1996 Fruit and Vegetable Research Report

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Problems in Accessing Commercial Markets for Fresh Fruits and Vegetables

JOHN ADRIAN AND STEPHEN KISER

A frequently heard comment among Alabama's fruit and vegetable growers is, "We can grow it, but we can't sell it." AAES research evaluated this professed dilemma to provide some insight into the problem. Goals were to determine and evaluate differences and compatibilities between produce growers and marketers in the state.

Forty-two marketers and 64 growers were personally interviewed to determine their role in and opinions of the fruit and vegetable system. About three-fourths of the fresh-produce-purchasing firms contacted were retailers, while the balance was equally represented by brokers and wholesalers. About two-thirds of these firms were proprietorships, while 21% and 14% were corporations and partnerships, respectively.

Product specifications most frequently desired by retailers for local produce were fresh, clean, appropriately packaged and vine-ripe products. Although retailers stated a desire to use more locally grown products, they indicated that market requirements and conditions were rigid and some local producers would have difficulty meeting them. Several considerations that influence the marketers' willingness and ability to purchase locally grown crops were identified. The most strongly stated factor related to provision of the desired quality of produce; difficulty in providing an adequate volume was second in importance. Retailers stated that producers generally could not provide a dependable level of supply for a sustained period; one or two deliveries were generally not adequate to establish an account with a grower. Another consideration was the retailers' hesitation to interrupt or decrease the flow of a product from normal channels. Loss of "good will" with present suppliers could adversely affect future product flows to the firm. Even with these recognized difficulties, retailers believed that local producers could favorably market their products through retail outlets in the future.

About two-thirds of the producers noted a strong orientation toward direct markets; 57% sold through farmers markets, and 31% used roadside stands or pick-your-own operations. Four percent and 3%, respectively, indicated an orientation toward brokers and wholesalers/retailers. The primary reason for using a particular outlet was convenience (53%). Other reasons noted for selecting a particular market were: only market available (18%), owner of retail outlets (7%), large volume required to use the market (6%), repeat sales (5%), and better prices (3%). The top-two problems associated with markets used were insufficient buyers and low price. Fifty-four percent of producers stated that price received at markets used was unsatisfactory.

On the buying side of the market, firms are interested in handling locally grown produce, but generally on a basis that is consistent with normal sourcing terms and conditions. Basically, retailers or their warehouse units can operate without locally grown produce, but under appropriate conditions, their business could be enhanced by availability of quality locally grown crops. Retailers want stability in product flow or, at least, sufficient lead time to promote items that are readily available.

On the selling side of the market, growers in the state are primarily oriented toward direct markets, which seem to become saturated with products during the primary production season, resulting in low prices and unsold products. Many producers lack sufficient volume of quality produce to access commercial outlets. Facilities are also often insufficient to handle produce so as to maintain quality or package product in appropriate form. Post-harvest handling of produce is often as important as production methods in determining the quality of a product and its shelf life.

Future growth of Alabama agriculture could be greatly influenced by better coordination between growers and marketers and better information about requirements to access commercial markets. Coordination can be improved through contracting, cooperative organizations, and leadership by key individuals throughout the state. Alabama growers need to understand that the commercial produce system can exist without them, but they will have difficulty moving volume without the system. If producers can help brokers, wholesalers, and retailers be profitable, they will enhance their chances for success in the commercial sector.

New and Profitable Crops for Alabama -- Asparagus

JOE KEMBLE, ERIC SIMONNE, JIM PITTS, JIM BANNON, AND ARNOLD CAYLOR

There are many possibilities for growers in Alabama. Many small and part-time growers in Alabama, who truck farm, have roadside stands, or sell their vegetable crops wholesale, rely on more traditional vegetable crops, such as southernpeas, collards, and watermelons for the bulk of their production and profit. Sometimes, a nontraditional approach can really pay off. Although not a traditional part of the southern diet, asparagus is becoming more common on dinner plates in Alabama.

Presently, little asparagus is grown in Alabama. Most of the asparagus sold here is grown in California, Washington, Michigan, and various islands in the Caribbean. As well as being valuable from a nutritional standpoint, asparagus also demands a high wholesale price. Alabama's unique climate and growing areas should be well suited to asparagus production.

In order to explore the feasibility of asparagus production in Alabama, three sites were selected to establish asparagus plantings. Transplants of 'Jersey Giant,' an all-male hybrid, were planted in 1996 at the E.V. Smith Research Center in Shorter, Chilton Area Horticulture Substation in Clanton, and North Alabama Horticulture Substation in Cullman. 'Jersey Giant' has shown good adaptation and consistent, high yields throughout many regions of the U.S. The term "all-male" refers to the fact that there are male and female asparagus plants. Female plants produce smaller spears than male plants, and they produce seeds that can germinate and form volunteers. An all-male cultivar such as 'Jersey Giant' is more tolerant of diseases and produces large, high-quality spears.

It will take three seasons for the asparagus to become fully established. After this point, the plantings can be subjected to a variety of treatments. This is also the point at which a commercial grower would begin harvesting. Once established, an asparagus planting can last more than 15 years if proper care is provided.

In other parts of the country where asparagus is grown, weeds tend to be the greatest production challenge. Initially, most of the AAES research will focus on weed control, using more novel devices such as a flame-cultivator in combination with new herbicides to control weed problems. Research will also focus on the use of row covers to blanch (whiten) developing asparagus spears. Blanched asparagus commands a higher price in the fresh-market, but has a very limited market acceptance.

Over the next several years, the performance of the plantings will be monitored for disease and insect problems. In 1998, yields and quality data will be collected. The first year is the most critical for establishing young transplants, and to date plantings at each location are off to a great start with no major insect or disease problems being observed.

For the Second Time, 'Silver Queen' Not Rated as Best-tasting Sweet Corn

AMY SIMONNE, ERIC SIMONNE, JIM PITTS, AND GARY GRAY

'Silver Queen' may be losing its status as the most-preferred sweet corn variety. AAES taste tests conducted in both 1995 and 1996 found that 'Silver Queen' was not rated as the best-tasting variety.

In 1995, a white sweet corn taste test was organized at the Chilton Area Horticultural Substation (CAHS) in Clanton. The primary objective of the taste test was to determine if 'Silver Queen' was actually recognized for its own attributes or if it benefited primarily from "name recognition." Among nine cultivars of sweet corn evaluated, 'Silver Queen' was ranked the seventh. These results prompted some skepticism from "sweet-corn connoisseurs," so the taste test was conducted again in 1996.

A taste-test experiment of white sweet corn varieties was organized at the CAHS in the same manner as in 1995. Cooked ears from the CAHS sweet corn variety trial were served to a panel of 100 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 coded by random three-digit numbers. The panelists were first asked to list all the sweet corn variety names they could remember, then they were asked to rate appearance of the sweet corn ears. After rating of appearance, the panelists were asked to taste the sweet corn and rate for sweetness, flavor, and overall preference. Panel members were mainly growers, gardeners, and retirees.

Ratings of appearance, sweetness, flavor and overall preference differed significantly among varieties (see table). Most of the selected cultivars received acceptable ratings. The appearance of 'FMX 413' was rated best, while 'Snow White,' 'Treasure,' 'Snow Belle,' and 'Silver Queen' were rated the lowest. The sweetness of 'Snow White' was the highest; whereas, 'Rising Star' and 'Silver Queen' were the lowest. Flavor rating was highest in 'Silverado' and was lowest in 'Silver Queen.' Results revealed that 'Silver Queen' was not ranked among the top-five varieties; it was ranked ninth for overall preference. Further, only 6% of panelists could correctly identify 'Silver Queen' in 1996, as compared to 30% in 1995. Major changes from last year's results occurred in 'Treasure,' which dropped from a 1995 overall ranking of first to a 1996 overall ranking of fifth. Snow White's overall rankings improved in 1996 from eighth in 1995, to first. All the top-five varieties in all attributes are either sugar-enhanced or supersweet sweet corn. In both years, 'Silver Queen' was located on the bottom scale in all attributes.

These results emphasize the importance of cultivar selection. Producers should constantly look for the ever-changing new cultivars or new releases in order to improve their production. Rankings from this study should by used in conjunction with yield performance and disease resistance before selecting a white sweet corn.

1996 SWEET CORN SENSORY EVALUATION[1]

Variety (type)[2]	Seed source	Overall preference	Visual appeal	Sweetness	Flavor	Overall rank sum[3]
Snow White (sh2)	Harris Seeds	10.0	6.8	10.4	8.4	10
Silverado (se)	Harris Seeds	9.4	8.2	9.9	9.0	10
Starshine (se)	Seneca	9.2	9.0	9.0	7.3	14
FMX 413 (sh2)	Ferry-Morse	8.1	9.7	10.0	6.8	14
Fantasia (se)	Asgrow	8.0	8.6	7.8	7.3	19
Treasure (sh2)	Harris Seeds	7.5	6.7	8.3	7.7	22
Snow Belle (se)	Asgrow	6.6	6.5	7.5	8.1	26
Rising Star (se)	SeedWay	6.2	7.5	4.9	5.1	30
Silver Queen (su)	SeedWay	5.6	6.7	4.2	5.8	33

[1]Varieties were rated on a 0-14 scale (0 = Undesirable/Dislike; 14 = Desirable/Like Extremely).
[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%.
[3]Overall rank sum was calculated by adding the ranks of each attribute (Maximum value = 36); the smaller the overall rank sum, the better.

Sensory Evaluation of Alabama Lettuce

AMY SIMONNE, ERIC SIMONNE, JOHN OWEN, LARRY WELLS, AND RON EITENMILLER

It is often said that lettuce grown in Alabama is too bitter because of the weather. However, an AAES sensory evaluation of various lettuce varieties revealed that acceptable quality and good-tasting lettuce can be grown in Alabama.

