trellising.

YIELD OF THREE CUCUMBER CULTIVARS IN DOUBLE-CROP EXPERIMENT

Cultivar	U.S. Fancy	U.S. No. 1	U.S. No. 2	Cull	Total marketable	Total season
	lb./a.	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*
Slice King	1,494.1	436.5	766.8	1,344.2	2,697.4	4,041.6
Centurion	987.2	562.7	1,129.4	1,097.6	2,679.3	3,776.9
Hustler	480.3	383.7	688.1	767.6	1,552.0	2,319.6

Optimal Timing of Insecticides for Control of Pickleworm on Cucumber and Squash

GEOFF ZEHNDER, TERI BRIGGS, JIMMY WITT, AND LARRY WELLS

An AAES study revealed bad news for cucumber growers: the commonly used insecticide spray schedule may begin too late to prevent pickleworm damage. Tolerance for pickleworm damage in the pickling cucumber industry is particularly low; even a small percentage of damaged fruit can result in rejection of the entire harvest.

At flowering, growers usually spray insecticides on a seven-day or more frequent schedule to protect fruit from this damage. However, AAES researchers found pickleworm larvae in buds before the flowers had opened. Pickleworm larvae cause damage to squash and cucumbers by feeding inside the fruit. Hatching larvae feed on foliage in the developing stem tips and flower buds, but later bore into the fruit where they will complete development. It is not uncommon to see a single squash fruit with five to six pickleworm entry or exit holes.

Field experiments were conducted at Wiregrass Substation in Headland and E.V. Smith Research Center in Shorter. At Wiregrass, 'Vlas-Pik' cucumber seed was planted on June 13 with 35.4-inch row spacing and 9.8-inch plant spacing. As soon as plants emerged and were large enough to sample, stem tips, foliage, and flowers were examined for pickleworm larvae in randomly selected areas. The first spray in each treatment was made based on the presence of insects or on plant growth stage; subsequent sprays were applied at four- to 10-day intervals. All treatments were sprayed with Asana XL insecticide at the rate of 9.6 fluid ounces per acre. Fruit were harvested every three to four days and examined for damage; fruit with at least one hole was considered damaged.

At E.V. Smith, 'Gold Slice' squash was direct-seeded on Aug. 5. Squash was used in this test because researchers previously observed greater pickleworm damage on squash than on an adjacent planting of cucumber. Previous experiments showed that the initial pickleworm insecticide application must be made before first open flower. Also, the first observed pickleworm larvae on plants was within a few days of the first presence of flower buds on plants. Based on those findings, the initial spray in this study was applied when larvae were first observed; subsequent sprays were made at four- to 10-day intervals. Sprays, insect sampling and harvests were done as described for the experiment at Wiregrass.

Overall pickleworm damage in the cucumbers was light. However, damage in the untreated control was severe enough to warrant rejection of the crop by the pickle processing industry; a maximum of 8.3% damaged fruit was recorded on Aug. 11 (Table 1).

TABLE 1. PICKLEWORM DAMAGE TO CUCUMBER UNDER VARIOUS INSECTICIDE TREATMENT REGIMES

First spray	Frequency	Pct. damage			
		Aug. 8	Aug. 11	Aug. 15	Total
First sign of buds	4-day	0	0	0	0
First sign of buds	7-day	0	1.1	0	0.2
First sign of buds	10-day	0	0	0	0
First open bloom	4-day	0	0	0	0
First open bloom	7-day	2.4	1.1	0	0.8
First open bloom	10-day	0	0	0	0.5
First sign of larvae in plants	4-day	0	0	0	0
First sign of larvae in plants	7-day	0	0	0.7	0.1
First sign of larvae in plants	10-day	0	0	0	0.1
Untreated control	--	7.6	8.3	4.2	4.3

Treatments where the initial spray was applied when pickleworm larvae were first observed in plant samples (July 13) exhibited little damage (Table 1). However, a low percentage of damaged fruit was seen in treatments where plants were not sprayed until the first open flowers. These results indicate that the first insecticide application for pickleworm should be applied either at the first presence of flower buds, or at the first sign of larvae in stem tips or buds of the plants.

Pickleworm infestation was severe in the squash experiment, with peak damage occurring on Sept. 23 and 26 (Table 2). Damage was most severe in plots treated at 10-day intervals, indicating that this interval is too long to provide effective control when the level pickleworm infestation is high. Results indicated that Asana applied at the first sign of larvae in plants and continued at four- to seven-day intervals will provide effective control of pickleworm damage.

Table 2. Pickleworm Damage to Squash Sprayed at Four- to 10-Day Intervals Beginning When Larvae First Observed

Spray interval	Pct. damage		
	Sept. 23	Sept. 26	Total
4-day	5.0	0	1.5
7-day	2.9	0	1.6
10-day	32.1	5.2	8.5
Untreated control	28.5	22.2	16.3

Root-Colonizing Bacteria for Control of Bacterial Wilt Disease and the Cucumber Beetle Vector

Geoff Zehnder, Joe Kloepper, Changbin Yao, Gang Wei,
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Bacterial wilt, caused by the insect-transmitted bacterium *Erwinia tracheiphila*, is a serious disease affecting production of crops in the cucumber family in the eastern U.S. Bacterial wilt is particularly destructive to cucumbers and muskmelons; squash and pumpkin are susceptible but are not affected as severely.

Fungicides are not effective against bacterial diseases, so the primary control method for bacterial wilt involves use of insecticides targeted against cucumber beetles that spread the pathogen from plant to plant. However, cucumber beetle infestations are impossible to control completely with insecticides because beetles are highly mobile and continually invade cucumber plantings from adjacent fields or weedy areas.

In 1993, AAES scientists began evaluating specific strains of root-colonizing bacteria, also known as plant-growth promoting rhizobacteria (PGPR), to determine how well they control the bacterial wilt disease and what effect they have on the cucumber beetle. These studies have shown the beneficial properties of PGPR when applied to cucumbers as a seed treatment or a root-drench application. Colonization by certain PGPR strains not only increases plant growth, it can also enhance a plant's defense mechanisms.

In field experiments at the E.V. Smith Research Center in Shorter, PGPR treatments were compared to an insecticide control (weekly sprays with Asana XL insecticide) and an untreated control. 'Straight 8' cucumber seeds were dipped into solutions containing PGPR bacteria before planting.

Cucumber yields from the PGPR-treated plants were higher than yields in the insecticide-treated and untreated controls (Table 1). In 1994, the percentage of wilted vines was seven to nine times greater in the untreated plots, and three to four times greater in the insecticide-treated plots, compared to the PGPR treatments. Unexpectedly, numbers of cucum-

TABLE 1. EFFECT OF PGPR TREATMENT ON CUCUMBER YIELD, CUCUMBER BEETLE NUMBERS, AND BACTERIAL WILT SYMPTOMS IN FIELD EXPERIMENTS (1993 AND 1994)

Treatment[1]	Fruit wt.		Beetles/plant		Wilted vines/plant
	1993	1994	1993	1994	1994
	lb./plot	*lb./plot*	*no.*	*no.*	*pct.*
89B-61	82.25	NT[2]	0.61	NT	NT
90-166	79.16	61.96	0.44	2.3	2.6
INR-5	72.10	NT	0.56	NT	NT
INR-7	81.81	58.43	0.73	2.9	3.4
Insecticide control	64.83	48.29	0.89	3.6	11.5
Untreated control	60.20	45.86	1.73	5.4	24.6

[1]Four PGPR strains were evaluated in 1993 (89B-61, 90-166, INR-5, and INR-7). Only 90-166 and INR-7 were evaluated in 1994.
[2]NT = not tested.

ber beetles in the PGPR treatments were not only lower than in the untreated control, they were also lower in insecticide-treated plots.

In the greenhouse experiments at the AU Plant Science Center, cucumber beetles infected with the bacterial wilt pathogen were released to feed on plants inside screened cages. For 23 days, beetles had a choice between PGPR-treated and untreated plants. Beetle feeding on cotyledons (earliest leaves on a seedling) of PGPR-treated plants was significantly lower than on untreated plants (Table 2). Also, the average numbers of wilted leaves per plant were significantly lower on PGPR-treated plants.

To explain the apparent non-preference of beetles for PGPR-treated plants, cotyledon leaves from PGPR-treated and untreated plants were analyzed to determine plant concentrations of the beetle feeding stimulant, cucurbitacin, which is present in cucumber and in other species of cucurbits. Results indicated that cucumber treated with some PGPR strains contained reduced concentrations of cucurbitacin.

