Crop Reports

Vidalia Onions—Sweet Onion Production in Southeastern Georgia

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Southeastern Georgia is ideal for sweet onion (*Allium cepa*) production. This region is noted for its mild winters, low sulfur soils, and abundant water supply. Vidalia onions with their national reputation for mildness have dramatically increased in availability in the last 10 to 12 years. Several factors have contributed to this increase including; national name recognition, regulatory control of the Vidalia name, ideal region of production, Marketing Order 955 (USDA, 1989), and the adoption of controlled atmosphere (CA) storage. These factors have resulted in a 3-fold increase in production since 1989 (USDA, 2001).

The growth of the Vidalia onion industry has not been without challenge or controversy. Wide fluctuations in performance from one year to the next have caused CA storage not to be as

consistent as expected for extending onion shelf life. In addition, some growers have expressed concern over some new varieties being too hot to be called Vidalia onions. Other varieties have increased problems with late season diseases. Vidalia onions, however, remain one of the bright spots in American agriculture by providing good returns for the producers. Although somewhat uncertain, the Vidalia onion's future remains promising. For the industry to continue to prosper issues concerning, increased competition, production problems including variety selection, and use of CA storage have to be addressed.

Vidalia onions are also referred to as yellow onions, salad onions, green onions, and dry bulb onions. In order to be a Vidalia onion they must be a yellow Granex type. Salad and green onions refers to immature onions. They are comparable to scallions, however they tend to be longer in total length with larger leaves and an expanded bulb, about 1 inch (2.5 cm).

The objective of this article is to highlight the Vidalia onion industry, and to describe its past, present and future with respect to production practices, issues of concern, and marketing.

Classification

Onions are monocots and members of the Alliaceae family, which includes garlic (*A. cepa*), leek (*A. ampeloprasum*), Japanese bunching onion (*A. fistulosum*), shallots (*A. cepa*), chives (*A. schoenoprasum*), elephant garlic (*A. ampeloprasum*), and a few ornamental types (Brewster, 1994).

Onions can be organized into two broad groups, the Common Onion Group and the Aggregatum Group (Brewster, 1994). The Aggregatum Group is noted for producing clusters of bulbs. The two main entries are potato

or multiplier onions (*A. cepa*) and shallots. By far, most of the cultivated onions fall into the Common Onion Group, noted for producing a single bulb per plant.

Onions are also classed by their response to day length. Short-day onions require a relatively short day length to trigger bulbing. In the Vidalia onion growing region, bulbing begins at day lengths slightly over 11 h. In comparison, intermediate-day and long-day onions bulb at day lengths that exceed 13 and 14 h, respectively (Brewster, 1994); however, the exact day length required for bulb initiation may vary from season to season and from field to field within seasons, because several other factors including, temperature, leaf area, variety, and intercepted light significantly affect the process. Within the short-day varieties grown in the Vidalia region, differential bulbing responses result in onions being harvested from the beginning of April to the beginning of May in most years. Even though factors other than day length influence bulb development, classifying onion varieties according to day length response is important to seed companies and growers because it indicates varietal adaptation to specific regions of production. The USDA National Agricultural Statistics Service uses the classification of spring nonstorage, summer nonstorage, and summer storage onions to report onion statistics (USDA, 2000). This roughly coincides with the short-day, intermediate-day, and long-day classes.

The short-day onions grown in southeastern Georgia bulb relatively early, usually during late February or early March as the day length increases. For this reason, seeds of such varieties are sown in the fall when days are getting shorter. This will enable seedlings to emerge and develop sufficient leaf area before bulbing is initiated in the spring. Short-day onions planted in the spring would begin to bulb almost immediately resulting in very poor yields.

Origin and variety development

Onions have been known to be in cultivation for at least 5000 years. They are native to the Eurasia region of Turkey, Afghanistan, Iran, Pakistan, and into northeastern China and Mongolia (Brewster, 1994). Wild alliums are typically found in open arid regions with cool climates.

Considered a cool-season crop, onions have been adapted to a wide geographic area through selection for

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Fig. 1. Granex onion pedigree.

bulbing response to day length. Onions have been adapted to most regions of the world from the most northern arable climates to the tropics.