Most of United States' annual 205,000-ton lettuce crop is grown in California. Although lettuce is a popular crop in home gardens, no commercial production exists in Alabama. Main types of lettuce commercially available are (1) iceberg (head lettuce), (2) Romaine, (3) butterhead, and (4) leaf lettuce. Head lettuce is more difficult for home gardeners to raise; whereas, leaf lettuce is harder for stores and restaurants to keep. In addition to variation in head shapes, lettuce with different foliage colors from traditional greens also are available. Most people are familiar with iceberg lettuce because it is commonly sold in stores, but leaf lettuce is commonly grown by home gardeners.

Because the harvestable part of lettuce is a rosette of leaves, any foliar damage caused by insects, viruses, and fungi reduces marketability. The main objective of lettuce breeding programs is to produce lettuce resistant to several viruses and diseases, as well as tip burn. Resistant genes from wild *Lactuca* lettuce species are often used as sources of resistance to viruses and other diseases. However, incorporating resistant genes from *L. saligna* or *L. virosa* often lead to increased levels of sesquiterpene lactones, which are known as bitter compounds. Little information exists on the relationship between bitterness and sesquiterpene lactones levels.

Commercially available lettuce varieties were grown at the Wiregrass Substation (WS) and Piedmont Substation (WS) following current fertilization and pest control recommendations. At maturity, it was hand-harvested, washed, and cut into bite-size pieces about the size used in tossed salad. Different types of lettuce were served one by one to a group of 15 trained panelists. Panelists were trained prior to the tasting session. The training session consisted of providing each panelist with a series of caffeine solutions with increasing bitterness and their corresponding bitterness rating (0%=0, 0.05%=2, 0.08%=5, 0.15%=10, and 0.20%=15). Hence, when the trained panelists were used, it was possible to quantify panelist response in numeric scores. Panelists were instructed to calibrate their taste using the caffeine solutions between each sample.

SENSORY EVALUATION OF BITTERNESS IN LETTUCE VARIETIES[1]

Variety (location)	Mean score	Most frequent	Lowest	Highest
Epic (WS)	1.6	1	0	6
Salinas (WS)	1.6	0	0	4
Nevada (PS)	2.0	0	0	9
Red Prize (WS)	2.2	2	0	7
Legacy (WS)	2.3	1	0	7
Sierra (PS)	2.5	2	0	7
Nancy (WS)	2.9	3	0	10
Red Salad Bowl (WS)	3.2	0	0	11
Brunia (PS)	3.3	1	0	10
Cabernet Red (WS)	3.5	2	1	13
Parris Island (WS)	3.6	3	0	14
Slobolt M.I. (WS)	3.8	2	0	10
Optima (WS)	4.1	2	0	12
Optima (PS)	4.9	0	0	13
Greeng (WS)	5.2	5	1	15
Nancy (PS)	8.4	4	0	15
Big Curly (PS)	9.3	13	0	15
Slobolt M.I. (PS)	10.1	15	1	15

[1]The lower the score, the less bitter the lettuce.

Mean, most frequent, lowest, and highest scores for each lettuce variety and growing locations are presented in the table. Scores varied considerably between panelists. Although significant differences between varieties were found, 34% of the lettuce varieties were rated lower than a score of 7. Most prevalent scores were less than 4, suggesting that the lettuce was not very bitter, if at all. Depending on the individual, bitterness scores of less than 7 would be considered acceptable, panelists reported. Panelists did not reject red or purple lettuce. Growing conditions seemed to affect bitterness scores.

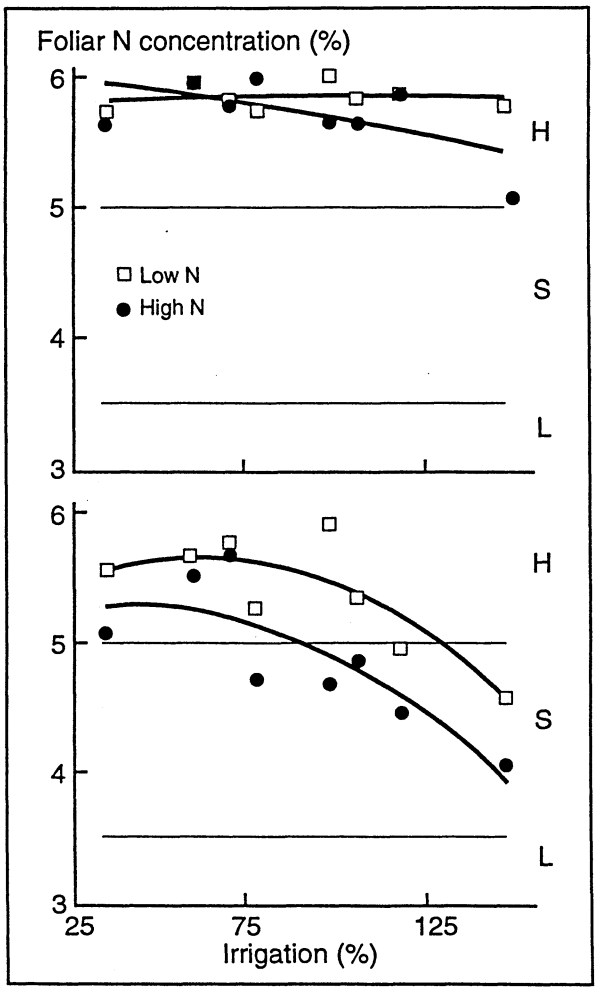
This study suggests that it is possible to grow non-bitter, pleasant-tasting lettuce in Alabama. Future studies will focus on determining the impact of cultural practices and harvest dates on sensory attributes of lettuce.

Effect of Irrigation and Nitrogen Fertilization on N Level in Pepper Leaves

ERIC SIMONNE, PAULINE LINDO, JOE EAKES, AND HARRY MILLS

Maintaining adequate moisture and nutrient levels to maximize yields are the primary objectives of irrigation and fertilization of fast-growing crops such as bell peppers. Commonly, irrigation is used when plants begin to wilt or when the soil feels dry. Peppers fertilized according to current recommendations typically receive a total of 120 pounds of nitrogen (N) per acre, 30-40 pounds of which are preplant incorporated. The remaining N is sidedressed at rates of 20 pounds of N applied approximately every two weeks.

An AAES study was conducted to determine if applications of N at current recommended rates maintain plant N status at levels that do not restrict bell pepper yields.



Nitrogen Concentrations (percent N, on a dry-weight basis) in bell pepper leaves sampled on 62 (top) and 84 (bottom) Days After Transplanting (DAT) as Affected by Rates of Nitrogen Fertilizer and Irrigation.

'X3R Camelot' peppers were grown on bare ground at the Horticulture Unit of the E.V. Smith Research Center following recommended cultural practices. Irrigation was applied overhead and scheduled by using an irrigation scheduling model based on daily pan evaporation (See "Response of Bell Pepper Yields to an Irrigation Scheduling Model" in the AAES *Research Report Series No. 11* for more information). Fertilization consisted of a "standard" sidedress application (per acre) of 15 pounds of N and a "high" rate of 30 pounds of N applied on 6, 11, 20, 44, 58 and 72 days after transplanting (DAT) as calcium nitrate.

On 62 DAT (harvest of first bloom) and 84 DAT (after five harvests), leaf samples were taken by pulling 30-40 of the most recently, fully mature leaves of each plot. Samples were processed for nutrient analyses, and N concentration was determined by complete combustion with a Leco FP-428 N analyzer.

Irrigation rate, fertilization rate and harvest date significantly affected foliar N concentration. At 62 DAT, foliar N levels were similar for both N rates, and all foliar N concentrations were above the 3.5-5.0% deficiency range (see figure). At 84 DAT, foliar N concentrations in plants receiving the recommended rate were significantly lower than those in plants receiving the high-N rate. Irrigation at rates above 75% of the model rate reduced foliar N levels, although the lowest foliar N level was still well in the sufficiency range.

These results suggest that the "high-N" rate maintained higher foliar N concentrations after five harvests than the recommended N application rate. The results of this one-year study suggest that current N fertilization recommendations maintain foliar N levels at non-limiting values for bell pepper production. However, because after five harvests, foliar N concentrations began to decline, current recommended rates may not provide adequate N in growing situations that allow for a larger number of harvests. Taking leaf samples during the harvest period may provide real-time information on bell pepper N status.

Year Two: Double-cropping Bell Peppers and Broccoli on Black Polyethylene Mulch

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. This can allow material and labor costs associated with plasticulture to be spread over two growing seasons. To date, there are no commercial recommendations for double-cropping vegetables in Alabama.

An AAES study is examining the effects of various fertility levels and mulch types on yield of double-cropped bell peppers and broccoli. This study is examining the production costs and economic returns for the various double-crop systems. 1996 marks the second year of this three-year study at the Chilton Area Horticulture Substation in Clanton.

Bell peppers grown on black polyethylene (plastic) covered plots with fertility levels ranging from 0-240 pounds of N per acre were compared to the conventional treatment, which is 120 pounds of N per acre on bare ground. Plants in bare-ground plots received additional nutrients via sidedressing, while bell peppers on black-plastic plots received nutrients via fertigation. Fertilizer was injected weekly after transplanting and continued through final harvest. Moisture levels were monitored with 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.

After two spring crops of the pepper 'Marengo,' total marketable yields were higher for the 120 pound per acre N treatment than for all of the other treatments (see table). Generally, yields in 1996 were higher than in 1995, likely due to more favorable growing conditions. Note that yields generally decreased when more than 120 pounds per acre were applied to the bell peppers. This indicated that more fertilizer is not always better and in fact can be harmful to marketable yields and especially quality. Decreased yield was more apparent in 1996 than in 1995. Application of more fertilizer than is required is also costly from an economic standpoint as well as for time and labor.

Hurricane Opal, combined with poor growing conditions in the fall of 1995, caused the first fall broccoli crop to fail. In 1996, broccoli was transplanted the first week of September.