These results indicate that PGPR-induced protection against bacterial wilt disease works on two levels. First, PGPR protects the plants against cucumber beetle feeding, thereby reducing spread of the disease. Second, PGPR-treated plants are more resistant or tolerant to bacterial wilt infection after the pathogen is introduced.

PGPR treatment represents an exciting and environmentally friendly tool for use in pest management. Unlike most other biological control agents, PGPR bacteria can protect against a wide spectrum of pathogens and/or pests. This advantage was demonstrated in recent AAES experiments, where two diverse pests (a bacterial pathogen and an insect) were controlled by PGPR.

TABLE 2. CUCUMBER BEETLE FEEDING DAMAGE TO CUCUMBER AND SPREAD OF BACTERIAL WILT DISEASE IN GREENHOUSE CAGE EXPERIMENTS

Days after beetle release	Pct. cotyledon leaf damage		Avg. no. wilted leaves/plant	
	Untreated	INR-7	Untreated	INR-7
3	10.8	1.7	0.00	0.00
7	20.6	8.1	0.00	0.00
11	54.2	25.5	0.25	0.00
15	100.0	74.2	0.50	0.00
19	100.0	91.6	0.94	0.00
23	100.0	100.0	1.88	0.06

Reflective Mulches Aid in Control of Aphid-Borne Viruses in Summer Squash

JAMES BROWN AND GEORGE BOYHAN

Aphid-transmitted viruses can devastate summer squash yields and render surviving crops unmarketable by creating mottled green patterns on the fruit. With many of these mosaic viruses, aphids only need to probe the plant tissue for a short period to transmit the virus. Therefore, using insecticides to control the virus carriers is ineffective; even the few aphids left after spraying can spread enough pathogens to destroy a summer squash crop.

TABLE 1. EFFECT OF DIFFERENT COLORED MULCHES, BARE GROUND, AND INSECTICIDE APPLICATIONS ON MARKETABLE YIELD OF SUMMER SQUASH, 1989-1990

Treatment	Marketable yield
	lb./a.
Silver plastic	9,589
Silver plastic w/ insecticide	8,697
White plastic	6,913
Yellow plastic	6,868
Black plastic	5,932
Black plastic w/ yellow edge	6,333
Bare ground w/ insecticide	4,772
Bare ground	4,282

Specific environmental stimuli cue these aphids to find suitable plants on which to feed. This phenomenon can be exploited with the use of reflective mulches, which are believed to confuse the insects by reflecting sunlight. AAES studies showed that using reflective mulches delays the onset of mosaic virus symptoms, thus increasing yields. Summer squash are generally harvested many times during the season while the fruit are young, so delaying symptom onset is particularly beneficial.

In a two-year study, silver plastic mulch without pesticide applications produced the highest yields of summer squash (Table 1). Additional work found that squash variety had no effect on the percent of virus infection, but benefits based on mulch type continued up to 55 days after transplanting (Table 2).

Recently, Asgrow Seed Co. in cooperation with Cornell University released two new cultivars, Freedom II and Prelude II, which have genetically engineered virus resistance. Although these varieties are not resistant to all viruses that affect summer squash, they offer a new approach to this problem which may preclude the need for reflective mulches. Further study is planned to evaluate the interaction of these new varieties with the use of reflective mulches.

TABLE 2. EFFECT OF MULCH TYPE ON PERCENT OF SUMMER SQUASH PLANTS FREE OF VIRUS SYMPTOMS

Mulch type	Percent virus free at 27-55 days after transplanting				
	27	35	42	49	55
Black Plastic	98	77	73	44	40
Silver Plastic	99	96	92	61	53

Potential New Watermelon and Cantaloupe Varieties

GEORGE BOYHAN, ERIC SIMONNE, JOE NORTON, DAVE HIMELRICK, BENJAPORN TANGSUKKASEMSAN, AND IRMA CHANG

Two advanced watermelon breeding lines and an advanced cantaloupe breeding line show promise as potential new varieties in Alabama. The watermelon varieties AW-82-50ss and AU-AS and the cantaloupe variety AC-82-37RNL were developed in the long-standing AAES plant breeding program.

AW-82-50ss is a small-seeded selection of the AU-Sweet Scarlet watermelon, which is resistant to several foliar diseases and has superior flavor. This advanced line has the same positive characteristics of the parent line, but its seed are about half the size of AU-Sweet Scarlet seed. Also, it produces slightly smaller fruit than AU-Sweet Scarlet, a characteristic generally associated with small seed size.

AU-AS, an Allsweet-type watermelon, is long and dark green with a light green stripe. It has bright red flesh, small seed, and enhanced flavor. This line was developed from backcrossing and recurrent selection with germplasm that possessed high levels of disease resistance.

AC-82-37RNL is a heavily netted cantaloupe with good shipping quality and excellent disease resistance. It produces somewhat larger-than-average, western-type fruit. Both AC-82-37RNL cantaloupe and AW-82-50ss watermelon tested favorably in a consumer acceptance study at two supermarket locations in Auburn.

At this time, only preliminary data are available on these melons (see table). More extensive evaluation of these lines is planned for 1996.

In other melon research, work continued in an effort to breed a commercial watermelon with resistance to zucchini yellow mosaic virus and watermelon mosaic virus. This experimental line was backcrossed with AU-Producer, a Crimson Sweet type watermelon with multiple resistance to foliar diseases.

YIELD AND FRUIT CHARACTERISTICS OF WATERMELON AND CANTALOUPE[1]

	Yield	Type	Melon weight	Soluble solids[2]
	lb./a.		*lb.*	*pct.*
		Watermelon		
AU-AS	9,943	Allsweet	18	9.3
Fiesta	12,697	Allsweet	9	6.8
AW-82-50ss	16,739	Crimson Sweet	24	10.3
Crimson Sweet	19,627	Crimson Sweet	14	9.6
		Cantaloupe		
AC-82-37RNL	16,067	Western	4	9.5
PMR 6	10,726	Western	4	10.7

[1]Results for watermelons are combined from studies at Sand Mountain Substation in 1994 and E.V. Smith Research Center in 1995. Cantaloupe results are from E.V. Smith Research Center in 1995.

[2]Soluble solids is a measure of fruit sweetness. The higher the percentage, the sweeter the fruit.

Double-cropping on Black Polyethylene Mulch: Fall Broccoli Following Spring Bell Peppers

JOE KEMBLE, BOBBY BOOZER, AND JIM PITTS

Despite the potential for greater yields of high quality produce, Alabama growers have expressed concern over the high costs of producing vegetables on polyethylene mulch with drip irrigation (plasticulture). Polyethylene mulch and drip irrigation lend themselves to double-cropping. In this way, material and labor costs associated with plasticulture are spread over two growing seasons. However, there are no commercial recommendations for double-cropping vegetables in Alabama.

BELL PEPPER YIELDS OF FIVE PLASTIC MULCH TREATMENTS COMPARED TO CONVENTIONAL PRODUCTION

Treatment	U.S. Fancy	U.S. No. 1	Cull	Total marketable	Total season
	lb./a.	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*
Black plastic					
0 lb. N	1,018.7	2,624.0	1,180.6	6,728.3	7,908.9
60 lb. N	2,320.9	5,397.5	1,178.2	12,277.7	13,455.9
120 lb. N	4,804.8	7,525.8	1,459.0	16,653.1	18,112.1
180 lb. N	4,417.3	7,501.7	12,17.2	15,962.4	17,179.6
240 lb. N	5,454.2	6,994.2	1,538.4	16,744.9	18,283.3
Bare ground					
120 lb. N	2,621.9	6,112.9	13,17.9	11,437.8	12,755.7

An AAES study is examining the effects of various fertility regimes (before and after planting) and mulch types on growth and yield of double-cropped bell peppers and broccoli. The study is also designed to determine the economic returns and production costs for the various double-crop systems. This three-year experiment is being conducted at the Chilton Area Horticulture Substation in Clanton.

Treatments were evaluated based on plant growth and development, fruit set, vine cover, and product quality and quantity. Yield was determined by weight, quality and/or fruit number of each marketable grade.

In the spring bell pepper study, black plastic plots with fertility levels ranging from 0-240 pounds of N per acre were compared to the conventional treatment for bell peppers, which is 120 pounds of N per acre on bare ground. Bare-ground plots received additional nutrients via sidedressing, while black-plastic plots received nutrients via fertigation. Control plots received 50% of all N and K and 100% of required P preplant. Black plastic plots received 30% of all N, 100% of required P (based on soil test results), and 30% of all K required (based on soil test results) preplant.