The biennial nature of onions poses challenges to plant breeders. In addition, breeding efforts must be specific to particular regions according to day length requirements. Selection of new varieties is therefore time consuming and difficult. The process can be accelerated with seed-to-seed production, which forces the plant to produce seed in the same season it is sown. This can be troublesome because ease of seedstem formation (bolting) is considered undesirable in the bulb crop. On the other hand, because bulb quality and yield are of utmost importance in the breeding process, and seedstems are considered objectionable, selection for bolting resistance often results in plants with poor seed producing ability.

The 20th century has seen the development of modern plant breeding techniques, which have resulted in tremendous advancements in yield and quality of onions. The discovery of male sterility in onions in 1925 led to a method of creating F₁ hybrid onions (Goldman and Havey, 1998). Male-sterile plants can be interplanted with pollenizer plants resulting in large-scale production of F₁ seed precluding the need for controlled hand pollinations. F₁ hybrids have advantages over open-pollinated varieties in that superior varieties can be developed more quickly and they exhibit heterosis or hybrid vigor (Simmonds, 1979). In addition, they tend to be more uniform in their performance, which is useful in commercial production particularly with mechanical harvesting.

The modern Granex varieties grown in the Vidalia region have their origin from Mediterranean onion varieties. Two important open-pollinated populations imported to the United

States were 'Valencia', which came from Spain and 'White Bermuda', which came from Italy via Bermuda (Goldman and Havey, 1998). These early populations were the foundation for short-day onions in New Mexico, Texas, and Georgia. 'Valencia' was ultimately the source for 'Texas Early Grano 951C', which was one of the parents for the hybrid 'Granex YB986'. A selection of 'Excel', became the other parent in the 'Granex' hybrid (Goldman and Havey, 1998). The 'Granex' name is conjoined from the names 'Grano' and 'Excel'. This hybrid became the basis for the Vidalia onion industry (Fig. 1).

Variety development has contributed to the release of several varieties adapted to the Vidalia onion growing region. One of the most popular early varieties, Granex 33, is still grown today. The industry's success, over the past decade, has fostered the release of several new varieties. Currently about 50% of the acreage is planted to 'Sweet Vidalia', which is an early to midseason onion.

In the mid-1990s, a new type of onion was introduced to the Vidalia onion industry. These Japanese overwintering onions had two important advantages over the traditional varieties. They were 2 weeks earlier than previous varieties and they had very good foliar disease resistance. However, many grow-

ers considered these varieties to be too pungent to market as Vidalia onions. The elevated pungency levels were especially troublesome because these varieties would be the first onions offered to the public in the spring. Many have suggested that it is not the pungency, but rather bitter off-flavors, that are the problem with the Japanese varieties.

Concerns related to the flavor of these early Japanese overwintering varieties prompted the Georgia Department of Agriculture in 1997 to restrict Vidalia onion varieties to 12 varieties (Table 1). These varieties were: Sweet Vidalia, Granex 33, Savannah Sweet, Pegasus, Granex F₁, Sweet Success, Dessex, Southern Belle, Southern Honey, Rio Bravo, Mr. Max, and Adonis. In 1999, this issue was again brought to the fore and three varieties: Sugar Queen, Spring Express, and Sweet Dixie were identified by the Georgia Department of Agriculture as unacceptable and were not allowed to be grown. In addition, rules were adopted that mandated the University of Georgia was to make variety recommendations to the Georgia Department of Agriculture based on variety trial including pyruvate analyses and taste panel evaluations (Georgia Department of Agriculture, 2001).

In 2000, the Georgia Department of Agriculture attempted to expand the

Table 1. List of current and proposed Vidalia onion varieties.

Variety	Source	Season
Adonis ^z	Harris Moran	Late
Cyclops (XP 6995)	Asgrow	
Dessex ^z	Sunseeds	Midseason
DPS 1032 ^{y,x}	D. Palmer	
Granex 33	Asgrow	Midseason
Mr. Max ^z	Sunseed	Late
Pegasus	Asgrow	
PS 7092 ^{y,x}	Petoseed	Midseason
Rio Bravo ^z	Sunseeds	Midseason
Savannah Sweet	Petoseed	
Southern Belle	D. Palmer	Midseason
Southern Honey	D. Palmer	Midseason
Sunseeds Improved Granex F ₁	Sunseeds	Midseason
Sweet Advantage (1058) ^y	D. Palmer	Early
Sweet Melissa (Sunex 1519)	Sunseeds	Midseason
Sweet Melody	Sunseeds	Midseason
Sweet Success	Sunseeds	Midseason
Sweet Vidalia	Sunseeds	Midseason
WI-3115 ^y	Wannamaker	Early
WI-609 ^y	Wannamaker	Early

^zDiscontinued varieties.