BELL PEPPER YIELDS BASED ON 1995 AND 1996 YIELD DATA

Treatment	U.S. Fancy		U.S. #1		Total marketable		Total yield	
	1995	1996	1995	1996	1995	1996	1995	1996
	lb./a.	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*
0 N	1,018.7	399.6	2,624.0	2,716.1	6,728.3	6,101.3	7,908.9	7,605.2
60 lb. N	2,320.9	1,665.8	5,397.5	5,030.0	12,277.7	10,906.5	13,455.9	12,613.8
120 lb. N	4,804.8	4,258.7	7,525.8	7,589.1	16,653.1	18,247.6	18,112.1	20,809.5
180 lb. N	4,417.3	4,332.3	7,501.7	6,663.2	15,962.4	16,285.2	17,179.6	18,855.1
240 lb. N	5,454.2	1,668.0	6,994.2	3,655.4	16,744.9	10,279.4	18,283.3	12,934.9
Bare ground	2,621.9	2,883.1	6,112.9	6,692.7	11,437.8	15,701.9	12,755.7	17,625.0

Root Growth Helps Schedule Irrigation for Plastic-Mulched Tomatoes and Bell Peppers

ERIC SIMONNE, DAVID DUBOIS, AND JIM BANNON

In order to estimate the maximum amount of water accessible to roots during the development of tomato and bell pepper plants grown on black-plastic with drip irrigation, AAES researchers at the Horticulture Unit of the E.V. Smith Research Center examined the rate of root system expansion for these plants. This amount of water represents the highest volume that should be applied in one irrigation if no leaching is desired.

'*Celebrity*' tomato and '*X3R Camelot*' bell pepper were transplanted onto three-foot-wide, nine-inch-deep raised beds. Tomato plots consisted of single rows of five plants spaced 18 inches apart. Bell peppers were planted on staggered double rows, 14 inches apart, at a 12-inch, within-row spacing. The soil type was a sandy-loam soil. Insect and disease control followed current recommendations. Drip irrigation was used to maintain adequate soil moisture. Fertilizer was injected weekly at a rate of 10 pounds of N per acre, alternately from calcium nitrate and potassium nitrate beginning one week after transplanting.

On 0, 4, 11, 17, 22, 28, 41, 48, 55, 63, and 71 days after transplanting (DAT), the depth (vertically), length (horizontally, in the direction of the bed), and width (horizontally, perpendicularly to the direction of the bed) of the roots were measured by destructively digging a three-foot-long section in the center of each plot. Root parameters were significantly different for both crops and were affected by digging date (see table). Root systems of two consecutive plants within a row "overlapped" on 17 DAT for bell pepper and 22 DAT for tomato. The volume of soil occupied by the roots was determined, and corresponding soil-water-holding capacity for a sandy loam soil was determined as V = 2.4 DAT, where V is maximum irrigation amount (in gallons per 100 feet), for DAT ranging between 15 and 50. At 50 DAT or more, the entire bed volume is occupied, the root system is established, and V = 120 gallons per 100 feet. Before 15 DAT, it is preferable to apply 36 gallons per 100 feet of bed. These results may be incorporated into irrigation scheduling models for vegetables grown on plastic-mulch with drip irrigation, because they adjust irrigation amounts to root growth. However, they should be validated and adjusted to soil type before being used with commercially grown tomato or bell pepper.

ROOT SYSTEM DEPTH, WIDTH, AND LENGTH OF TOMATO AND BELL PEPPER, AND CORRESPONDING AVAILABLEWATER FOR SANDY LOAM SOILS[1]

DAT[2]	Stage of development[3]	Rooting depth	Rooting width	Rooting length	Available water[4]
		in.	*in.*	*in.*	*gal./100 ft.*
		'Celebrity' Tomato			
0	L2	2	1	1	0
4	L4	4	2	2	0
11	L4	6	4	5	4
17	L6	5	13	14	21
22	L9-10	9	20	15	62
28	Bloom	8	27	15	87
41	Small Fruit	7	33	15	86
48	Small Fruit	9	35	15	119
55	Medium Fruit	8	35	15	115
63	Mature Fruit	8	34	15	104
71	Harvest 1	8	36	15	112
		'X3R Camelot' Bell Pepper			
0	L2	2	1	1	0
4	L4	3	2	2	0
11	L4	5	5	6	6
17	L6	6	17	12	43
22	L9-10	9	27	12	89
28	L13-15	8	27	12	85
41	Bloom	8	31	12	90
48	Small Fruit	9	35	12	116
55	Medium Fruit	8	36	12	113
63	Mature Fruit	8	37	12	112
71	Harvest 1	8	37	12	108

[1]Sandy loam soil with a 0.15% total soil-water-holding capacity.
[2]DAT = Days After Transplanting.
[3]L = leaf
[4]For a maximum allowable soil water tension of 0.25 bar (25 kPa).

Mulch Color Affects Bell Pepper Yield

RUDY YATES JR., JAMES BROWN, BILL GOFF, CINDY CHANNELL-BUTCHER, AND LAURA SANDERS

Mulch surface colors have been widely reported to influence bell pepper yields; however, reports have varied in their conclusions with respect to mulch color effects on yield. A study was conducted at the E.V. Smith Research Center in Shorter to determine the effects of plastic mulch surface colors on the yield of bell pepper plants.

Treatments consisted of six mulch surface colors (black, white, red, aluminum, green IRT-76, and blue) and a bare soil control. A black plastic mulch was applied to the soil in mid-March, along with trickle irrigation tubing and methyl bromide fumigant. After allowing for adequate fumigation, treatments were applied in mid-April. Polyurethane oil enamel paints were used to obtain the aluminum ("Aluminum 32"), red ("Chinese Red 15"), and blue ("Bermuda Blue 21") mulch surface colors. 'Skipper' bell pepper plants were transplanted into field plots in early April at an in-row spacing of 18 inches, one row per plot. Lime and fertilizer were applied to the soil according to soil test recommendations prior to treatment applications. The treatments with outstanding marketable values were aluminum and blue (see table).

MULCH COLOR EFFECTS ON BELL PEPPER YIELD

Color	Marketable yield
	lb./a.
Black	5,358
White	7,443
Red	7,949
Aluminum	10,488
Green (IRT-76)	7,359
Bare ground	6,942
Blue	8,796

[1]Marketable yield is the mean of three harvests: July 8, July 23, and Aug. 7.

Surveying Irish Potatoes for Three Viruses

MICHAEL GUERINI, JOHN MURPHY, ED SIKORA, LEWIS TAPLEY, AND ED TUNNELL

Irish potatoes represent one of the largest vegetable industries in Alabama. Unfortunately, little is known in Alabama about viral disease problems in this crop. Because Irish potato is an early-season crop, it could serve as a reservoir for a number of viruses that infect other crops that are grown throughout the summer.

To examine this potential, commercial Irish potato production fields were surveyed for three economically important viruses, cucumber mosaic virus (CMV), potato virus Y (PVY), tobacco etch virus (TEV). These viruses have and can caused serious losses on many other vegetable crops important to Alabama, such as tomatoes, peppers, and watermelons. All three viruses are transmitted by aphids in a nonpersistent manner. The problem with these viruses being transmitted in a nonpersistent manner is that their spread cannot easily be controlled by the application of insecticides.

Samples were collected from 10 fields in Baldwin County, nine fields in Jackson County, and one field in Cullman County. Most of Alabama's Irish potatoes are grown in these counties. Samples were collected in Baldwin County in late May and from Jackson and Cullman counties in late June. Samples were placed on ice, transported to the laboratory, and tested for the presence of the three viruses using a method called ELISA.

A total of 251 samples were collected in Baldwin County. PVY occurred most frequently, being detected in 24.7% of the samples (62 of 251). CMV was detected in 17.1% of the samples (43 of 251), while the incidence of TEV was 4.4% (11 of 251). CMV and PVY were detected more often from samples taken from East Baldwin County.

In Jackson and Cullman counties, 211 plant samples were collected for analysis by ELISA. PVY was detected in 23.2% of the samples (49 of 211), and CMV in 18.5% of the samples (39 of 211). TEV occurred in 55% of the samples (116 of 211).

These results suggest that all three viruses occurred in Irish potato samples taken from the three counties, and therefore, the Irish potato crops could serve as a source of inoculum for other vegetable crops. Next year in addition to assaying for CMV, PVY, and TEV, plants will be tested for potato leafroll virus and potato virus X, two other economically important viruses that infect Irish potatoes grown in other states and Canada. Although ELISA is an excellent tool for detecting the presence of a plant virus; data from the ELISA test can sometimes be somewhat ambiguous. Thus, a second method of analysis of samples will be incorporated into the next survey as a means to confirm the serological analyses (ELISA test).

Appearance and Performance of Selected Red-skinned Irish Potatoes

JOE KEMBLE, ERIC SIMONNE, ELLEN BAUSKE, ARNOLD CAYLOR, AND MARVIN RUFF

The Alabama Irish potato industry has changed a great deal over the past 10 years. Annually, almost 11,000 acres of Irish potatoes are produced. In past years, most of this production was grown for processing, but now, most of the acreage is devoted to production for the fresh-market (table stock). New research initiatives are underway to identify varieties that perform well in Alabama and are acceptable to retailers and consumers.

A cooperative research project with the Irish potato breeding program at North Dakota State University is underway to evaluate selected red-skinned potatoes from the North Dakota program under Alabama's growing conditions. Seven varieties were grown at two locations, North Alabama Horticulture Substation (NAHS) in Cullman and at Sand Mountain Substation (SMS) in Crossville. Seed pieces were planted in April and harvest in mid-July.

Overall yields were greater at NAHS than at SMS (see table). For U.S. "A" and total marketable yields, 'LaRouge' out yielded all other varieties. 'Red Norland' and 'Red Ruby' produced the lowest marketable yield at NAHS, while 'Red Norland' and 'NorDonna' produced the lowest marketable yield at SMS.

Skin color, tuber shape, and internal color were also examined after two months in storage at 40°F. In terms of most red to least red skin color, the seven varieties ranked in the following order for decreasing redness: ND 2225-1R > Red Ruby > NorDonna > LaRouge > Red Norland > Red LaSoda > Viking at SMS; and Red Ruby > ND 2225-1R > Red Norland > NorDonna > LaRouge > Viking > Red LaSoda at NAHS. Overall, ND 2225-1R and Red Ruby produced the reddest skin color, while 'Viking' and 'Red La Soda' produced the poorest and were often more brown in appearance.