Proper weed, insect, and disease control was maintained. Fertilizer was injected weekly beginning the week of transplanting and continuing through final harvest. Moisture levels were monitored via switching tensiometers placed in a representative plot of each treatment. After final harvest, plants were sprayed with the herbicide glyphosate, allowed to die back, and then removed.

Initial data in this ongoing study indicates that plasticulture production using total nitrogen rates of 120, 180, and 240 pounds produced marketable bell peppers of higher quality and in greater quantity than the conventional, bare-ground treatment (see table). These three plasticulture treatments also produced more U.S. Fancy Grade fruit, which return a higher price in the fresh market. 1995 data will be compared to results from next year's study.

In the fall study, fertility for broccoli was based on soil test results and desired level of fertility, so total amount injected or sidedressed was determined after soil test results were returned. Bare-ground plots received preplant nutrients via sidedressing, while black-plastic plots received nutrients via fertigation. In September, broccoli transplants were placed into previously punched holes. Proper weed, insect, and disease control was maintained. Moisture levels were monitored as in the spring study. More information on the results of this portion of the study will follow in the next Fruit and Vegetable Research Report.

Lipid-Based Edible Coatings Improved Shelf Life and Consumer Acceptance of White Bell Peppers

AMY SIMONNE, CHRISTY MOORE, ERIC SIMONNE, ROBERT HAGENMAIER, NANCY GREEN, FLOYD WOODS, AND RONALD EITENMILLER

Modified- and controlled-atmosphere packaging increase vegetable shelf-life by controlling water and gas exchanges between the product and surrounding environment. Coating vegetables with edible films provides the same benefits, but there is no solid waste to discard with this method. Edible coatings are commonly made from polysaccharides, proteins, or lipids. Antioxidants and antifungal and antimicrobial substances can also be incorporated into the coating formulation to reduce rancidity and contamination.

EFFECT OF BELL PEPPER COATING ON WATER LOSS AND SENSORY EVALUATION

Treatment	Percent water loss	Firmness[1]	Overall preference[1]	Color[1]	Glossiness[1]
Control	9.8	1.6	1.3	3.6	2.9
Wax A (8%)	3.4	4.2	3.6	3.9	3.1
Wax B (15.2%)	3.4	4.3	4.0	4.5	4.6
Wax A (16%)	2.9	4.1	3.6	4.2	3.0

[1]These sensory characteristics were rated on a five-point scale: 1 = worst; 5 = best.

An AAES study found that selected lipid-based, edible films improved the shelf life of white bell peppers and delayed color change, loss of firmness, and loss of weight during storage. Coated peppers were well accepted by the trained panelists. This study shows that lipid-based edible coatings for bell peppers have potential for commercial application.

Immediately after harvest, approximately 100 unblemished 'Dove' and 'Ivory' bell peppers of the US#1 or US#2 grades were washed and disinfected with chlorinated water. Peppers were dried and randomly assigned to four treatment groups, three of which involved various coating formulations and a fourth that was left uncoated as a control.

"Wax A" was a 16% candelilla wax, with 2.5% oleic acid, 0.8% palmitic acid, 0.3% gelatin, 200 parts per million (ppm) antifoaming agent, morpholine, ammonia, and water. One treatment used the full 16% Wax A, while a second used Wax A diluted 1:1 with water to make an 8% formulation. "Wax B" was a 15.2% candelilla wax, with 0.9% oleic acid, 1.5% palmitic acid, 0.7% soy isolate, 200 ppm antifoaming agent, ammonia, and water. Peppers were submersed into the appropriate coating solutions once. Coated peppers from all treatments were stored in open boxes under accelerated storage conditions at 25°C in normal indoor lighting for 20 days or until coated peppers lost more than 7% of their original weight.

Fifteen experienced panelists were asked to evaluate pepper samples at three-day intervals throughout the course of the experiment. Panelists rated the coated peppers as firmer than the uncoated peppers (see table). Wax B received the highest scores for glossiness and color, and the uncoated control, the lowest. For overall acceptability, uncoated peppers were rated the lowest, and among the coated peppers, differences in overall acceptability were not significant.

Coating significantly reduced water loss of bell peppers. Although, the effects of the three coatings on water loss was not significantly different, Wax A (16%) reduced water loss the most, but Wax A (8%) was not significantly different in preventing water loss. Overall, coated peppers lost 5% of their original weight by day 12; whereas, the uncoated peppers lost 15%. Normally, peppers are considered unmarketable after losing more than 7%. The concentration of all coatings seemed to be adequate to reduce water loss and minimize water stress.

Results suggest that coating does not affect the loss of ascorbic acid from peppers. Ascorbic acid content of control peppers appeared to increase slightly after 14 days. However, this finding may be due to the concentration effect; uncoated peppers lost more moisture, so the relative amount of ascorbic acid would increase.

Chitosan Coating Delays Postharvest Ripening of Bell Peppers

FLOYD WOODS, RABAH AYNAOU, JAMES BROWN, ERIC SIMONNE, SADIK TUZUN, AND TRACEY LAND

Bell peppers are typically refrigerated after harvest, but since the fruit are sensitive to chilling, long-term cold storage is not feasible. AAES researchers found that coating peppers with a material known as chitosan delays ripening.

Fruit ripening is characterized by changes in texture and carbohydrate metabolism. Bell pepper softening is generally attributed to degradation of cell wall biochemicals, primarily the water-soluble carbohydrate pectin. This process is associated with increased activity of Polygalacturonase, an enzyme responsible for softening fruits and vegetables. Chitosan, which acts as a selective barrier to diffuse gases and maintain a water-saturated environment, is hypothesized to significantly alter pectin content and enzyme activity in the cell wall during ripening.

Peppers were harvested at the mature green stage and surface-sterilized with a .5% solution of commercial bleach before postharvest treatment. Peppers were individually hand dipped in 1.5% chitosan solution, drained, and allowed to surface dry before storage. Control peppers were submersed in a .1% solution of Tween 80 and allowed to surface dry before storage. Peppers were stored at 13°C and 85% relative humidity for approximately 20 days.

Following the 20-day storage, overall quality and appearance of chitosan-treated fruit was superior to uncoated fruit. Chitosan-treated fruit appeared firmer and more uniform in color. They suffered less postharvest decay and wilting. Chitosan application caused an initial decline in Polygalacturonase activity within the first four days of storage (Figure 1). It also had a marked effect on pectin levels, and thus on fruit ripening (Figure 2).

With progressive fruit softening, both chitosan-treated and control fruit showed an increase in Polygalacturonase activity, reaching maximum activity by day eight. However, Polygalacturonase activity in chitosan-treated fruit was significantly lower. After the eighth day, Polygalacturonase activity in treated and control fruit declined rapidly and remained near levels observed initially. Throughout the ripening period, chitosan-treated fruit tended to have lower Polygalacturonase activity.

Water-soluble pectin content during the first four days in storage remained similar for both treatments. During day eight, tissue softening was higher for the control. This pattern of ripening remained throughout storage until day 20, when the chitosan-treated peppers were softer than control fruit.

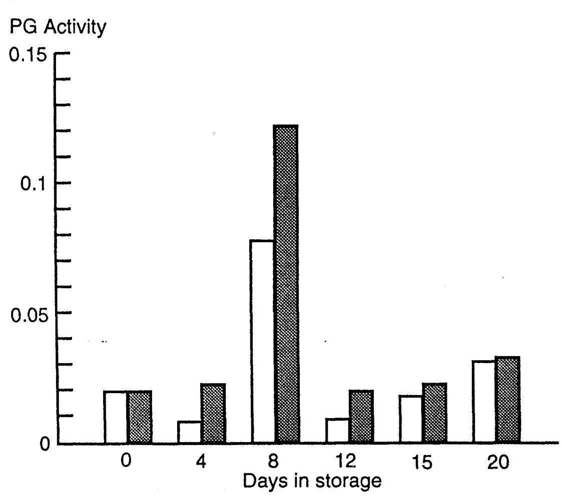


Figure 1. Chitosan coating generally reduced the activity of polygalacturonase (PG), an enzyme associated with cell wall degradation in ripening fruit. As polygalacturonase activity decreases, peppers age slower.