^yProposed additions to the variety list by the University of Georgia for 2001–02 season.

^xProposed additions by the Georgia Department of Agriculture for the 2001–02 season.

^wAsgrow (Asgrow Vegetable Seeds, Oxnard, Calif.); D. Palmer (D. Palmer Seed Co., Inc., Yuma, Ariz.); Harris Moran (Harris Moran Seed Co., Modesto, Calif.); Petoseed (Petoseed, Oxnard, Calif.); Sunseeds (Sunseeds Co., Morgan Hill, Calif.); Wannamaker (Wannamaker International, St. Matthews, S.C.).

variety list with inclusion of seven additional varieties; however, after holding hearings and failing to get a clear mandate from the growers, the Georgia Department of Agriculture decided to maintain the original 12 varieties while including three additional varieties, Cyclops, Sweet Melody, and Sweet Melissa based on University of Georgia recommendations. Several seed companies and growers promptly sued the Georgia Department of Agriculture alleging they did not follow their own rules regarding the inclusion or exclusion of varieties and won the case. As a result there were no restrictions on varieties for the 2000–01 growing season.

With the completion of 3 years of trials, the University of Georgia has recommended the inclusion of five additional varieties; DPS 1032, PS 7092, Sweet Advantage (1058), WI-3115, and WI-609. Two of these varieties, WI-3115 and WI-609 are early Japanese overwintering varieties. The Georgia Department of Agriculture has decided to adopt only two of the University of Georgia's recommendations, 'DPS 1032' and 'PS 7092'. This will extend the list of acceptable varieties to 17. In addition to the 3 years of University of Georgia trials and testing for pungency, the Georgia Department of Agriculture based their decision on the inclusion of 1 year of taste panel evaluations.

Production statistics

Total onion acres harvested in the United States was 169,200 acres (68,473 ha) in 1999, an increase over the 166,340 acres (67,315 ha) harvested the previous year (USDA, 2000). The total value of the onion crop in the United States was \$654,282,000 in 1999. According to the USDA National Agricultural Statistics Service, Georgia produced 14,500 acres (5,868 ha) of spring onions, somewhat less than the 15,765 acres (6,380 ha) accessed through the marketing order by the Vidalia Onion Committee. The 14,500 acres represents almost 39% of the total spring onion acres grown in the United States. If the summer nonstorage onions are included, Vidalia onion acreage drops to 28% of the total. The value of the Vidalia onion crop was reported as \$74,661,000 in 1999 which represents a little over 40% of the total value of the spring onion crop and a little over 26% of the spring and summer nonstorage onion crop grown in the United States. In 2000, based on a survey of the Georgia county extension

agents, the Vidalia onion crop was estimated to be valued at \$94,487,900 (University of Georgia, 2000)

Vidalia onion history

Short-day onion production began in southeastern Georgia in 1931 (D. Bland, personal communication). The first grower to produce sweet onions was a local grower, Mose Coleman. He was able to produce and sell sweet onions for the unheard of price of \$3.50 for a 50-lb (22.7-kg) bag. Considering 400 bags/acre (22.4 t·ha⁻¹) as an average yield, this was a fabulous return, especially with the advent of the Great Depression. Other growers soon saw the value and potential profitability of these onions and began growing them.

A farmer's market was constructed in Vidalia, Georgia in the 1940s to help growers sell their produce. In addition, Vidalia was strategically located on the crossroads of some of the most important preinterstate north–south routes. Word spread among travelers driving through Vidalia about those mild sweet onions. Piggly Wiggly, a well known supermarket chain, also maintained a warehouse distribution center in Vidalia and purchased these onions when in season for distribution in their stores. All of these factors contributed to the development and growth of this industry. By the 1970s there were about 600 acres (243 ha) of production.