Tuber shape and internal color seemed to be consistent within a variety at both locations, with the exception of 'Viking,' which tended to produce off-shaped tubers with an off-white interior color. 'NorDonna' seemed to suffer from early die back at both locations and produced a great deal of tubers with secondary growth.

Most of Alabama's Irish potatoes are grown without the benefit of irrigation, but it is likely that they would benefit from it. Research is being conducted to demonstrate the benefit of supplemental irrigation for the production of Irish potatoes (see "Could Irrigation Increase Irish Potato Yields in Alabama" on p. 11).

IRISH POTATO YIELDS BASED FROM NORTH ALABAMA HORTICULTURE SUBSTATION (NAHS) AND SAND MOUNTAIN SUBSTATION (SMS) IN 1996

Variety	U.S. "A"		U.S. "B"		Cull		Total marketable	
	NAHS	SMS	NAHS	SMS	NAHS	SMS	NAHS	SMS
	lb./a.	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*	*lb./a.*
La Rouge	17,720	11,715	5,819	1,151	2,240	n/a	24,267	13,037
Red LaSoda	15,682	14,235	2,458	669	3,127	n/a	18,748	15,044
Viking	14,546	9,366	952	700	2,340	n/a	15,609	10,159
ND 2225-1R	11,233	10,486	5,041	1,525	1,484	n/a	17,230	12,213
Red Norland	11,155	8,277	1,467	545	1,672	n/a	12,883	8,837
NorDonna	10,704	5,476	3,547	1,245	949	n/a	16,212	6,939
Red Ruby	10,548	10,968	2,551	1.229	3,127	n/a	13,852	12,322

Could Irrigation Increase Irish Potato Yields in Alabama?

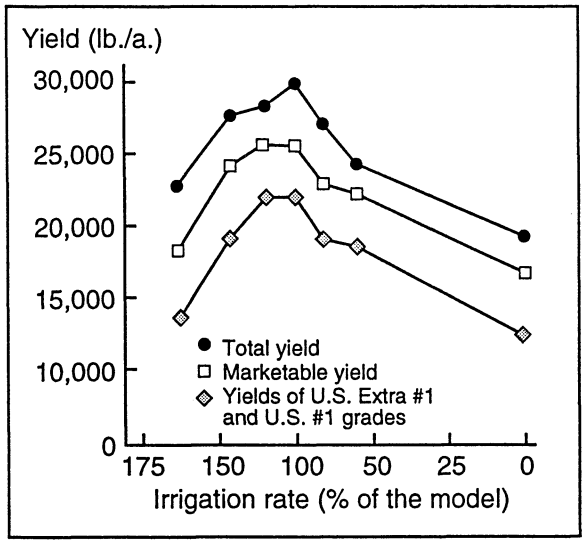
ERIC SIMONNE, JOE KEMBLE, AND ARNOLD CAYLOR

Although Irish potato is classified as a drought-sensitive vegetable crop, it is seldom irrigated in Alabama. This practice makes potato yield dependent on rainfall pattern. The objective of this AAES study was to (1) evaluate the effect of irrigation on potato yield, and (2) develop a water budget for scheduling irrigation of Irish potatoes.

The model uses class A pan evaporation data to determine daily the amount of water used by the crop. In areas where weather data are not readily available or where official data are of limited use because of the presence of a microclimate, a calibrated container such as a #2 wash tub, a ruler and a rain gage may be used to collect on-site weather data. The water balance takes into account crop age, soil type, and weather (pan evaporation and rainfall). The model is practical because it provides information on when to start irrigation and how much to apply each time.

Seed pieces of 'Red LaSoda' potatoes were planted at a 12-inch within-row spacing on 20-foot long plots on April 9 at the North Alabama Horticulture Substation in Cullman. Soil type was a fine sandy loam with a water-holding capacity of 0.13 inch per inch. Fertilization consisted of a preplant application of 850 pounds per acre of a 5-10-15 fertilizer and two sidedress applications of ammonium nitrate. Because the effect of nitrogen (N) fertilization is often dependent on water application, the validation included two N rates: 35 pounds of N for the low-N and 50 pounds of N for the high-N rate. Total N fertilization was 120 and 150 pounds of N per acre, for the low and high N treatments, respectively. Insect and pest control practices followed current recommendations.

Seven controlled irrigation levels were created by accurately controlling the rate and time of irrigation from the drip tapes placed on each bed. A treatment with no irrigation was used as a control.



Irish Potato Response to Controlled Water Applications

Potatoes were harvested on July 22 and graded as U.S. Extra #1 and U.S. #1 (diameter >1.9 inch), U.S. #2 (diameter > 1.5 inch) and culls (damaged or diameter < 1.5 inch). The high-N treatment tended to produce higher yields than the low-N treatment, but these differences were not statistically significant.

The model scheduled four irrigations between June 17 and July 1. Irrigation significantly influenced total yield, marketable yield, and combined U.S. #1 grade (see figure). Differences in culls were not significant. The results of this one-year study suggest that supplementing rainfall with irrigation could increase Irish potato yields. These results also suggest that controlling the amount of water applied by adjusting irrigation to pan evaporation and rainfall may result in higher potato yields. Excessive water, as well as not enough water reduced potato yields.

Evaluation of Fungicide Treatments to Control Late and Early Blight in Irish Potatoes

Ed Sikora, Ellen Bauske, Monte Nesbitt, Bobby Boozer, Arnold Caylor, Ronnie McDaniel, Jim Pitts, and Derenda Hagemore

Alabama Irish potato growers typically make six or more fungicide applications to their crop during an average growing season to control the fungal diseases early blight and late blight. The most common spray program consists of a protectant fungicide such as Bravo 720 alternated weekly with a systemic/protectant fungicide combination such as Ridomil/Bravo 81. Initiation of the spray program during the season varies among growers. Some will make their first fungicide application at plant emergence, while others may wait until plants reach 10 inches in height. The earlier a spray program begins generally means more fungicide applications will be made at greater expense to the grower. Growers, however, who delay their first application may experience higher levels of disease.

This study was conducted to evaluate two spray programs that are commonly used in Alabama, as well an Integrated Pest Management (IPM) program based on disease scouting. The experiment was conducted at the North Alabama Horticulture Substation in Cullman, Chilton Area Horticulture Substation in Clanton, and Gulf Coast Substation in Gulf Shores. Treatments included:

(1) A fungicide spray program alternating between Bravo 720 (one pint per acre) and Ridomil/Bravo 81 (1.5 pounds per acre) weekly, beginning when plants were four inches tall and continuing until harvest;

(2) A fungicide spray program alternating between Bravo 720 (one pint per acre) and Ridomil/Bravo 81 (1.5 pounds per acre) weekly, beginning at bloom and continuing until harvest; and

(3) A fungicide spray program consisting of Bravo 720 (one pint per acre) applied weekly, beginning when either early blight or late blight first appears (plots were scouted a minimum of twice per week) and continuing until harvest.

Effect of Starting Date of a Fungicide Spray Program on Total Number of Fungicide Sprays Applied at Three Alabama Field Sites in 1996

Begin spray program when:	No. application at each site		
	Fairhope	Chilton	Cullman
Plants are four inches tall	6	6	6
Plants are at bloom	3	4	5
Disease first appears	3	0	1
Unsprayed control	0	0	0

Due to abnormally dry weather conditions in late spring during the experiment, there was little disease pressure at any of the sites. Trace amounts of early blight were observed at all three sites, but no late blight was noted. There were no differences in disease incidence among treatments. There were also few differences in yield among the treatments (data not shown). Fewer applications were made when the spray program started at bloom and in the IPM scouting program. In either case, a cost savings would have been realized by the grower due to reduced fungicide applications. It is still uncertain, however, how these alternative spray programs will perform when weather conditions favor higher levels of disease development.

The dry conditions in 1996 were not favorable for development of significant levels of late blight or early blight. Late blight can be very destructive under cool, wet conditions and delaying fungicide applications under these conditions could be disastrous. Results from this study are preliminary and the experiments will be repeated in 1997.

Transgenic Tomatoes Withstand CMV Epidemic

JOHN MURPHY, ED SIKORA, AND KARRIE LOVINS

Tomato plants genetically engineered to express the cucumber mosaic virus (CMV) coat protein gene were evaluated for the second year under the epidemic conditions in North Alabama. An epidemic caused primarily by CMV has devastated the fresh-market tomato industry in Blount and St. Clair counties each year since 1992. CMV has an extremely large natural host range and can be spread by at least 75 species of aphids in a nonpersistent manner. Due to the lack of resistant tomato varieties available to growers and because of the nature of CMV, the epidemic has continued unabated. As an alternative approach, nine genetically engineered tomato lines were evaluated under grower conditions for their ability to withstand the extreme disease pressure that occurs in North Alabama.

Plants were grown at a single location, in cooperation with a commercial grower. Plants were evaluated periodically for expression of CMV-like symptoms during the course of the growing season. Plants were tested for the presence of the CMV antigen using indirect ELISA. Leaves from each plant were collected, stored on ice and transported to the laboratory.

The first sign of viral symptoms occurred on the non-transgenic control (or susceptible control) plants within three weeks of transplanting. During the course of the first three evaluation dates, obvious CMV-like symptoms were observed only on the non-transgenic control plants. In plants that became symptomatic at later times (by the fourth evaluation date), symptoms consisted primarily of upward curling of the leaves; however, those plants that developed symptoms at earlier times were usually more severely affected. This was particularly obvious for the non-transgenic control plants which became extremely stunted with deformed leaves (typical shoe-stringing symptoms induced by CMV). Most plants, however, remained symptomless throughout the experiment.