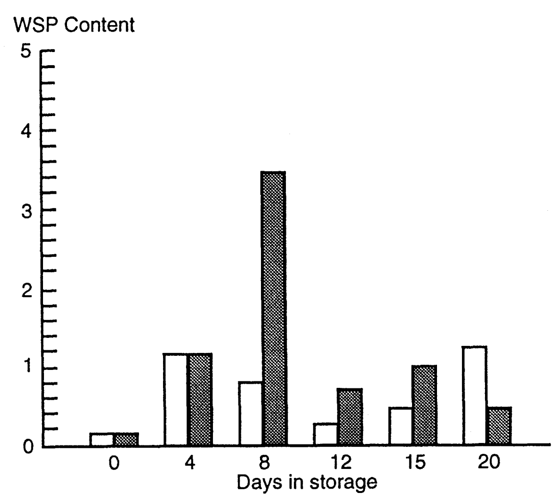


Figure 2. Chitosan coating had a significant effect on water-soluble pectin content (WSP). As water-soluble pectin increases, peppers become softer.

Response of Bell Pepper Yields to an Irrigation Scheduling Model

ERIC SIMONNE, VANESSA DROUOT, JIMMY WITT, AND JOE KEMBLE

Rainfall patterns in Alabama are irregular, so supplemental irrigation is needed to ensure a continuous supply of water to fast-growing vegetable crops such as bell pepper. Often, farmers begin irrigation when the soil feels dry or when plants begin to wilt. However, this approach often results in inadequate water application, possible nutrient leaching, and subsequent yield reduction.

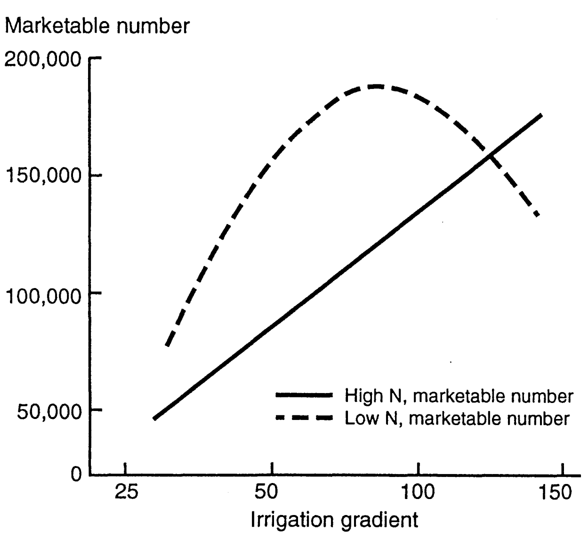
AAES research has developed a system for calculating daily water budgets for overhead irrigated bell peppers. This irrigation scheduling model is based on actual crop water use and can be used to adjust water applications to weather demand and crop age. Under recommended nitrogen (N) applications, bell pepper yields were highest in plots receiving the amounts of water indicated by the model.

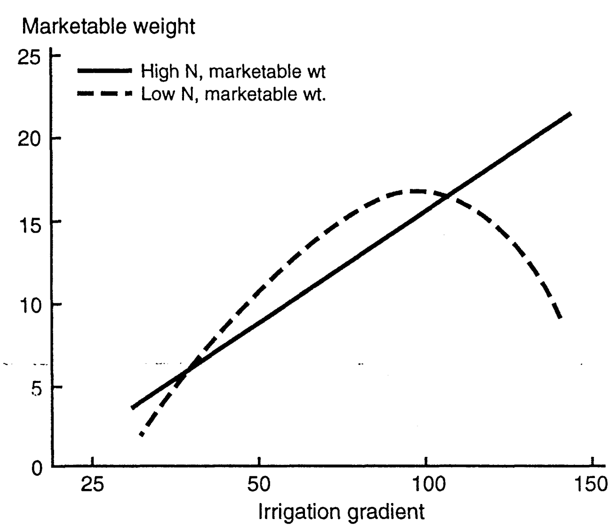
Experimental bare-ground plots were designed to test the effect of various irrigation rates: the rate recommended by the water budget model, along with several rates higher and lower than the recommended amount. The study also examined two N rates. Total N, including preplant and sidedress applications, was 112 pounds per acre for the low-N treatment, which corresponded to the medium recommended rate. The high-N treatment was 170 pounds per acre.

The herbicide Treflon HEC was applied before planting at the rate of one pint per acre. Five-week-old *'X3R Camelot'* were transplanted on May 23. Three irrigations were applied 1-6 days after transplanting (DAT) to ensure stand uniformity. Irrigation according to the water budget model began seven DAT.

The irrigation model used rainfall and evaporation data obtained from the Agricultural Weather Service at AU. This information is modified by a formula based on the age of the pepper crop to determine when irrigation should be applied and at what rate. A complete description of the model is beyond the scope of this publication, but more information is available from the authors.

Under low-N fertilization (figures 1, 2), plots irrigated at the rate predicted by the model had the optimum marketable yield and number of peppers. Results showed that an optimum irrigation rate exists for bell peppers. Yield reductions may be observed with insufficient or excessive water applications. Under high-N fertilization, the highest water application rate may not have been sufficient to optimize bell pepper yield. Results of this one-year study were not sufficient to determine the optimum water application rate under high-N fertilization.





Figures 1-2. An irrigation gradient of 100% represents the amount predicted by the water-budget model; other gradients, both higher and lower than this recommended rate were evaluated. Marketable number is measured per hectare (multiply by .4 to calculate number per acre). Weight is measured in metric tons per hectare (multiply by .446 to calculate English tons per acre). High N is 170 pounds per acre; Low N is 112 pounds per acre.

Subjective and Objective Evaluation of Color in Bell Peppers

ERIC SIMONNE, JOHN EASON, JOE LITTLE, JIM PITTS, JOHN OWEN, MARVIN RUF, AND JOE KEMBLE

Retail price for colored peppers is usually three to five times that of green peppers, but a lack of information about the color descriptions of such varieties can make marketing them a tricky proposition. An AAES study was conducted to define color changes of new colored bell pepper varieties.

Color characteristic and uniformity are important attributes of bell peppers. For wholesale, only peppers of the same and uniform color can be mixed for shipment. Typically, peppers are green when immature, ripen into a partly red fruit, and finally become fully red. However, this sequence of color changes does not apply to some new varieties. The initial fruit color may be white or purple, instead of green. Some varieties may be yellow or orange at maturity. Others express more than two fully colored stages; initially green, they become brown or black, before turning red.

Using fully colored, fancy and US#1 peppers from AAES bell pepper variety trials at four Alabama locations, a subjective description of the skin color was based on visual observation and information provided by seed suppliers. Color changes were described using a five-color-stage scale. Also, a chromameter (Minolta Spectrophotometer model CM-2002) was used to objectively measure color parameters during each stage.

Coloration affected either the skin alone, or both the skin and flesh. For green, red, yellow, orange, or white peppers, skin and flesh colors were similar. However, the flesh of purple varieties was white; that of brown and black fruits was green. For each variety, visual observation did not permit the detection of differences between peppers grown at different locations (Table 1).

Chromameter readings suggest that location, and therefore growing condition, did not affect color development (Table 2). However, variety and stage of development did significantly affect objective color measurements. Most importantly, color measurements taken with the chromameter were in good agreement with the subjective, verbal descriptions. Therefore, chromameter measurements are not systematically necessary when referring to bell pepper colors.

TABLE 1. VISUAL DESCRIPTION OF COLOR STAGES FOR SELECTED VARIETIES OF BELL PEPPER VARIETIES

Variety	Location[1]	Fruit Color[2]				
		1	2	3	4	5
Black Bird	CAHS, PS, SMS	green	black	--	red	deep red
Blue Jay	CAHS, PS, SMS	white-green	purple	orange	red	deep red
Cardinal	CAHS, SMS	green	--	--	red	deep red
Chocolate Beauty	CAHS, LCPS	green	brown	deep brown	red	deep red
Dove	CAHS, PS, SMS	green-white	white	orange	red	deep red
Golden Bell	CAHS, SMS, LCPS	green	--	--	yellow	orange
Ivory	CAHS, PS, SMS	green-white	white	--	yellow	deep yellow
King Arthur	CAHS, SMS, LCPS	green	--	--	red	deep red
Klondike Bell	CAHS, SMS, LCPS	green	--	--	yellow	deep yellow
Oriole	CAHS, SMS, LCPS	green	--	--	yellow	orange
Orobelle	CAHS, LCPS	green	--	--	yellow	deep yellow

[1]CAHS = Chilton Area Horticulture Substation, Clanton; PS = Piedmont Substation, Camp Hill; SMS = Sand Mountain Substation, Crossville; and LCPS = Lower Coastal Plain Substation.