Initially the sweet Vidalia onions were marketed primarily in Georgia and bordering states. However, as the acreage increased, growers saw the need to develop national markets for Vidalia onions. Annual festivals were established in both Vidalia and Glennville, Ga. Through the remainder of the 1970s and into the 1980s the industry grew to about 4,000 acres (1,619 ha). Because of the profitable market premiums paid for Vidalia onions, some growers began buying onions from Texas, rebagging them in Vidalia onion bags, and selling them as Vidalia onions. Although upsetting many, this practice was not illegal at the time. Growers asked the Georgia legislature to regulate marketing of Vidalia onions to prevent such practices. As a result, a standard was set for Vidalia onions. In 1986, the Georgia Department of Agriculture was given ownership of the Vidalia name for the purpose of regulating marketing of these unique onions. In addition, laws were passed mandating that onions sold as Vidalias had to be a Granex-type yellow onion

and could be grown only in a specifically designated area of Georgia. The designated Vidalia growing region includes 12 counties in their entirety and parts of 8 others. The state of Georgia defined the Vidalia onion growing region, which includes all of Appling, Bulloch, Candler, Evans, Emanuel, Jeff Davis, Montgomery, Tattnall, Telfair, Toombs, Treutlen, and Wheeler counties, as well as, parts of Bacon, Dodge, Jenkins, Laurens, Long, Pierce, Screven, and Wayne counties (Fig. 2). Over the years, this legislatively designated area has become popularly known as the onion belt. For growers to market onions as Vidalia onions they must grow them in fields within this region.

Although this legislation gave the onion industry protection within Georgia, it did not give the industry protection in the rest of the U.S. However, in 1989 the industry obtained national protection with Marketing Order 955 (USDA, 1989). This order gave recognition and protection to Vidalia onions and to the state mandated onion-growing region. This marketing order also established the Vidalia Onion Committee, which collects monies from growers based on volume of onions sold. This money is used for promotional efforts and for research that benefits the production and marketing of Vidalia onions. Since establishment of the Vidalia Onion Committee, more than \$0.5 million has been funneled into onion research, primarily through the University of Georgia.

In 1990 the industry began adopting CA storage for onions. This technology, borrowed from the apple (*Malus × domestica*) industry, relies on a low oxygen (3%), high carbon dioxide (5%) refrigerated atmosphere to preserve and extend the marketing season of Vidalia onions. Instead of being marketed only during the spring, CA storage enables growers to extend their marketing season into the fall. Currently there is enough storage capacity in the region to store 20 million bags of onions. This represents about half of the annual Vidalia onion production in Georgia. By dramatically increasing the duration of the marketing season, CA storage is a major factor contributing to the increase in Vidalia onion acreage from 4,900 acres (1,983 ha) in 1989 to its current level of 15,000 acres (6,070 ha) (USDA, 2001).

Another important development in the Vidalia onion industry has been the adoption by some growers of me-

Fig. 2. Onion growing region of southeastern Georgia, which encompasses 12 whole counties and parts of 8 others.

chanical harvesting. Since 1997, some acreage has been mechanically harvested. Although several of the larger growers have invested in harvesting equipment and modified their packing shed operations to accommodate this technology, the bulk of the acreage continues to be hand harvested. Complete adoption of mechanical harvesting across the onion belt has not occurred because of the high capital costs, the fact that smaller fields do not lend themselves to large harvesting equipment, and continued technical problems.

Composition and uses

Short-day onions are high in water and low in total solids. Nutritionally, they have no fat or cholesterol, but are a source of carbohydrates including simple sugars. A single medium sized onion has about 60 calories, 2 g of protein, 14 g of carbohydrates, and 3 g of fiber (Richter, 2000). Onions are also

a good source of vitamin C.

Onion flavor and the underlying chemistry is both interesting and complex. Onion flavor is primarily the result of the hydrolysis of S-alk(en)yl cysteine sulfoxide to sulfenic acid, which quickly rearranges into a myriad of strongly flavored compounds (Wall and Corgan, 1992). This hydrolysis occurs in the presence of alliinase, which is released when the onion is macerated. When eaten, onions do not impart a pungent flavor immediately, however, several seconds after the onion is chewed, pungency is detected as the alliinase is released and hydrolysis of the sulfur-containing precursors begins. Pungency intensity depends on the level of S-alk(en)yl cysteine sulfoxide precursor. Whether mild or hot, the unique flavor of onions is their most important attribute.