In contrast to evaluation of plants for symptom development, analysis of plants for CMV using ELISA indicated that most plants were infected. Among the nine varieties, percent infection ranged from 60-100%. It should be noted, however, that the majority of plants accumulated low levels of CMV. Thus, even though most plants were infected with CMV, they appeared to resist high-level accumulation of the virus and as a result remained symptomless throughout the course of the experiment. In contrast, the non-transgenic control line accumulated high levels of CMV early after transplanting and developed severe symptoms.

Data strongly suggest that genetically engineered tomato is able to resist the extreme pressures of the CMV epidemic in North Alabama. These plants resisted the expression of infection by CMV (i.e. viral symptoms) throughout much of the experiment (many never developed detectable symptoms). Moreover, although a majority of the plants did become infected with CMV, the virus levels in these plants remained low. These results are in agreement with data obtained from 1995 trials of transgenic tomato plants. The use of genetically engineered tomato appears to be a valuable option to combat the CMV epidemic in North Alabama.

Alabama's Fresh-market Tomato Growers Use Integrated Pest Management

ELLEN BAUSKE, ED SIKORA, GEOFF ZEHNDER, AND JOE KEMBLE

U.S. consumers are increasingly concerned with the use of pesticides in food production. As a result of public concern, the federal government mandated that by the year 2000, 75% of all cropland should be farmed using Integrated Pest Management (IPM) practices. In order to determine the level of IPM implementation in Alabama, fresh-market tomato growers in North Alabama (Blount County) and South Alabama (Geneva County) were surveyed.

Results of the survey show that Alabama tomato farmers plant an average of 22 acres of tomatoes each year (see table). North Alabama producers applied slightly more insecticides and fungicides than producers in the South Alabama. A survey score of 0-50% was considered a low level of IPM usage, 51-75% a medium level, and 76-100% a high level. The average score on the survey was 57%. Clearly, Alabama's fresh-market tomato producers are well on their way to achieving the federal mandate.

The survey was developed as part of the USDA/Land-Grant University IPM initiative by IPM teams from Alabama, North Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee. Teams were composed of growers, private consultants, Extension personnel, and researchers. The survey listed IPM practices in three sections: cultural practices, pesticide application techniques, and specific pest management practices. In order to customize the surveys to the unique conditions in participating states, state team members weighted the IPM practices listed from 1 (low importance) to 4 (high importance). In Alabama, the team placed the most importance on IPM practices concerned with maintenance of pesticide application equipment, application practices, insect and disease scouting, and control of viral diseases. Growers who used insect and disease scouting, regularly maintained their spray equipment, and used cultural practices that reduced the introduction and spread of disease tended to score high on the survey. Growers were also asked to identify insect, disease, and production problems, as well as any technology or research developments that they felt would benefit the industry.

Producers in Geneva County identified early blight and fruitworm as their primary disease and insect problems, while producers in North Alabama identified cucumber mosaic virus, aphids, and stinkbugs as their primary pest problems. Growers in both areas identified diseases, insects, and poor weather conditions as their key production problems. The problems faced by Alabama's tomato producers were similar to the problems faced by producers throughout the Southeast.

In the process of creating this survey, the state IPM teams outlined a clear definition of IPM in fresh-market tomato production. These survey results establish a baseline which can be used to measure the success of programs designed to increase IPM adoption. The survey also provided an opportunity for growers throughout the region to identify pest problems of importance to them. Results of this survey can be used to influence the extension/research agenda in the universities in the Southeast.

SUMMARY OF IPM SURVEY RESULTS

Region	No. growers	Avg. production	Avg. score	Avg. no. applications		
				Fungicide	Insecticide	Herbicide
		acres	*pct.*			
South Alabama	10	17.8	61.2	7.9	8.6	2.1
North Alabama	15	25.4	55.2	10.0	10.1	1.9

Evaluation of Biological Control Treatments for Bacterial Spot Control on Tomatoes

ELLEN BAUSKE, PAUL BACKMAN, JOE KEMBLE, AND ED SIKORA

Field tests were designed to determine the effectiveness of two bacterial strains and chitin amendments in controlling early blight on tomatoes. However, Mother Nature had other designs; she provided a very stringent test of the ability of these biological control agents to limit the spread of bacterial spot disease. Unfortunately, the biocontrol agents were no match for bacterial spot.

Two strains of the bacterium *Bacillus thuringiensis* (BP24A and BT8) were mixed and applied as foliar treatments. Commercial chitin preparations were also applied as foliar treatments on 'Marion' tomatoes. These bacterial strains have previously demonstrated control of early blight. The chitins (CPT Insectinet 270 and 568, Chemical Products Technologies, Cartersville, Ga.) increase populations of chitinolytic (chitin degrading) microorganisms. Since chitin is a major component of many fungal cell walls, chitinolytic organisms can degrade fungal cell walls and have potential as biological control agents. Weekly treatments of these biological controls were compared with weekly application of Bravo 90 DG (ISK Biotech, Mentor, Ohio).

Bacterial spot spread quickly through all plots in the test. Leaves were sampled and rated for disease severity on a 0 (no disease) to 4 (severe disease) scale. There were no indications that any of the treatments reduced disease severity in the presence of bacterial spot (see table). Yields were poor in all treatments due to damage from bacterial spot (data not shown).

EFFECT OF BIOLOGICAL CONTROL TREATMENTS ON SEVERITY OF BACTERIAL SPOT DISEASE OF TOMATO

Treatment	Disease rating[1]
Untreated control	1.99
Bacterial strains[2]	2.30
CPT Insectinet 270	2.18
CPT Insectinet 568	2.09
CPT Insectinet 270 and bacterial strains	2.68
CPT Insectinet 568 and bacterial strains	2.26
Bravo 90 DG	2.33

[1]Ten leaves were removed from each plant and bacterial spot severity was determined using a 0 (no disease) to 4 (severe disease) scale.
[2]Two strains (BP24A and BT8) of *Bacillus thuringiensis* in a mixture.

Ideally, biological control agents would be used to replace chemical pesticides. This test underscores some of the difficulties involved in the application of biological control agents. Neither the bacterial strains nor the chitins were effective against bacterial spot. Use of copper compounds or antibiotics to control bacterial spot would have also reduced populations of beneficial bacteria, leaving the crop with no protection against early blight. Producers using these treatments may have to switch to chemical pesticides in the common event of a bacterial spot epidemic.

Reproduction of Reniform Nematodes on Snap Beans Commonly Grown in Alabama

ED SIKORA, ELLEN BAUSKE, JOE KEMBLE, AND LEONARD KUYKENDALL

Reniform nematodes, which have been found in more than 25% of Alabama's counties, can cause serious damage to a variety of agronomic and horticultural crops. Results from an AAES study suggest that reproduction of reniform nematodes may vary on different snap bean cultivars commonly grown in the state.

In the U.S., the reniform nematode is considered the second most damaging nematode of cotton, causing yield losses of up to 70%. Fresh market beans, cowpeas, tomatoes, okra, and cantaloupe are also particularly susceptible to damage from the pest. Resistance to reniform nematodes has been reported in some soybean cultivars but had not been previously evaluated in snap beans.

Ten commercially available snap bean cultivars (see table) were evaluated in a Chambers County field known to be infested with reniform nematodes. Seed were planted on April 29, 1996. Soil samples were taken at planting and on July 11 (approximate day of harvest) for nematode analysis. Extremely dry conditions during the growing season resulted in a poor stand and extremely low yields.

Reniform nematode reproduction was greatest on 'Pod Squad,' with the population more than doubling during the growing season (see table). Populations also nearly doubled on 'Magnum.' Few differences were observed in reproduction of the nematode among 'Opus,' 'Blue Lake,' 'Rushmore,' 'Green Crop,' or 'Bronco.' The population appeared to only maintain itself at "at-planting" levels on 'Mustard' and 'Strike,' while populations decreased on 'Goldrush.'

Results indicate that reniform nematode reproduction can vary greatly among commercial snap bean cultivars. While some cultivars, such as 'Pod Squad' and 'Magnum,' appeared to cause an increase in nematode reproduction, others, such as 'Mustard,' 'Strike' and 'Goldrush,' appeared to only maintain or reduce nematode populations. At this time, it is uncertain if this is due to cultivar tolerance or resistance, or simply due to environmental factors. How these differences in populations levels effect yield is also unknown. This study will be repeated in both greenhouse and field tests in 1997.

REPRODUCTION OF RENIFORM NEMATODES ON 10 SNAP BEAN CULTIVARS IN CHAMBERS COUNTY, 1996

Cultivar	No. reniform nematodes		Population differential[1]	Population index[2]
	4/29	7/11		
Mustard	359	414	55	1.15
Pod Squad	359	794	434	2.21
Opus	333	509	176	1.52
Blue Lake	275	446	171	1.62
Rushmore	362	522	160	1.44
Goldrush	376	143	-239	0.38
Magnum	648	1,259	611	1.94
Strike	445	529	84	1.18
Green Crop	374	600	226	1.60
Bronco	379	516	137	1.36

[1]Final nematode population minus population at time of planting.
[2]Population at harvest divided by population at time of planting.

Molecular Markers in Watermelon

FENNY DANE, XIAN ZHANG, AND BILLY RHODES

Information needed to grow and maintain plants is encoded in the structure of DNA as genes on chromosomes. This information is translated into proteins, including enzymes and hormones, that regulate plant growth and development. Plant improvement has always relied on the evaluation and selection of the right combination of genes. A large number of genes is often required to improve even the simplest of characteristics. The characterization of important genes and the determination of their chromosomal location has been difficult or often impossible. New DNA-based technologies allow researchers and plant breeders to track valuable genes in segregating populations using genetically linked molecular markers. Extensive sets of genetically mapped molecular markers have been produced for many species; however, little research has been conducted on watermelon, even though this crop is cultivated worldwide.

Watermelon production in the Southeast is often hindered by the susceptibility of available germplasm to several pathogens, especially Fusarium wilt and watermelon fruit blotch. Resistance mechanisms are invariably overcome by the pathogenic variability of the pathogen. Alternative genes may be found in wild relatives, but combining many genes to provide broad sustainable resistance is often difficult. A recently developed strategy called bulked-segregate analysis allows the identification of DNA-based markers linked to important disease resistance genes.