[2]Color changes were described using a five-color-stage scale. Stages 1 and 4 described the initial and final fruit color, respectively. Stage 5 corresponded to an apparently overripe color. Stages 2 and 3 corresponded to intermediate colorations; not all peppers had intermediate stages. The typical commercial color is underlined.

Measurements from the chromameter can be used in a complex mathematical formula to calculate numerical expressions of all visible colors. These color expressions are measured with three values -- "L," "a," and "b." "L" is measured on a scale of 0-100, where 0 is black and 100 is white; the lower the "L" value, the darker the pepper. Value "a" represents a scale from green to red, while "b" represents a scale from blue to yellow. Negative "a" values mean that a pepper has some percentage of green, while positive "a" values mean that it has some percentage of red. Likewise, negative "b" values indicate a pepper has some percentage of blue, and positive "b" values indicate that it has some percentage of yellow. The larger the numbers, the greater the percentage of the given color; in other words, "-50 a" would have a large percentage of green. For example, Orobelle at stage 5 was described in Table 1 as being deep yellow. In Table 2, Orobelle has an "L" value of 53, which means it is moderately dark; an "a" value of 18, which means it reflects a small amount of red; and a "b" value of 30, which means it reflects a fairly large amount of yellow.

Colors observed in this study were in good agreement with the color description provided by seed suppliers. Colors such as purple, brown, and black remained uniform for several days and affected only the skin of the fruit. It was possible to provide a verbal definition of the different stages of uniform color for selected bell pepper varieties. Each stage was clearly defined and visually identifiable.

Color descriptions will help producers in selecting bell pepper varieties of similar colors and in harvesting for a specific color stage. Another important factor is that peppers of the same variety grown at different locations can be mixed for shipping and still meet requirements for color uniformity. Findings from this study will also allow scientists to use varieties with untypical colors as model systems in physiology studies on fruit ripening, fruit composition, and pigment synthesis instead of the traditional green-to-red varieties.

Table 2. Objective Parameters of Color Stages for Selected Varieties of Bell Pepper

Stage[1]	L[2]	a[2]	b[2]
		Black Bird	
1	33	-5	11
2	21	0	0
4	26	20	7
		Blue Jay	
1	42	-2	14
2	24	4	-2
3	39	23	18
4	28	23	10
		Canary	
1	37	-7	15
4	42	3	20
5	44	10	22
		Cardinal	
1	28	-5	8
4	26	19	7
		Chocolate Beauty	
2	25	7	5
3	23	4	2
4	31	30	11
5	28	21	9
		Dove	
1	55	-2	18
2	56	-2	21
3	39	23	16
4	28	25	10
		Golden Bell	
4	49	9	26
5	42	23	22
		Ivory	
1	53	-5	22
2	50	-1	20
4	53	0	25
5	41	9	20
		King Arthur	
1	29	-6	11
4	26	26	9
5	33	34	15
		Klondike Bell	
1	29	-6	10
4	48	10	26
5	43	9	21
		Oriole	
1	32	-5	11
4	39	18	19
5	39	23	19
		Orobelle	
1	33	-6	13
4	51	12	28
5	53	18	30

[1]Color changes were described using a five-color-stage scale, as described in Footnote 2 of Table 1.
[2]See text for definitions of L, a, and b.

Two New Pinkeye Southernpeas Released

OYETTE CHAMBLISS AND GENE HUNTER

The Alabama Agricultural Experiment Station has released two new pinkeye southernpeas -- 'Alagreen Pinkeye' and 'Pickworth Pinkeye' -- which have great potential for sale in several markets. Seed should be available to Alabama seedsmen by the 1998 growing season.

'Alagreen Pinkeye' has a distinguishing combination of a persistent green seed coat and a distinct, non-bleeding pink eye. These characteristics give it a clean appearance without the gray shadow below the eye which is present in most pinkeyes. 'Alagreen Pinkeye' is well suited for the fresh-market.

'Pickworth Pinkeye' was released because of its special appeal to pick-your-own consumers, as well as fresh-market production for wholesale lots in the pod or retail sale of shelled peas. It is distinguished from 'Alagreen Pinkeye' by the presence of both green and white dry seeds. Approximately half of its plants produce a dry green seed coat, while the other half produce a white seed coat. When harvested at the mature green to early dry stage, this mixture produces a pleasant blend of green and white peas.

Plants of both varieties have an erect, determinate growth habit; are approximately 20 inches in height; and produce limited lateral vines. Pods are slightly curved, concentrated above the plant, have a glossy surface, and are green, changing to reddish-purple at the mature green stage. The pods average 10 inches in length and almost a half inch in diameter. They are slightly constricted about the seed and produce an average of 14 seed per pod. The seed are medium to large (18-24 grams per 100 seed) and are kidney shaped. If pods remain in the field 10-14 days after drying, the persistent green seed coats will bleach. Significant bleaching can occur even within the first week after drying.

'Alagreen Pinkeye' was entered in the Southern Cooperative replicated trials in 1991 and 1992 in Alabama, Arkansas, Louisiana, Missouri, South Carolina, Tennessee, and Texas. In 1991, it was the highest yielding of four pinkeye breeding lines in the trial, but yielded less than Pinkeye Purple Hull-BVR, the commercial check. In 1992 it was the lowest yielding of five pinkeye lines, and yielded less than the check. Its yield is adequate (about a ton per acre) for its use in the frozen food trade, since it can be marketed as a specialty item to enhance grade. With the exception of Louisiana and Texas, 'Alagreen Pinkeye' seems fairly well adapted across the South.

In Alabama, both varieties were entered in a three-year southernpea variety trial (1992-1994) with 10 other pinkeyes (see table). Average three-year yield of 'Alagreen Pinkeye' ranked third, fourth, and eighth at the Wiregrass Substation in Headland (only two years), North Alabama Horticulture Substation in Cullman, and E.V. Smith Research Center in Shorter, respectively. In the same trials, 'Pickworth Pinkeye' ranked fourth, seventh, and third. The rank of check varieties commonly used by the industry ranged from the first to eleventh across locations.

PINKEYE SOUTHERNPEA VARIETY TRIALS IN ALABAMA: AVERAGE YIELDS FOR 1992-1994 [1]

Entry	EVSRS	NAHS	WS
Corona	2,142	2,003	1,582
Coronet	2,143	2,598	1,786
C.T. Pinkeye Purplehull	2,143	2,833	1,158
Kiawah	2,158	2,022	1,287
Mississippi Pinkeye	2,936	2,874	2,465
Pinkeye Pinkpod	2,180	2,205	1,543
Pinkeye Purplehull-BVR	2,138	2,004	930
AR-92-552	--	--	1,824[2]
Santee Early Pinkeye	2,295	2,322	1,597[2]
Texas Pinkeye	1,753	1,765	1,210
Alagreen Pinkeye	2,000	2,341	1,761
Pickworth Pinkeye	2,180	2,190	1,729

[1]Trials were conducted at E.V. Smith Research Center (EVSRS), North Alabama Horticulture Substation (NAHS), and Wiregrass Substation (WS). Fresh shelled yield was measured in pounds per acre. Yield was based on once-over harvest when 80% of pods were dry. EVSRS and NAHS yields are based on three years of data, while WS yields are based on two years.

[2]Average is based on one year of data.

The Value Of Host Plant Resistance in Controlling Cowpea Curculio in Southernpeas

GENE HUNTER, OYETTE CHAMBLISS, AND LARRY WELLS

Damage caused by the cowpea curculio, a small black weevil, can severely limit the marketability of southernpeas sold for processing or offered in fresh markets and pick-your-own operations. AAES studies found that southernpea lines originating from an Auburn-developed breeding line were most resistant to curculio damage. Using these resistant varieties proved to be more effective than using insecticides to reduce curculio damage.

Adult cowpea curculio damage southernpeas by feeding on immature seeds, leaving characteristic "stings" on seeds and pods. Curculio eggs are deposited on seeds in the early mature-green stage, generally one egg to each seed. After larvae feed on dry seed, they chew exit holes in the pods and fall to the soil where they pupate.