Vidalia onions like all short-day onions are high in water and low in solids, which means there is a relatively low level of the S-alk(en)yl cysteine sulfoxide precursor resulting in mild onions. Vidalia onions also benefit from the low sulfur soils in southeastern Georgia and the abundance of irrigation water. Low

sulfur means there is less of these precursors formed and irrigation water ensures maximum water content in the onions. This results in some of the mildest onions produced anywhere in the world.

Recently there has been an increased interest in the health benefits of various compounds found in alliums, particularly garlic. Onions also produce many of these compounds that have been implicated in enhancing human health. Properties of onions that are thought to hold the greatest potential for human health benefits included their hypocholesterolemic, antioxidant, and fibrinolytic effects (Augusti, 2000). Onion oils have also been shown to increase serum insulin levels in humans with lowered blood sugar. Research continues in these areas.

Crop production and management

High levels of residual soil sulfur or large applications of sulfur fertilizer particularly during the latter part of the crop cycle can result in pungent onions (Granberry et al., 1987). The sandy loam Coastal Plain soils of southeastern Georgia are naturally low in sulfur, typically less than 0.001 ppm ($\text{mg}\cdot\text{L}^{-1}$). In addition, southern Georgia sits on top of the Floridan aquifer, an abundant source of low-sulfur water. Irrigation is a necessity for production of mild Vidalia onions. In the Georgia onion belt, irrigation water is supplied by deep wells, and applied overhead primarily through fixed center-pivot systems. These systems are relatively inexpensive and easy to operate. The downside of using these fixed systems is onions are generally not rotated in production, but are continually produced on the same site. This contributes to increased incidence and severity of soil borne diseases such as pink root (*Phoma terrestris*). Vidalia onions are a long season crop requiring intensive management, high fertility, and a great deal of labor. Vidalia onion production encompasses the production of three different crops; transplant production, salad onion production, and dry-bulb onion production.

Production can begin as early as late July or early August with land preparation for planting salad onions. Salad onions are produced either from direct-seeded onions or from transplants (Boyhan et al., 1999). Land preparation begins with deep turning to bury the previous crop litter, application of lime if needed, and incorporation of metam-

sodium, to control dampening-off and weeds. Although there are several different fertility programs used by growers the following is typical of production practices for Vidalia onions. Preplant applications of 400 to 800 lb/acre (448 to 897 kg·ha⁻¹) of 5-10-15 fertilizer (5N-4.4P-12.5K), which contains 4% to 9% sulfur, are incorporated before sowing. Salad onions are sown on beds or panels (as they are called locally), which are slightly raised and formed during the final step in land preparation. These beds or panels are prepared 6 ft (1.8 m) on center (all equipment in the onion belt is based on 72-inch (183-cm) tractor wheel spacing). Salad onions are sown four rows to the bed with a between row spacing of 14 to 18 inches (35.6 to 45.7 cm) and an in-row plant spacing of 1 to 2 inches (2.5 to 5.1 cm) when direct seeded. When they are seeded for transplant production of salad onions, 40 to 70 seed are sown per linear foot (0.3 m). Many growers apply 150 lb/acre (168 kg·ha⁻¹) of diammonium phosphate [(NH₄)₂ H₂PO₄] immediately after sowing. However recent studies have shown that high phosphorus fertilizers are not required at this time due to high soil temperatures coupled with high residual phosphorus levels. After seeding, beds are kept evenly moist until seed germination occurs. This often requires irrigation with a 1/10 inch (0.25 cm) of water several times a day. Two to three additional broadcast applications of calcium nitrate (CaNO₃) are applied at 200 lb/acre (224 kg·ha⁻¹) beginning 4 weeks after seeding. Salad onions are ready for harvest in 12 to 14 weeks. Overall, salad onions represent a very small part of the onion crop, but on a per acre basis they can be very profitable, especially for those growers that market them at retail.