Research was initiated at Auburn University to identify and target DNA-based markers linked to Fusarium wilt disease resistance. Segregating (F_2) populations from a cross between a primitive watermelon (PI 296341), known for its resistance to Fusarium wilt, and 'New Hampshire Midget,' an early-maturing watermelon with small round fruit and susceptibility to all races of the Fusarium wilt pathogen, were used. DNA was isolated from young seedlings. Seedlings were subsequently inoculated with the Fusarium wilt pathogen and evaluated for their resistance to different races of the pathogen. A high number of polymorphic DNA markers were detected in the watermelon populations. At present, genetic analyses are being conducted. These mapped markers should enable us to dissect the control of complex traits such as disease resistance and provide plant breeders with information to manage these traits in a plant breeding program.

Isozyme Markers in Kiwifruit

FENNY DANE AND HONGWEN HUANG

The availability of kiwifruit is an example of the successful development of a worldwide fruit industry from a wild species. Related plants are found throughout Asia, but kiwifruit is native to the mountains and hills of South-Central and Southeast China. All species contain individual plants with either male or female flowers, but show variations in their basic chromosome number. This fact, and the small size and large number of chromosomes, greatly hinders the genetic study of traits important for the identification of cultivars and species in this genus. The majority of the breeding programs for cultivar improvement thus far have depended on extensive selections from natural populations. In order to develop cultivars with higher quality, stress tolerance, and pest resistance, a knowledge of chromosome behavior and mode of inheritance of traits is required.

Protein electrophoresis, the migration of proteins or enzymes under the influence of an electric field, is among the most cost-effective methods of investigating genetic phenomena at the molecular level. Isozymes, which are functionally similar forms of enzymes, have been used extensively in other fruit breeding programs as genetic markers for a variety of reasons. AAES research was conducted to establish isozyme markers for kiwifruit and to evaluate the variation within and between different species.

Hybridization studies were initiated at the kiwifruit repository of the Wuhan Institute of Botany in Hubei, P.R. China. Progenies from interspecific crosses were used for genetic analyses. Isozyme assays were conducted at Auburn University on winter dormant buds. Gels were assayed for many different enzymes and isozymes with high-resolution banding patterns were used. The isozyme data provided many useful markers. Even though the commercially developed kiwifruit is known to contain six pairs of 29 chromosomes, it was found to behave genetically like a diploid (a plant with only two pairs of chromosomes). All cultivars of different commercial species can now be uniquely identified by any combination of three different isozymes. These results are important for the development of effective kiwifruit breeding strategies.

Effect of Mulch Color on Strawberry Production using Annual Hill Plasticulture

DAVID HIMELRICK AND RANDY AKRIDGE

The effects of various types of plastic mulches on total, early, and late-season yield were evaluated for three years in an annual hill strawberry production system at the Brewton Experiment Field in Escambia County. Seven mulch treatments were applied in the first two years with two additional mulches being evaluated in the third year.

'Chandler' plants typically averaged more than twice the yield of the day-neutral 'Selva' in all treatments. Since black plastic is the standard industry practice, treatments were compared against this benchmark. Based upon this comparison, the black plastic mulch treatment differed only from the bare-ground treatment. Although not significantly different in any year, the top-performing mulch treatments varied with production year and cultivar.

In the wet and warm harvest season of 1991, the highest-yielding treatments were IRT-76, clear, and ALOR-brown for 'Chandler'; and clear, black, and ALOR-brown for 'Selva.' In the dry and cool 1992 season, the top performers were white on black, black, and ALOR-brown for 'Chandler'; and ALOR-brown, IRT-76, and white on black for 'Selva.' For the cool and moderately wet 1993 season, the best performance was recorded on black, white on black, and clear for 'Chandler'; and black, IRT-76, and clear for 'Selva.' The bare-ground treatment consistently produced the lowest yields.

Inconsistent results were seen when using various plastics to influence soil temperature and affect the aerial microclimate around the plant to shift, accelerate, delay, or extend the harvest season. Generally, the plastic mulches that produced the highest soil temperatures caused plants to flower and fruit somewhat earlier. The laminated white on black mulch produced the coolest soil temperatures of any mulch treatment and improved late-season performance in the two cool harvest season years. Average soil temperatures from warmest to coolest were black, black on white, clear, IRT-76, ALOR-brown, red, silver, white on black, and bare-soil treatments.

TOTAL YIELD FOR 'CHANDLER' STRAWBERRIES GROWN ON VARIOUS TYPES OF PLASTIC MULCHES

Treatment	1991	1992	1993
Clear	18,493	18,996	22,443
Black	16,698	21,844	23,398
Black/White	17,570	20,220	21,314
White/Black	15,052	23,337	23,166
IRT-76	19,080	20,379	20,489
ALOR-Brown	17,974	20,961	20,822
Red	--	--	20,605
Silver	--	--	22,081
Bare Ground	12,644	18,579	13,598

After three years of research examining the feasibility of using a variety of plastic mulches to maximize production and possibly extend the fruiting season, black plastic mulch remains the best for commercial plantings. In addition to productivity, the inconsistency of other mulches, cost, availability, and weed control factors all contribute to this conclusion. In certain cases, a co-extruded white on black mulch may provide an opportunity to extend the harvest season later into the spring in certain years.

Frost Protection of Satsumas with Microsprinkler Irrigation

MONTE NESBITT, RONNIE MCDANIEL, AND BILL DOZIER

The satsuma is a hardy, mandarin-type citrus that bears heavy crops of high-quality fruit. Satsumas are grown along the Gulf Coast on *Poncirus trifoliata* rootstock, but can be killed by temperatures below 25°F (depending on seasonal hardening). The common method of protecting satsumas from freeze is to "bank" the crown of the tree with soil, which saves the graft union, but sacrifices the canopy. Substantial production is then lost for 4-5 five years while the canopy regrows. Freezes in successive years are very detrimental to reestablishment of trees. Better methods of freeze protection are needed to make satsuma production a sustainable industry in South Alabama.

Microsprinklers have been used successfully in other regions to protect tropical and subtropical fruits from frost and freeze. As water emitted from these low-volume sprinklers freezes, energy is released in the form of heat. Continual application of water by microsprinklers during the period of freezing temperatures keeps irrigated tissues at 32°F.

A test was initiated at the Gulf Coast Substation in Fairhope to compare placement and flow rates of microsprinklers in 'Owari' satsumas for freeze protection. Budded trees were planted in March 1990. Tree spacing was 15 feet x 25 feet. Seven treatments were applied including: (1) control with no protection; (2) control with typical soil banking; (3) low-volume (11 gallons per hour [gph]) microsprinkler placed on ground under tree; (4) high-volume microsprinkler (24 gph) placed on ground under tree; (5) high-volume microsprinkler placed in canopy; (6) high-volume microsprinkler placed in canopy with low volume microsprinkler on ground; and (7) high-volume microsprinkler placed in canopy with high-volume microsprinkler on ground. No significantly damaging frost or freeze events occurred until 1996.

On Feb. 2, 1996, an advective freeze occurred at the Gulf Coast Substation. No buds, blooms, or fruit were present. The lowest temperature measured was 15°F. Temperatures ranged from 15°F to 34°F for a period of 85 hours. Irrigation was activated when temperatures dropped to 33°F, and ran continuously for 87 hours. A second significant freeze event occurred on March 8, 1996, with nightly low temperatures ranging from 27° to 32°F over a four-day period. During this freeze, irrigation was applied at night, because daytime temperatures were well above freezing.

FREEZE DAMAGE OF 'OWARI' SATSUMAS WITH AND WITHOUT MICROSPRINKLER PROTECTION

Treatment	Pct. foliage retention 3/7/96	Pct. foliage retention 3/22/96	No. broken limbs	Stem dieback[1]
Control (no protection)	11.8	2.0	0.00	1.10
Control (banked)	10.8	2.0	0.00	1.30
11 gph ground	23.7	9.1	0.05	1.15
24 gph ground	30.7	20.2	0.05	1.65
24 gph canopy	46.2	29.4	0.35	1.75
24 gph canopy/ 11 gph ground	46.0	30.0	0.80	1.96
24 gph canopy/ 24 gph ground	53.9	40.1	0.25	1.55

[1]0 = no dieback; 1 = 1-5%; 2 = 6-10%; 3 = 11-25%; 4= >25%.

Unprotected satsuma trees and trees with soil banking were almost completely defoliated by the February freeze. Placement of a single 24 gph microsprinkler in the central canopy, with a second 24 gph sprinkler placed under the canopy, preserved more foliage than other treatments. When only one microsprinkler was used per tree, better protection of foliage was obtained by placing it in the central canopy area. Ice accumulation caused some limb breakage in each microsprinkler treatment, but the average number of major limbs broken per tree was low.

Trees in all treatments, including controls, initiated new leaves following the last freeze. Temperatures in the whole test plot may have been elevated by the large number of irrigated trees in the study, offering a level of protection to the control treatments. Unprotected trees in another orchard on the substation had a much higher loss of major limbs. Visual ratings were made on a 0-4 increasing scale to estimate the amount of freeze damage on small-diameter shoots. While all treatments had some dieback of small shoots, unprotected controls had less than some of the irrigated treatments. This might be explained by the fact that ice buildup in the central canopy prevents microsprinklers from continually applying water to the outer shoots. No fruit was produced on unprotected trees in 1996, while irrigated trees set a small number of fruit. Fruit will be harvested in 1996 to determine if any irrigation method gave better yields.

New Peach Thinning Material Evaluated

Bobby Boozer, Bill Dozier, Jr., and Jim Pitts

While thinning peaches was not a problem for most peach producers in 1996, most seasons it is. Most years, hand thinning fruit runs from 30-35% of the total variable costs associated with peach production. During June 1996, an AAES research project was initiated to evaluate the potential of a new product for peach fruit thinning.