At the Wiregrass Substation in Headland, nine southernpea varieties and one breeding line were planted on June 3. Treatments included THIODAN 3EC and PENNCAP-M at the recommended rate of one pound of active ingredient per acre and at one-quarter the recommended rate. Control treatments were set up to illustrate the impact of tractor traffic, which could affect insect feeding. One included no insecticide but had tractor traffic; the other received no insecticide or tractor traffic. Chemicals were applied three times at five-day intervals from first blooms. Southernpeas were harvested when 80% of the pods were dry. Harvested pods were kept in paper bags in metal trays until all curculio larva emerged. A 50-pod sample from each plot was examined for curculio-damaged seed, number of sound seeds, number of larval exit holes, and weight of sound seeds.

There was no difference between the effectiveness of treatments in reducing the number of seeds damaged by the cowpea curculio (see table). When the average percentage of damaged seed for the two control treatments (12.2% damage) was compared to each insecticide treatment, only the one-pound-per-acre Pencap-M treatment differed significantly (7.3% damage).

However, varieties differed in the percentage of curculio-damaged seed 'California Blackeye #5,' which is known as the standard for curculio susceptibility, suffered the most damage. 'Carolina Cream,' 'Bettergreen,' and the breeding line CR-22-2-21 had the least amount of damaged seed. 'Freezegreen' also was fairly resistant. These four lines with the least amount of damage originated from the breeding line Alabama 963-8, which was developed as part of Auburn's cowpea curculio resistance breeding program.

PERCENTAGES OF SEEDS DAMAGED BY COWPEA CURCULIO IN SOUTHERNPEAS USED TO EVALUATE THE VALUE OF HOST PLANT RESISTANCE

Variety	Check w/o traffic	Check w/ traffic	PENNCAP-M		THIODAN 3EC		Avg.
			.25 lb./a.	1 lb./a.	.25 lb./a.	1 lb./a.	
AUBe (blackeye)	9.4	12.7	7.6	2.5	8.4	9.9	8.4
Bettergreen (cream)	3.9	4.9	6.1	3.8	4.5	5.2	4.7
Bettergrow Blackeye	7.6	10.9	7.1	2.3	10.0	6.9	7.5
California Blackeye #5[1]	45.9	48.1	37.4	36.1	47.5	40.8	42.7
Carolina Cream	8.5	3.6	3.3	1.3	4.0	1.6	3.7
Carolina Crowder	11.5	10.0	15.6	5.6	7.4	6.5	9.5
CR-22-2-21	5.9	8.3	5.6	3.1	5.5	6.4	5.7
Freezegreen (cream)	6.7	6.9	9.7	6.7	6.1	6.6	7.1
Pinkeye Purplehull	7.8	9.9	7.4	3.0	9.9	10.2	8.0
SaDandy (cream)	7.7	9.6	7.6	7.7	9.1	4.7	7.6

[1]The commonly grown 'California Blackeye #5' is accepted as the standard for curculio susceptibility. It was used as the yardstick for measuring resistance of other breeding lines and varieties. This does not mean that resistant southernpeas are not damaged by the cowpea curculio, but the damage is significantly less than that found in 'California Blackeye #5.'

Is Silver Queen Still the Best-Tasting Sweet Corn?

Amy Simonne, Eric Simonne, Jim Pitts, Gary Gray, and Nancy Green

The sweetness, texture, and aroma of sweet corn, along with its high yield and desirable grain color, make this a $2.7 million crop in Alabama. For almost 20 years, the most popular sweet corn variety has been the white, "sugary" (su) cultivar 'Silver Queen.' Sweet corn connoisseurs prefer 'Silver Queen' and claim they can identify its typical flavor.

However, with the abundance of sugar-enhanced (se) and supersweet (sh2) white, sweet-corn cultivars, 'Silver Queen' yield and quality may be surpassed. An AAES study was conducted to determine if 'Silver Queen' is actually recognized for its own attributes or if it benefits primarily from "name recognition." A taste-testing panel in this study rated six se and sh2 varieties as superior to 'Silver Queen.' Only a few tasters could properly identify this popular variety.

Cooked ears from the sweet corn variety trial conducted at the Chilton Area Horticulture Substation in Clanton were served to a panel of tasters. A total of nine varieties were evaluated, but each panelist was asked to rate a selection of only five cultivars. Each five-sample set included 'Silver Queen,' along with four other varieties. Samples were identified only by random three-digit numbers. The panel was comprised mainly of growers, gardeners, and retirees.

Ratings of appearance, sweetness, flavor, and overall preference were significantly affected by variety (Table 1). However, most of the selected cultivars received acceptable ratings. The appearance of 'Silverado' and 'Even Sweeter' ears was rated highest, while 'Fantasia' and 'Snow White' were rated lowest. Sweetness was found the highest in 'SS 7801,' 'Treasure,' and 'Even Sweeter.' The sweetness rating of 'Snow White' was the closest to undesirable. Flavor ratings were highest for 'Starshine' and lowest for 'Snow Belle.' 'Treasure' and 'Silverado' received the highest scores for overall preference. Overall, 'Treasure' was ranked first, 'Even Sweeter' and 'Silverado' tied for second, and

Mean Ratings of Selected Sweet Corn Varieties [1]

Variety (seed source)	Type[2]	Overall preference	Appearance	Sweetness	Flavor	Overall rank sum
Treasure (Harris Seeds)	sh2	9.7	8.5	9.1	8.8	8
Silverado (Harris Seeds)	se	9.4	10.4	7.6	8.6	14
Even Sweeter (Asgrow)	sh2	8.3	10.1	9.0	7.7	14
SS 7801 (Abbott & Cobb)	sh2	8.0	7.6	9.9	8.6	15
Fantasia (Asgrow)	se	7.3	7.0	8.0	8.8	21
Starshine (Seneca)	se	7.0	7.9	7.4	9.4	22
Silver Queen (Rogers NK)	su	7.9	7.3	7.9	7.7	23
Snow Belle (Asgrow)	se	7.5	8.2	7.7	6.1	25
Snow White (Harris Seeds)	sh2	6.0	6.1	5.6	6.3	35

[1]Varieties were rated on a 0-14 scale (0 = Undesirable/Dislike; 14 = Desirable/Like Extremely). Overall rank sum was calculated by adding the ranks of each attribute (Maximum value = 36); the smaller the overall rank sum, the better.
[2]The types of sweet corn are sugary (su), sugar enhanced (se), and supersweet (sh2). Typically, su cultivars have 5-15% sugar at harvest; se, 8-20%; and sh2, 25-40%.

'SS 7801' was ranked fourth. Three of these four top-rated cultivars are sh2 varieties. 'Silver Queen' was ranked seventh out of nine in overall preference.

Panelists were asked to identify 'Silver Queen' among the five corn samples they tasted. Thirty percent of the panelists properly identified 'Silver Queen,' 58% could not identify it, and 12% did not give any answer. Since each panelist was presented five varieties, the odds of correctly choosing 'Silver Queen' at random were 20%. Therefore, only a small fraction of the panel recognized 'Silver Queen.'

Panelists also were asked to list all the sweet corn variety names they could remember. Of 67 completed responses, 34% did not name any sweet corn variety. The most commonly named varieties were 'Silver Queen' (by 61% of the responding panelists), 'Golden Queen' (10%), and 'Bantam' (5%). These results illustrate the popularity of 'Silver Queen.'

These results emphasize the importance of cultivar selection in the production of sweet corn. Sugar levels in sweet corn kernels are genetically controlled, thus variety choice is critical. Rankings from this study should be used in conjunction with yield performance and disease resistance before selecting which white sweet corn to plant.

Effect of Rate of Banded and Broadcast Phosphorous on Yield of Sweet Corn

JOE KEMBLE, ELIZABETH GUERTAL, AND JOHN EASON

Broadcast fertilizer application, a method commonly used by sweet corn growers in Alabama, can endanger water quality when phosphorous moves toward surface waters through runoff. However, there is evidence that efficiency of P uptake and crop utilization may be increased when P is banded with the crop at planting, compared to broadcast applications.

An AAES study was conducted to determine if differences in leaf P concentration and crop yield occurred when P was applied either as a broadcast or banded treatment. This experiment was conducted at the Sand Mountain Substation in Crossville.

Preliminary soil tests indicated that the soil was low in available P_2O_5. Nitrogen and K_2O were applied based on standard crop and soil test recommendations. Phosphorus (0-46-0) was banded (2x2 band) or broadcast at five rates (0, 30, 60, 90, and 120 pounds per acre). 'Snow Belle' sweet corn was sown into plots four rows wide on April 15. Cultural practices followed current recommendations for Alabama. Ear leaf samples were removed at pollination, dried, ground, and analyzed for phosphorous content.