Transplant production begins with seeding of onions on beds in mid to late September (Boyhan et al., 2001). Transplant onion production is similar to salad onion production; however, the seed are sown later and are grown only for 8 weeks before transplanting. Land preparation, fertilization, and fumigation are similar to salad onions with perhaps one less fertilizer application. For producing dry bulb transplants, seed are sown at a rate of 40 to 70 per linear foot. Spacing is similar to salad onions with the exception of a few growers who plant five rows per bed instead of four.

The dry bulb onions, which make up the bulk of the crop, are transplanted

to the field beginning the week before Thanksgiving and continuing until Christmas. Transplants are pulled and bundled with 50 to 80 plants per bundle. The tops, which represent 50% or more of the growth of the plants, are removed resulting in a 4 to 6 inch (10 to 15 cm) transplant before transporting to fields for planting.

Fields to be used for dry-bulb onion production are prepared 2 to 4 weeks before transplanting by deep turning to bury any previous crop residue. Plant beds are prepared by chiseling, disking, and/or rotovating. A typical fertility program begins with 400 lb/acre of 5-10-15, which includes 4% sulfur applied preplant and incorporated. In addition, chlorpyrifos is applied to reduce populations of soil borne insects such as onion maggots (*Delia antiqua*) before transplanting.

A specialized piece of equipment called a pegger is used for final bed preparation and to form the holes where the onions will be transplanted (Fig. 3; color version at <http://www.uga.edu/hort/hortpub/HT1540.html>). The desired spatial arrangement is to have four rows planted 14 to 18 inches (35.6 to 45.7 cm) apart with an in-row spacing of 4.5 to 6 inches (11.4 to 15.2 cm) (Fig. 4; color version at <http://www.uga.edu/hort/hortpub/HT1540.html>). All onions grown from transplants are set by hand. Mechanical transplanters are too slow to meet the crop establishment time frame. Growers wish to have the entire crop set within 4 to 6 weeks.

Transplanted onions are fertilized throughout the growing season beginning immediately after transplanting with a broadcast application of 150 lb/acre of diammonium phosphate. This is followed with two broadcast applications of 150 lb/acre of 6-12-18 (6N-5.2P-14.9K), which contains 4% sulfur at 4 and/or 6 weeks after transplanting, and, by two broadcast applications of CaNO₃ at 200 lb/acre 10 weeks and 12 weeks after transplanting. All the sulfur fertilizer is applied by the end of January and all the fertilizer is applied by the end of February. The earliest onions are ready for harvest in early April.

Diseases and insects

Insects are not generally a problem through the winter. As mentioned previously, soilborne insects, including onion maggots, seed corn maggot (*Delia platura*), cut worms (species of the Noctuidae family), and mole crickets (*Scapteriscus acletus*), are controlled with a single application of insecticide before transplanting.

Thrips, which can become a problem in late winter and early spring, are controlled by one to two applications of an appropriate insecticide. Two thrip species are found on Vidalia onions, western flower thrips (*Frankliniella occidentalis*) and tobacco thrips (*F. fusca*). Interestingly, onion thrips (*Thrips tabaci*) occur in very low numbers on

Fig. 3. Onion pegger used for final bed preparation and to mark holes where the onions will be planted.

Fig. 4. Typical field layout of four rows on a bed or panel.

Vidalia onions. Scouting is an important part of thrip control, because their occurrence can vary widely from year to year. Spraying begins when an average of five thrips are present per plant.

Disease control during the winter includes the regular use of fungicides such as chlorothalonil and dithane. Copper fungicides are also applied periodically to control bacterial diseases.

The incidence and severity of various onion diseases depend on the weather and time of year. Rainy, humid weather will aggravate disease problems. In recent years, bacterial diseases including bacterial streak (*Pseudomonas viridiflava*), center rot (*Pantoea ananatis*), and sour skin (*Burkholderia cepacia*) have become a major concern among growers. Bacterial streak generally is seen during the winter when the weather is cool and humid. Center rot occurs as the weather warms from late winter to harvest. Sour skin is a disease of late varieties and usually requires temperatures above 85 °F (29 °C).