Release LC (Abbott Laboratories) is a gibberellic acid which has been shown to inhibit fruit bud formation in peaches. The product is now labeled in California, and several researchers in the Southeast are evaluating the product for use.

'Harvester' peaches (third leaf) were sprayed on June 12 with 50 parts per million of Release LC. Treatments varied with the amount of spray water delivered per acre and the addition of a surfactant. Additional treatments will include the use of ethephon during November to increase winter hardiness and delay bloom.

While no data has been collected from the study at this point, visual assessments have been made and reduced bud formation appears to have occurred. A pre-winter and post-winter bud count will be made and followed up with bloom counts per inch of shoot length.

Touch-up hand thinning of fruit will be performed in 1997 and comparisons made based on treatments. A second application of treatments will be made in June 1997, and yields will be evaluated as well as fruit quality.

Preliminary data should be available by April 1997 to see how this product performs under the study conditions. Information at that time will be based only on bud data. This study is on-going and will be modified over the next several years in an attempt to reduce the cost per acre associated with fruit thinning.

Maximizing Irrigation in Peach Production

Bobby Boozer, Bill Dozier, Jr., Beth Guertal, and Jim Pitts

Peach irrigation in Central Alabama consists of the use of drip-type emitters, usually two one-gallon-per-hour emitters per tree. The widespread use of irrigation has often been limited to final swell during dry years. Maintaining sufficient soil moisture during this period of time can be difficult with drip emitters. The use of microspray devices for irrigation has not been evaluated in Alabama for peach production, nor has the use of irrigation systems to supply fertilizer to the trees.

In 1996, a study was initiated by AAES at the Chilton Area Horticulture Substation to evaluate the use of drip irrigation and micro-spray irrigation for supplying fertilizer. A block of 'Harvester' entering their third leaf was used.

Many crops are now fertilized through irrigation systems. This approach could optimize the use of the fertilizer by reducing losses from leaching, runoff, and weeds. The study will look at tree growth and yield based on treatment effects.

Fertilization of peaches involves modified broadcast or spot fertilization to the surface. In extremely wet springs, many growers are uncertain of the amount of available fertilizer remaining for tree growth and fruit production. This study will determine the most cost-effective method. With fertigation, less fertilizer may be required for optimum growth and yield.

Not unlike many of the commercial peach producers, no fruit was harvested during the 1996 season. Growth measurements and leaf tissue samples were taken. These will be analyzed and results included in future updates.

Soil solution access tubes were installed to remove soil solution at a depth of 36 inches. Nitrate concentration will be determined on these samples to examine the potential loss of fertilizer nitrogen from the different treatments. This study will be on-going for several more years.

Evaluation of Fungicides for Scab and *Glomerella* Control on Pecans

ED SIKORA AND RONNIE MCDANIEL

Pecan scab is the most limiting factor to pecan production in the Southeast. To control the disease, growers must maintain a calendar spray program from bud break through mid-August. In 1996, Abound, a new fungicide from Zeneca, Inc., was evaluated for its ability to control pecan scab.

The test was conducted at the Gulf Coast Substation in Fairhope on mature 'Cape Fear' and 'Cheyenne' trees. The first three sprays of each fungicide treatment were applied at two-week intervals during the pre-pollination period (see table). Cover sprays were applied at three-week intervals starting three weeks after the final pre-pollination spray and were continued through mid-August. In one treatment, three applications of Abound were applied at two-week intervals after the final cover spray to determine if it would affect development of *Glomerella*, a late-season disease of pecan. Also evaluated was a fungicide program that alternated Abound with the commonly used fungicides, Super Tin 80WP and Enable 2E.

Leaf scab ratings were taken on July 7 and nut scab ratings were taken on Sept. 5. No differences were observed among fungicide treatments for either leaf or nut scab, though all treatments had less disease then the unsprayed control (see table). Dry weather during May and June resulted in unusually low levels of leaf scab. More disease was observed on 'Cheyenne' trees than on 'Cape Fear,' as expected, since 'Cheyenne' is considered more susceptible to scab. *Glomerella* was not observed during the test, so no conclusions could be made on the ability of Abound to control this disease. Based on the results of this test, it appears that a fungicide spray program that included Abound in the pre-pollination or cover spray period would be a viable treatment for pecan scab control in Alabama.

EVALUATION OF FUNGICIDE SPRAY PROGRAMS FOR PECAN SCAB CONTROL ON 'CHEYENNE' AND 'CAPE FEAR' TREES IN FAIRHOPE

Treatment[1]	Pct. leaf scab[2]		Pct. nut scab	
	'Cheyenne'	'Cape Fear'	'Cheyenne'	'Cape Fear'
Abound (4 oz.) then Super Tin 80WP (7.5 oz.)	4.4	T	52.1	2.0
Enable 2E (8 oz.) then Super Tin 80WP (7.5 oz.)	5.3	T	54.7	3.0
Enable 2E (8 oz.) then Abound (3.0 oz.)	3.1	T	52.0	0.2
Enable 2E (8 oz.) then Super Tin 80WP (7.5 oz.) then Abound (4 oz.)[3]	5.7	T	61.0	1.4
Abound alternating program with Enable 2E and Super Tin 80WP[4]	7.8	T	49.7	0.8
Unsprayed control	18.4	6.0	96.6	68.2

[1]The first fungicide listed is a pre-pollination spray, while the subsequent fungicides are cover sprays. Rates are described in parentheses.
[2]T = Trace amounts of leaf scab was observed.
[3]Abound was applied three times at two-week intervals beginning two weeks after the final Super Tin cover spray.
[4]Fungicides were applied in the following order: Abound (4 oz.), Enable (8 oz.), and Abound (4 oz.) were applied as pre-pollination sprays at two-week intervals; then Super Tin (7.5 oz.), Abound (3 oz.), Super Tin (7.5 oz.), Abound (3 oz.), and Super Tin (7.5 oz.) were allied as cover sprays at three-week intervals beginning three weeks after the last pre-pollination spray.

Evaluation of Fungicides for Pecan Scab Control in Central Alabama

ED SIKORA AND JIM SMITH

Pecan scab is the most limiting factor to pecan production in the Southeast. In 1996, a fungicide trial was conducted to evaluate fungicides that are not currently labeled for use on pecans for their ability to control scab.

The fungicides, Bravo 720 and IB11522 (ISK Biosciences), and Folicur 3.6F (Bayer Corp.), were evaluated with commercially available compounds and against standard spray programs (full-season Super Tin 80WP and Orbit 3.6EC pre-pollination sprays with Super Tin 80WP cover sprays). Results indicate that Bravo 720, IB11522, and Folicur 3.6F performed as well as the standard fungicides currently used in Alabama.

The test was conducted at the Turnipseed-Ikenberry Place in Union Springs on mature 'Stuart' trees. The first three sprays of each fungicide treatment were applied at two-week intervals during the pre-pollination period. Cover sprays were applied at three-week intervals starting three weeks after the final pre-pollination spray and continuing through mid-August.

Trees were evaluated for leaf scab incidence on June 6 and for nut scab on Sept. 5. Dry weather during May and June resulted in unusually low levels of leaf scab. No differences in leaf scab were observed among treatments, including the unsprayed control. No differences were observed among fungicide treatments for nut scab, although all treatments had less disease incidence than the unsprayed control (see table). All fungicides tested appeared to control pecan nut scab. Further evaluation of Bravo 720, IB11522, and Folicur 3.6F are needed to determine the efficacy of these compounds for leaf scab and under weather conditions more favorable for the development of pecan scab.

EVALUATION OF FUNGICIDES FOR PECAN SCAB CONTROL ON STUART TREES IN UNION SPRINGS, 1996

Treatment[1]	Rate	Pct. nut scab
IB11522 (pre-pollination) then Super Tin 80 WP (cover)	2.0 pt. 7.5 oz.	8.2
Bravo 720 (pre-pollination)[2] plus Enable 2E (cover)	1.0 pt. 4.0 oz.	5.2
Super Tin 80WP (full season)[3]	7.5 oz.	14.4
Folicur 3.6F (pre-pollination) then Super Tin 80WP (cover)	4.0 oz. 7.5 oz.	1.9
Folicur 3.6F (pre-pollination) then Super Tin 80WP (cover)	6.0 oz. 7.5 oz.	1.4
Orbit 3.6EC (pre-pollination) then Super Tin 80WP (cover)	4.0 oz. 7.5 oz.	6.9
Unsprayed control	--	33.9

[1]Pre-pollination sprays were applied three times at two-week intervals and were followed by five cover sprays applied at 21-day intervals through mid-August.
[2]Bravo 720 and Enable were applied as a full season tank-mix.
[3]Super Tin was applied alone, full season.

Evaluation of New Pecan Cultivars for Scab Resistance

BILL GOFF, MONTE NESBITT, AND LYNN SLOCUM

Pecan Scab is extremely difficult and expensive to control. Susceptible cultivars must be sprayed 6-10 times each growing season in Alabama to prevent major foliage and nut loss. The airblast sprayers that are needed to apply protective fungicides to mature pecan trees are cost-prohibitive to small farms or home settings. A primary goal of AAES researchers is to identify new pecan cultivars that have strong genetic resistance to pecan scab, and will be productive without a great dependency of fungicides.

In 1995, an evaluation of scab resistance was initiated at the E.V. Smith Research Center in a high-density planting. Test cultivars included 97 unreleased selections from the USDA Pecan Breeding Program in Texas (example: 72-6-12); two named USDA cultivars (Houma and Oconee); two popular cultivars originating in Alabama (Surprize and Jubilee); six commonly planted cultivars (Curtis, Elliott, Desirable, Farley, Melrose, and Moreland); and 40 new or unknown seedling cultivars, reported to be scab resistant. Five trees of each test cultivar were propagated by bark grafting in April 1995. Failed grafts were re-grafted in April 1996.

Leaflets were rated for scab on a 1-5 scale, where 1 = no infection; 2 = trace to 10%; 3 = 11-25%; 4 = 26-50%; and 5 = 51-100% infection. Ratings were made in July 1995, and August 1996. Scab was also measured in 1995 on stem tissue, by counting the number of scab lesions present on the worst 12-inch stem section. Necrotic spots caused by black aphid feeding were counted on each cultivar in 1995 and 1996.