Treatment differences were apparent in the vegetative growth. Fresh weight of harvested ears did not differ between the banded and broadcast treatments. As level of P increased up to 120 pounds per acre, fresh weight of harvested ears increased. It appeared that yields were not quite maximized within the range of applied P. However, yield probably would have leveled off near 120 pounds P per acre.

Percent of P in corn ear leaves did not differ among treatments. There were no differences in P leaf concentrations between the banded and broadcast treatments, indicating that yield response occurred because of rate of P application as opposed to method.

Evaluation of Foliar-applied Insecticides for Control of Whitefringed Beetle in Sweetpotatoes

GEOFF ZEHNDER, TERI BRIGGS, AND JIM PITTS

Whitefringed beetles can cause serious damage to sweetpotatoes in Alabama and other southern states. An AAES study found that soil insecticides applied at planting are generally not effective because the insecticide residue dissipates by the time larvae enter the soil.

In central and northern Alabama, adult whitefringed beetles emerge from the soil in early July and begin laying eggs. If sufficient moisture exists, eggs hatch and larvae, or grubs, crawl into the soil. Larvae develop in the soil and feed on sweetpotato roots. The most serious feeding damage occurs late in the season after larvae have matured.

'Cordner' sweetpotatoes were planted on May 18, 1994, and May 24, 1995, at the Chilton Horticulture Substation in Clanton. Treatments consisted of eight rows bordered on both sides by eight untreated rows. Beginning the first week in July, plots were sprayed either weekly or biweekly with a tank mix of Sevin 80S (one pound per acre) plus Penncap-M (one pint per acre). Sprays were applied with a tractor-mounted sprayer delivering 40 gallons per acre. Adults were sampled approximately weekly by examining sweetpotato foliage and the soil surface in four locations per plot. Larvae in the soil were sampled every two to three weeks by taking soil core samples in four locations per plot. Soil samples were taken back to the laboratory where larvae were extracted.

Foliage and soil samples taken in 1994 for whitefringed beetles indicated that the foliar insecticide sprays reduced the numbers of adults and larvae up to fourfold, compared with the untreated control. Correspondingly, the percentage of damaged sweetpotatoes was reduced 57% in the biweekly insecticide treatment and more than 300% in the weekly insecticide treatment, compared with the untreated control.

Similar results were seen in the 1995 test, where the weekly and biweekly sprays significantly reduced whitefringed beetle damage compared with the nontreated control.

These results indicate that foliar spray treatments are an effective alternative to soil-applied insecticides for whitefringed beetle control.

INSECTICIDES ON WHITEFRINGED BEETLE POPULATIONS AND DAMAGE IN SWEETPOTATO

Treatment	Timing	Adults per plant[1]	Grubs per soil sample[2]	Percent damaged roots 1994	Percent damaged roots 1995
Sevin + methyl parathion[3]	Weekly	0.09	0.08	5.1	9.5
Sevin + methyl parathion[3]	Biweekly	0.13	0.13	10.7	4.3
Untreated control	--	0.40	0.42	18.7	25.7

[1]Adult counts averaged over eight sample dates in July, August, and September. Each time, foliage and the soil surface were examined in four 90-centimeter row sections per plot.
[2]Grub counts are from soil core samples from five sample dates in August and September. Cores were 10 cm in diameter and 30 cm deep.
[3]Sevin 80S and Penncap-M were applied at one pound and one pint per acre, respectively, using a tractor-mounted sprayer.

Biocontrol Of Black Rot of Cabbage with Plant Growth Promoting Bacteria: Detection Through Bioluminescence

FENNY DANE, GANG WEI, AND JOE SHAW

Black rot is considered the most destructive disease of cabbage and other crucifers. In an AAES study, the bacterium which causes black rot was genetically engineered to give off low levels of light, thus making it possible to study the course of this disease and to test the effectiveness of beneficial bacteria in controlling black rot.

Black rot is caused by the bacterium *Xanthomonas campestris* pathovar *campestris* (*Xcc*). Light-producing genes from a fish-associated bacterium were introduced into the *Xcc* bacteria. These transformed *Xcc* bacteria could then be detected inside plants with special computer-assisted camera equipment long before symptoms were expressed. This technique allowed detailed studies of *Xcc* growth inside plants.

Two studies used this method to investigate the effect of different biological control agents on *Xcc* survival. Greenhouse experiments were set up to test if bacteria that are known to stimulate the plant's defense mechanism have an effect on growth and survival of the bioluminescent *Xcc*.

In the first study, cabbage seedlings were inoculated by syringe injection with one of 10 different plant-growth-promoting-root (PGPR) bacteria. One week later, two leaves per plant were injected with bioluminescent *Xcc* bacteria. In the second study, mist inoculation experiments were conducted with the three most effective PGPR strains from the first study. Solutions containing the PGPR bacteria were inoculated into the main stems of cabbage seedlings. One week later, the plants were mist inoculated with bioluminescent *Xcc* bacteria using a hand-held sprayer. Growth of the bioluminescent bacteria was measured over time and quantified with the computer-assisted camera. The ability of the PGPR strains to induce resistance in cabbage was also examined by evaluating the protein profiles of leaves of treated and untreated plants.

The initial screening study showed that ME1, IN114, and INR7 strains of PGPR bacteria significantly reduced the growth of *Xcc* (Table 1). Even though the PGPR effect was more pronounced following the syringe injections in the first study, ME1 treatment in the second study did reduce the spread of *Xcc* (Table 2). However, no effect was detected on protein profiles of the leaves of treated plants. Also, there was little effect of PGPR on disease symptom reduction. More studies are needed to determine the long-term effect of PGPR bacteria on control of black rot disease in the field environment.

TABLE 1. EFFECT OF PGPR STRAINS ON GROWTH OF THE BIOLUMINESCENT BLACK-ROT PATHOGEN IN CABBAGE PLANTS FOLLOWING SYRINGE INJECTION[1]

Treatment	Day 5	Day 8	Day 12	Day 15	Day 20
ME1	80	7,200	--	--	13,810
IN114	10,260	--	17,330	--	0
SE76	3,770	--	56,860	--	10,680
IN726	15,660	34,340	--	23,670	13,680
INR7	17,180	36,370	--	42,480	14,030
SE56	19,870	42,450	--	24,280	27,040
T4	6,380	30,710	--	56,690	30,820
SE34	15,860	--	79,450	--	7,830
SE49	25,380	37,660	--	25,840	29,160
SE52	--	40,680	47,210	--	8,090
Control	16,910	56,130	--	87,860	5,200

[1]Bacterial bioluminescence is expressed as mean light quanta per plant. The lower numbers indicate reduced growth of the bioluminescent *Xcc* strain in the plant.

TABLE 2. EFFECT OF SELECT PGPR STRAINS ON GROWTH OF THE BIOLUMINESCENT BLACK-ROT PATHOGEN IN CABBAGE PLANTS FOLLOWING MIST INOCULATION [1]

Treatment	Day 6	Day 11	Day 18	Day 21	Day 26
ME1	17,750	27,590	56,030	31,080	35,600
INR7	12,850	14,570	69,590	27,480	23,480
IN114	23,190	40,340	68,200	56,170	56,390
Control	23,950	27,880	82,990	32,960	32,080

[1]Bacterial bioluminescence is expressed as mean light quanta per plant. The lower numbers indicate reduced growth of the bioluminescent *Xcc* strain in the plant.

Evaluation of Fungicide Spray Programs for Brown Rot Control on Peaches

Ed Sikora, Jim Pitts, Bobby Boozer, and Ellen Bauske

Peach producers have a variety of products available for use in a fungicide spray program, but effectiveness of disease control, cost per application, and disease resistance management are vital factors in developing a program.

Overuse or abuse of a fungicide can lead to development of fungal strains resistant to that fungicide, as well as all other fungicides within its class. An effective resistance management fungicide spray program relies on reducing the number of applications of a fungicide class during the season, using tank-mixes of compounds when appropriate, and/or alternating different classes of fungicides within the spray program during the season. Growers who follow these practices will reduce the chances for the development of a resistant fungal strain in their area.