Botrytis neck rot (*Botrytis allii*) has become more of a concern because of the increased use of CA storage. This disease enters the bulb either at the soil line or through the cut surface when the tops are removed (Lacy and Lorbeer, 1995). In the past it has not been that troublesome because no one used CA storage. With CA storage the fungus enters the bulb and is all but impossible to

detect until the onions are removed from storage at which time the bulbs exhibit the problem and are rendered unsalable. This disease is highly variable from year to year and is associated with damage to the onions. This damage can be from cold weather or rough handling. In some years growers have lost 50% to 70% of the onions coming out of storage.

Harvesting and handling

Vidalia onions are primarily harvested by hand. Plants are undercut when bulbs reach harvest maturity, as indicated by weakened neck tissue, which can result in tops falling over. After undercutting they are left in the field for 1 to 3 d to dry. Then the tops and roots are clipped and the onions are bagged (Fig. 5; color version at <http://www.uga.edu/hort/hortpub/HT1540.html>) before transporting to the packing shed where they are unloaded and heat cured at 95 to 105 °F. (35 to 40 °C) for 1 to 3 d before they are graded and packaged.

Over the past 5 years mechanical harvesting has become more prevalent in the Vidalia onion region. Traditionally, mechanical harvesting was avoided because growers believed it would be too damaging to the onions. However, recent studies have shown that mechanical harvesting is as effective or in some cases more effective, than hand harvesting in preventing damage to the onions. In addition, the use of some mechanical harvesting equipment in other onion production areas has relied on a completely mature crop (all the

tops down) before harvesting. Vidalia onions are generally harvested before this point and in fact, some varieties would be completely unusable if allowed to reach this level of maturity. Having some erect green tops has hindered the more rapid adoption of mechanical harvesting by growers. However, current research continues to address this problem. Finally, there are some small fields where mechanical harvesting will never be adopted.

Onions are graded into size classes based on USDA standards for Bermuda-Granex-Grano-type onions. Vidalia onions are primarily sold under two size classes, mediums and jumbos. Mediums have a minimum diameter of 2 inches (5.1 cm) and a maximum diameter of 3.25 inches (8.25 cm). Jumbos have a minimum diameter of 3 inches (7.6 cm) and no maximum size. There is also a colossal size that is occasionally sold with a minimum diameter of 3.75 inches (9.5 cm) (USDA, 1995).

Processing and marketing

Vidalia onion growers and packers are required to register with the Georgia Department of Agriculture before the beginning of the harvest season. They are required to list the name and address of their farm as well as the varieties they will be selling. In addition, they are required to have the onions inspected.

Table 2 gives a breakdown of the estimated cost of production as well as an estimate of the return on a 40-lb (18.1-kg) box of Vidalia onions. With an average yield of 500 boxes/acre (22.4 t·ha⁻¹) the return is \$1,990/acre (\$4,917/ha).

Vidalia onions are packaged fresh in a number of different size boxes and bags. Until recently, prices were quoted based on a 50-lb bag of jumbos or mediums. Recently this has changed and prices are now quoted on a 40-lb box. This change was requested by the chain stores, which were interested in a lighter container for ease of handling. Onions are still available in a variety of bag and box sizes from 5 (2.3 kg) to 50 lb.

Along with the wholesale market, Vidalia onions are direct marketed at retail by several growers. Mail order catalogs and Internet marketing have been quite successful. In addition, Vidalia onions are used to make a variety of processed dressings and sauces, which are marketed by retailers and directly from growers. Vidalia onions are also processed into frozen onion rings and pieces. Cracker Barrel Restaurants, for

Fig. 5. Bagged onions ready for transport to the packing shed.

example, features Vidalia onion rings.

Vidalia onions have traditionally commanded a premium in the marketplace. This is due to the mild nature of short-day onions coupled with the ideal conditions for onion production in southeastern Georgia. Georgia has consistently produced some of the mildest onions in the world. This is borne out by the prices received for Vidalia onions, which sold for \$27.10/cwt (\$0.60/kg) in 1999 compared to the range of \$5.53/cwt to \$24.40/cwt (\$0.12/kg to \$0.54/kg) for spring and summer nonstorage onions produced in other states (USDA, 2000).

Conclusions

The Vidalia onion industry has been quite successful particularly in the last 10 to 12 years. The adoption of CA storage, which has extended the marketing window, federal/state recognition and protection, and check-off funds resulting in increased advertising and name recognition have all contributed to the success and

growth of the industry.