Cultivars were eliminated from study if a single tree had a leaf scab rating higher than 2, or if stem scab lesions exceeded 10 on a 12-inch stem section. More than 75% of the 147 selections had moderate to severe levels of scab that would preclude their culture in Alabama without fungicides. Seven cultivars exhibited no leaf scab through two seasons and had very low numbers of scab lesions on stems. Because the pecan scab fungus has the ability to evolve rapidly, future observations must be made to ascertain the long term stability of resistance in these cultivars.

PECAN CULTIVARS WITH GOOD RESISTANCE TO SCAB

Cultivar	1996 mean leaf scab	1995 mean leaf scab	Mean stem lesions	1995 black aphid damage	1996 black aphid damage
70-3-34	1.0	1.0	0.5	6.0	37.0
Mount	1.0	1.0	1.0	7.5	14.5
86-4-151	1.0	1.0	1.3	9.0	11.3
89-11-3	1.0	1.0	2.0	3.3	44.7
Dixie	1.0	1.0	3.0	2.3	43.5
Colchicine2	1.0	1.0	4.5	5.0	33.8
Deakle Sp.	1.0	1.0	5.0	0.0	14.0
4X	1.0	--	1.5	5.0	35.0
87-10-42	1.0	1.5	0.5	22.5	21.0
McMillan	1.0	1.5	5.5	1.8	13.8
Elliott-AL	1.2	1.0	6.0	1.5	49.4
82-15-9	1.3	1.0	1.5	1.5	22.3
Farley	1.3	1.0	1.5	1.5	22.3
Forey	1.3	1.0	4.0	7.0	29.5
Schutz 1	1.3	1.0	5.0	2.3	19.5
Schutz 2	1.3	1.0	5.3	0.5	16.0
87-2-631	1.3	1.3	0.5	6.0	18.8
86-4-178	1.3	1.3	1.0	2.5	18.3
89-10-7	1.3	1.3	2.7	5.7	14.0
Buchel 1	1.3	1.0	7.0	0.0	14.5
Carter	1.3	1.3	1.7	6.7	40.3
Hughes	1.3	1.3	1.7	8.8	23.8
Jenkins 1	1.5	1.0	4.3	0.3	22.7
Elliott-TX	1.5	1.0	5.6	1.7	22.3
Syrup Mill	1.5	1.3	4.0	0.0	16.5
Tinker	1.5	1.3	4.3	1.0	12.3
81-6-86	1.5	1.3	1.0	6.3	46.0
87-12-107	1.5	2.0	1.3	8.7	14.0
82-17-680	1.7	1.0	3.3	4.5	26.5
Curtis	1.7	1.0	7.0	0.0	17.0
88-1-71	2.0	1.5	--	11.0	38.7
Carol Leigh	2.0	2.0	4.0	5.0	12.0

Yield and Kernel Percentage of 22 Pecan Cultivars from 1992-1995

MONTE NESBITT, BILL GOFF, LYNN SLOCUM, AND RONNIE MCDANIEL

The pecan industry in Alabama suffered four disastrous years from 1992 to 1995. Following heavy crops and severe disease pressure in 1991, total state production in 1992 was 4 million pounds, a low not seen since 1940. In 1993, state production was 27 million pounds, the highest level since 1981. Overproduction in 1993 caused nut quality to be poor, and severely depressed prices paid to growers. Trees were stressed from overbearing and set very little crop in 1994. Total state production in 1994 was 4 million pounds, and nut quality was poor. Hurricanes in August and October, 1995 destroyed trees, decimating an estimated two-thirds of the crop, and severely reducing nut quality.

A pecan orchard was planted at the Gulf Coast Substation in Fairhope in 1983 to compare performance of several cultivars. Trees were planted at 40 x 40 feet, and were established with drip irrigation. Weeds were controlled by herbicide applications, maintaining a sod and strip orchard floor. Soil and leaf samples were taken annually, and fertilizers were applied accordingly. Fungicide applications were begun at bud break, and a full-season schedule was maintained. Insects were controlled when scouting indicated an economic injury level was present. Yield and nut quality parameters (nut size, kernel percentage, and kernel grade) were measured each year. In 1992, the trees were in their 10th leaf.

Nut production and kernel percentage measurements in this trial from 1992-1994 reflect the general production problems encountered statewide during the same time. Data from these years, however, is useful in identifying cultivars that perform well in South Alabama under adverse conditions. Kernel percentage, in particular, is an important indicator of cultivar performance. 'Forkert,' a cultivar known for producing high-quality kernels, had the best kernel quality in this study from 1992-1995. Average percent kernel for all cultivars was low, but 'Shoshoni,' 'Gloria Grande,' 'Cheyenne,' and 'Davis,' had especially low kernel percentages.

The benchmark for pecan yields in the Southeast is 1,000 pounds per acre per year. Over the four-year period presented, only three cultivars produced at this level. The best cultivar of these three was 'Surprize,' which had better kernel quality and a more consistent pattern of annual production as an older tree. 'Cape Fear' and 'Elliott,' popular cultivars in Alabama, were among the lowest-yielding cultivars over the four-year period. 'Elliott' is susceptible to late summer defoliation by insects and mites, which reduced yield in 1995. 'Cape Fear' is a heavy-bearing cultivar, but in 1993, kernel quality was so poor that nuts were unmarketable.

When yield and kernel percentage are considered, 'Pioneer,' 'Surprize,' 'Forkert,' 'Harris Super,' 'Creek,' and 'Kiowa' had the best performance from 1992-1995. Some of these cultivars have other limitations not discussed here, including dark kernel color, kernel specks, weak shell sutures, late nut maturation, etc.

KERNEL PERCENTAGE AND MARKETABLE YIELD[1]

Cultivar	Avg. pct. kernel	Yield 1992	Yield 1993	Yield 1994	Yield 1995	Avg. yield/ acre/year[2]
Jubilee	44	48	103	0	58	1,421
Pioneer	46	20	88	0	74	1,240
Surprize	47	31	88	0	62	1,231
Forkert	56	14	76	0	42	894
Harris Super	48	0	69	0	55	844
Sumner	50	27	52	2	38	809
Creek	47	13	65	0	39	792
Desirable	44	43	55	1	16	779
Kiowa	48	48	34	1	26	743
Gloria Gr.	37	16	47	11	28	692
Candy	41	2	57	0	39	664
Stuart	41	16	61	0	19	660
Pawnee	52	15	49	0	30	643
Melrose	49	33	44	0	4	558
Davis	33	5	54	0	21	547
Choctaw	47	12	44	0	17	499
Elliott	49	8	48	0	16	490
Cape Fear	43	4	0	0	62	455
Maramec	52	13	36	0	14	430
Jackson	50	9	20	1	15	303
Shoshoni	31	0	0	0	28	189
Cheyenne	40	4	6	0	5	100

[1]Pounds of in-shell nuts per tree.
[2]Calculated based on 40 x 40-foot spacing, which equals 27.2 trees per acre.

Weed Control Increases Yield and Economic Return from Young 'Desirable' Pecan Trees

WHEELER FOSHEE, BOB GOODMAN, MIKE PATTERSON, AND BILL GOFF

The economic benefits of improved weed control in pecan orchards have not been fully established. Yields and corresponding economic returns above treatment costs were determined from young 'Desirable' pecan trees grown for nine seasons under 10 combinations of orchard floor management practices and irrigation at the Gulf Coast Substation in Fairhope.

Orchard floor management practices included (1) weedy-unmowed, (2) weedy-mowed, (3) total weed control with herbicides, (4) grass control only with herbicides, and (5) weed control by disking. Herbicide applications included oryzalin (Surflan AS) plus paraquat (Gramoxone) in March, followed by glyphosphate (Roundup) in June and August, and an application of norflurazon (Solicam) in the fall. Also, in the second growing season, simazine (Princep) was added to the oryzalin-paraquat treatment.

Mowing and disking were performed on a two-week and four-week schedule, respectively. Pecan samples and grading information were presented to a commercial buyer who established a price he would offer for the pecans if buying in wholesale commercial lots on the date pecans could have been delivered to market. Treatment costs were based on vendor surveys and Alabama Cooperative Extension Service budgets.

In the humid environment of South Alabama, the effect of irrigation on yield and crop value was negligible (Table 1). Total weed control with herbicides, however, increased cumulative yield through the ninth season by 361%, compared to no weed control. By the eighth season, this floor management technique had recovered establishment costs for the young 'Desirable' trees (Table 2).

TABLE 1. CUMULATIVE YIELDS OF IRRIGATED AND NON-IRRIGATED PECAN ORCHARDS

Treatment	Irrigated	Non-irrigated	Avg.
No weed control	1,228	1,055	1,142
Mowing	1,614	1,472	1,544
Total control with herbicides	4,292	3,930	4,127
Grass control with herbicides	1,802	1,773	1,789
Disking	3,626	2,255	2,947
Average	2,512	2,097	--

TABLE 2. FINANCIAL SUMMARY: CUMULATIVE DEBT PER ACRE[1]

Year	None	Mowing	Total herbicide	Grass herbicide	Disking
			Irrigated		
1989	$1,920	$1,936	$1,970	$1,934	$1,933
1990	2,284	2,316	2,184	2,312	2,091
1991	2,663	2,712	2,175	2,572	2,000
1992	2,473	2,520	389	2,255	630
1993	2,182	2,276	-528	1,972	-198
1994	2,554	2,584	-281	2,331	10
			Non-Irrigated		
1989	$1,847	$1,863	$1,897	$1,861	$1,860
1990	2,208	2,240	2,065	2,137	2,234
1991	2,584	2,633	2,188	2,524	2,459
1992	2,609	2,246	535	2,369	1,902
1993	2,553	1,870	-540	2,044	1,534
1994	2,914	2,215	-293	2,439	1,839

[1]Negative numbers indicate a positive net present value.