An AAES study was conducted to evaluate the effectiveness of eight fungicide spray programs, using products from various pesticide classes, for the control of brown rot. This disease developed resistance to benzimidazoles (Benlate) in the U.S. and to dicarboximides (Ronilan and Rovral) in Australia. The fungicide classes include the DMI's (Orbit, Indar, Nova, and Funginex); the MBC's (Benlate and Topsin M); the dicarboximides (Ronilan and Rovral); and the multi-site compounds (Captan, Bravo, and sulfur).

A number of the experimental programs used fewer applications of certain fungicides (Orbit, Indar, Rovral) and/or alternated applications of these fungicides with compounds from other fungicide classes. The experiment was conducted at the Chilton Area Horticulture Substation in Clanton on the cultivar Harvester. Fungicides were applied using an airblast sprayer at a total volume of 100 gallons per acre.

Estimated Cost of Nine Fungicide Spray Programs and Their Effect on Brown Rot Control of Peaches

Treatment	Time of applications[1]						Pct. disease	Cost[3]
	B	PF	C[2]	2	1	D		
1	I[4]	I	C	C	I	I	1.2	$113.50
2	C	C	C	C	O	O	0.0	110.14
3	C	C	C	C	I	I	0.0	114.80
4	C	C	C	C	R	R	1.2	169.30
5	C	C	C	C	C	C	3.8	116.10
6	C	S	S	S	C	C	16.8	47.64
7	C	C	C	R	O	O	1.2	136.74
8	C	C	C	R	I	I	1.2	141.40
Control	--	--	--	--	--	--	26.2	0.00

[1]Phenological time of spray applications: B = blossom spray (3/20); PF = petal fall (3/29); C = cover sprays (4/12, 4/25, 5/11, 5/29); 2 = two weeks before harvest (6/14); 1 = one week before harvest (6/19); and D = one day before harvest (6/22).
[2]There were four cover spray applications for each treatment.
[3]Total estimated cost of each spray program.
[4]Treatments 1-8 consisted of applications of various combinations of fungicides: O = Orbit (four ounces per acre — $9.92 per application); S = sulfur 80% (nine pounds per acre -- $1.49 per application); I = Indar 75WSP (two ounces per acre — $12.25 perapplication); R = Rovral 50WP (two pounds per acre — $39.50 per application); and C = Captan 50WP (six pounds per acre — $12.90 per application). No fungicides were used in the control, thus no costs were incurred.

Treatments were applied at full bloom, petal fall, as cover sprays, and at preharvest. Fruit were harvested on June 23. Fruit samples from each treatment were rated for percent brown rot five days after harvest following incubation at room temperature.

The weather conditions in 1995 were unusually hot and dry for the area. Little or no brown rot was observed in the orchard before harvest. Differences were observed among treatments for brown rot following the five-day incubation period. Significantly more brown rot occurred in the unsprayed control treatment and the sulfur/Captan spray program than in the other seven treatments. There were no differences and little disease observed among the other seven treatments. Estimate costs of each spray program is shown in the table.

Evaluation of Fungicides for Brown Rot and Scab Control on Peaches

Ed Sikora, Jim Pitts, and Ellen Bauske

Brown rot, scab, and Rhizopus rot are three diseases that limit production of peaches each year in Alabama. In 1995, an AAES experiment was conducted to evaluate a new experimental fungicide product developed by Zeneca for control of these diseases.

The new product, known as 5504, was compared to two rates of Captan for full-season use (except preharvest sprays). The experiment was conducted at the Chilton Area Horticulture Substation in Clanton, using the cultivar Alred Elberta.

Fungicides were applied using an airblast sprayer at a total volume of 100 gallons per acre. Treatments were applied at first pink (March 19), full bloom (March 22), shuck split (March 31) and in cover sprays (April 14 and 25, May 11 and 29, June 13 and 30). The fungicide Orbit EC (four ounces per acre) was applied as a preharvest spray for all treatments except the control on July 13. Fruit were harvested on July 14 and rated for percent scab incidence. After five days of incubation at room temperature, fruit were rated for percent brown rot and Rhizopus rot.

The weather conditions in 1995 were unusually hot and dry for the area. Little brown rot and Rhizopus rot were observed in the orchard before harvest, nor were there any significant differences among treatments five days after harvest. The intermediate and high rate of 5504, along with the six-pound rate of Captan, provided the best control of scab. The low rate of 5504 was significantly better then the control but did not perform as well as the intermediate and high rates.

Effect of Fungicides on Scab and Brown Rot Control on Peaches

Treatments[1]	Scab	Brown Rot	Rhizopus
	pct.	*pct.*	*pct.*
Control[2]	84.3	7.5	3.1
5504 80WG (0.05 lb. ai) + Latron 1956 (1 pt.)	35.0	1.2	0.0
5504 80WG (0.10 lb. ai) + Latron 1956 (1 pt.)	11.8	0.0	1.2
5504 80WG (0.15 lb. ai) + Latron 1956 (1 pt.)	13.7	1.2	0.6
Captan 50 WP (6 lb.)	11.8	1.8	1.2
Captan 50 WP (4 lb.)	26.2	0.0	1.8

[1]Rates per acre of the respective treatments are in parentheses.
[2]The control received no fungicide applications but was treated with insecticide.

Evaluation of Mechanical Thinners on Bloom/Fruit Removal and Yield of Encore Peaches

BOBBY BOOZER, BILL DOZIER, AND JIM PITTS

Proper fruit thinning is necessary in peach production to obtain marketable size fruit. Most peaches are thinned by hand, which is costly and labor intensive. Mechanical shakers, which are used in some heavy fruiting years, can thin fruit but are not always consistent in performance. Recently, a mechanical rope thinner was introduced to growers for thinning during bloom.

AAES researchers at the Chilton Area Horticulture Substation (CAHS) evaluated the bloom thinning ability of the peach rope thinner in a grower block of Encore peaches. The mechanical rope thinning equipment consisted of a rotating cross beam, 10 feet in length, with 12-foot ropes doubled and spaced five inches apart along the beam. This equipment was mounted on a front-end loader. Objectives were to determine the percent of blooms removed, where bloom removal was occurring within the fruiting canopy, and how mechanical rope thinning compared with mechanical shaking on yield and size of fruit.

Because of the versatility of the peach rope thinner, three different operation methods were used: single pass, double pass, and bi-directional double pass. All operations were performed at the same rate of speed. These methods were compared to the mechanical shaker, which was operated based on guidelines used by the CAHS.

Results showed that the mechanical rope thinner can remove an average of 42% of the blooms when operated at 2 mph and 1.5 revolutions per tree with a single clockwise pass. Using the same tractor speed and speed of rotation, the mechanical rope thinner removed 55% of the blooms with two clockwise passes. Making two passes — one clockwise, one counter-clockwise — produced 57% bloom removal. All three rope thinning methods removed more blooms from above five feet of the fruiting canopy. Also, the single pass and double pass methods removed slightly more blooms on the right side of scaffold limbs. The mechanical shaker, which was used 30 days after full bloom, removed 73% of the fruit; a higher percent of the fruit was removed from below five feet within the fruiting canopy.

There was a strong trend toward increasing total yield by use of the mechanical rope thinner, compared to the mechanical shaker (see table). Fruit weight increased after the double-pass, rope thinner operations. However, extremely dry weather during the growing season is believed to have reduced overall treatment effects.

The Mechanical Rope Peach Thinner appears to be a viable option for peach producers to use for removing excess fruit during the bloom stage. Being able to alter the number of passes, speed of tractor and rotation rate of ropes gives producers options to how much thinning they want to accomplish. Blooms can easily be counted from five to ten shoots positioned five feet or higher within the fruiting canopy and recounted after rope thinning operation is performed. Average bloom removal can be calculated and adjustments can be made to thinning. Touch up hand thinning will still be required, but more of the touch up work will be closer to the ground, which should reduce the time needed to perform the task.

PERCENT, NUMBER, AND POSITION OF BLOOMS/FRUIT REMOVED BY FOUR THINNING TREATMENTS

Treatment	Percent removed per shoot	Number removed by position on tree				Total yield	Average Fruit weight
		Left	Right	High	Low		
	pct.	*no.*	*no.*	*no.*	*no.*	*lb.*	*oz.*
Mechanical Shaker	72	18	17	15	20	101.43	4.73
Mechanical Rope Thinner							
Two-pass, clockwise and counter-clockwise	57	15	15	17	13	119.07	5.08
Two-pass, clockwise only	55	12	15	15	12	116.87	5.02
One-pass	42	9	13	11	10	114.66	4.44