The Vidalia onion industry continues to evolve and address new problems. The industry faces increased competition not only from other states but also from South American production. South American production costs are much lower than Georgia's and this poses a serious threat to the continued growth and success of the Vidalia onion industry. Researching and developing new production methods that reduce costs are high priorities.

The development of improved varieties and the evaluation of Japanese overwintering onions continues to be important issues. Disease resistance, quality parameters (particularly mild flavor), yield, and harvest dates are the major parameters currently being addressed by the seed companies.

The success of CA storage has been, at times, inconsistent and below original expectations. Botrytis neck rot, and other storage diseases, can be serious problems in some years. Research on identifying diseased onions before they enter storage is underway.

Disease control, particularly, those caused by bacteria, continues to be a concern. New varieties and new methods of control need to be developed to help minimize losses from bacterial diseases.

The Vidalia onion industry has been a great success in an agricultural economy that has faced many setbacks in recent years. Consistent production of some of the mildest onions in the world has allowed this industry to grow, prosper, and command a premium in the market. Finally, although there are a number of challenges facing the industry, the future appears bright.

Literature cited

- Augusti, K.T. 2000. The role of garlic and onions in health management. *Alliums 2000*. 3rd Intl. Symp. Edible Alliaceae. 29 Oct–3 Nov. 2000. p. 19.
- Boyhan, G.E., D.M. Granberry, and W.T. Kelley. 1999. Green onions. Univ. Ga. College Agr. Environ. Sci. Circ. 821.
- Boyhan, G.E., D.M. Granberry, and W.T. Kelley (eds.). 2001. Onion production guide. Univ. Ga. College Agr. Environ. Sci. Bul. 801.
- Brewster, J.L. 1994. Onions and other vegetable alliums. CAB Intl., Wallingford, UK.
- Georgia Department of Agriculture. 2001. Rules of Georgia Department of Agriculture. Chapter 40-7-8. Additional regulations applicable to Vidalia onions. Ga. Dept. of Agr., Atlanta.
- Goldman, I.L. and M.J. Havey. 1998. History and pedigree of public onion releases in the United States. Proc. 1998 National Onion (and other Alliums) Res. Conf., Sacramento, Calif. 10–12 Dec. 1998. p. 25–34.
- Granberry, D.M., D. Smittle, W. McLaurin, and R.L. Shewfelt. 1987. The effects of calcium sulfate on leaf and bulb tissue, sulfur content and on pungency of the Vidalia onion. Proc. Natl. Onion Res. Conf. 10–11 Dec. 1987. p. 27–32.
- Lacy, M.L. and J.W. Lorbeer. 1995. Botrytis neck rot, p. 18–19. In: H.F. Schwartz and S.K. Mohan (eds.). *Compendium of garlic and onion diseases*. API Press, St. Paul, Minn.
- Richter, H. 2000. Fresh produce guide. Try-Foods Intl., Apopka, Fla.
- Simmonds, N.W. 1979. Principles of crop improvement. Longman Inc., New York.
- Univ. of Georgia. 2000. 2000 Vegetable acreage estimates. Univ. Ga., Athens.
- U.S. Department of Agriculture. 1989. Marketing order: Vidalia onions grown in Georgia. Code Fed. Regulat., Chapter IX, Part 955. USDA, Wash., D.C.
- U.S. Department of Agriculture. 1995. U.S. standards for grades of Bermuda-granex-grano type onions. USDA, Wash., D.C.
- U.S. Department of Agriculture. 2000. Vegetables 1999 summary, p. 31–34. USDA, Wash., D.C.
- U.S. Department of Agriculture. 2001. Georgia crop estimates. USDA Natl. Agr. Stat. Serv., Wash., D.C.
- Wall, M.M. and J.N. Corgan. 1992. Relationship between pyruvate analysis and flavor perception for onion pungency determination. *HortScience* 27:1029–1030.

Table 2. Estimated costs and return on producing a 40-lb (18.1-kg) box of Vidalia onions.

Parameter	\$
Preharvest variable cost per box	2.55
Harvest and marketing cost per box	3.68
Fixed costs per box	0.63
Total budgeted cost per box	6.86
USDA National Agricultural Statistics Service estimated return per box	10.84
Net profit	3.98