CROP PROFILE FOR **Cowpeas** IN GEORGIA

UGA extension

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Production Facts

Georgia ranks in the nation's top 10 in cowpea (southern pea, Vigna unguiculata) production, with estimates of more than 4,900 acres grown in approximately 49 of 159 counties in the state in the 2014 production season. Colquitt County, located in southwest Georgia, leads the state in production with 1,900 acres. According to a 2014 U.S. Department of Agriculture census, there were 19,289 total acres of cowpeas harvested in the U.S., with Georgia ranking fifth nationally. However, the census of agriculture likely underestimates production, as other sources put production in the Unites States between 60,000 and 80,000 acres (Quinn and Myers, 2002). Cowpeas are one of the few dry beans traditionally produced in the southern United States. The majority of dry bean production occurs in the upper-Midwestern United States, with North Dakota producing more than 30 percent of dry beans in the United States out of approximately 1.8 to 2 million acres of beans (http://www.usdrybeans.com/resources/production/production-facts/). Although large numbers of small farmers produce cowpeas for fresh market sales, the majority of commercial acres are devoted to frozen or processed cowpeas.

Typical yields for shelled peas range from 1,000 to 2,000 pounds per acre, depending on variety and whether they are machine or hand harvested, while green pod yields are typically 2,500 to 4,000 pounds per acre (Brandenberger et al., 2007). Cowpeas are often sold shelled in 10 lb plastic bags, which are the rough equivalent of a shelled bushel. A USDA bushel of green peas in the hulls is approximately 25 pounds (Perkins-Veazie and Buckely, 2014).

Production costs for machine-harvested cowpeas are typically $350 per acre with an additional $750 per acre for harvests and marketing costs (University of Kentucky, 2012). Although prices vary depending on market, an average of $1.30 per pound is often used when developing budgets for machine-harvested cowpeas. Assuming a yield of 1,500 pounds per acre, most budgets estimate a return of approximately $1,000 to $1,500 per acre above variable costs and a total return approaching $3,000 per acre (Clemson University estimates, 2016). Using these estimates, the value of the cowpea industry in Georgia is approximately $9.9 million.

Most cowpeas are sold domestically, particularly in the Southern United States, where they are commonly consumed as part of the region's traditional diet.

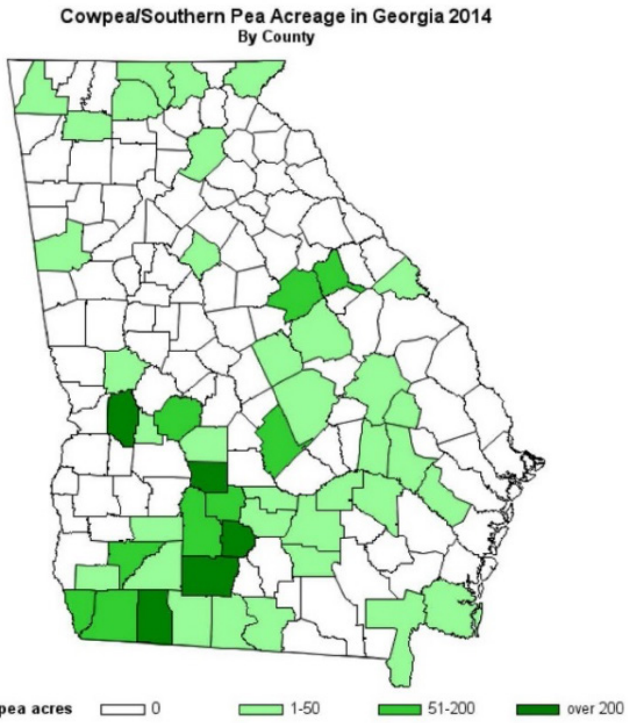

Figure 1. Cowpea/Southern Pea acreage in Georgia, 2014, by county.
Sources: D. Riley (mapping) and 2014 Georgia Farm Gate

Production Areas

Much of the commercial production of cowpea in Georgia occurs in the southwestern portion of the state. As described previously, Colquitt County is the leading county in the state with nearly 1,900 acres grown. Crisp County is ranked second with 758 acres, followed by Tift County with 520 acres. Marion, Grady, Worth, Seminole, and Decatur counties contribute another 893 acres of production. The plantings in these counties are typically machine-harvested on a large scale and sold in the wholesale market, namely, to a processing facility. Additional commercial acreage is also grown in eastern Georgia. Most of the remaining acres in the northern region of the state are sold for fresh market or retail and are generally harvested by hand.

Production Practices

Cowpeas are well adapted to grow under dry conditions. However, most commercial acreage in southwest Georgia is grown with irrigation, and the majority of that acreage is irrigated using a center-pivot system, which waters crops using sprinkler equipment that rotates from a midpoint. Planting dates vary, but in southern Georgia, dates range from mid-March for a spring planting to late August for a fall planting. Because of their adaptability to heat, cowpeas will set seed even under the high of mid-summer when other horticultural beans may suffer due to poor pollination. Typically, it is suggested that growers wait until soil temperatures reach 60 oF to plant, otherwise seeds may germinate poorly. In Georgia, plants are usually seeded at four to six seed per foot for bush types and two to four seed per foot for vining types. Seed are usually planted ¾ to 1¼ inches deep. Most rows are spaced 30 or 36 inches apart.

Due to their adaptability, cowpeas can be grown on relatively poor soils and need minimum fertility. Generally, growers will apply no more than 40 to 50 lb/acre of nitrogen to produce a crop. Excessive nitrogen applications can cause excessive growth, render harvest difficult, and increase disease susceptibility. Cowpeas can be successfully grown in conventional or conservation tillage. The tillage regime is usually dependent on the other crops that will be grown in rotation with the cowpeas.

As a legume, cowpeas are excellent rotation partners for a wide range of vegetables as well as traditional agronomic crops. All cowpeas are direct seeded, and most are machine-harvested. “Fresh frozen” peas are often machine-harvested when partially dry and rehydrated before packaging and cooling. Unlike very labor intensive vegetable crops, virtually no hand labor is used for cowpea harvest except for small you-pick acreage or household plantings. Thus, for commercial production, re-entry intervals (REIs) of pesticides are not a significant concern.

It should also be noted that growers routinely use cowpeas as warm-season cover crops. The ‘Iron and Clay’ mix of cowpeas have become very popular for growers looking to put in a drought-tolerant, nitrogen-fixing, summer cover crop. Although they may be harvested for seeds to be replanted for feed plots or cover crops, these are generally not harvested for commercial edible production.

Cowpeas are afflicted by various pests in Georgia, most notably the cowpea curculio, which can be production limiting. This insect pest is fairly widespread, but not all production sites experience the same degree of crop damage on any given year or production season. For example, certain fall plantings of cowpea can experience less damage, even if located in a historically cowpea-curculio-infested region.

For Georgia, the general ranking of pest categories by importance from high to low is: one, insects; two, plant pathogens; and three, weeds, mainly due to the perceived ease of control with registered pesticides. This crop seems to be amenable to more biologically based pest management in the absence of key pests like the cowpea curculio. The following is a brief summary of the major pests of cowpea in Georgia.

Pests

Insects

The following insects are ranked from the most important and common pests in Georgia, with an emphasis on southern Georgia, where the majority of the production occurs. All insect pests but the cowpea curculio, have satisfactory control options available to growers. The cowpea curculio is the main production-limiting key pest where it occurs in the Southeastern United States.

Cowpea curculio, *Chalcodermus aeneus* (Coleoptera), is a weevil (Figure 2), that seems to have originated from the Caribbean and Central American regions. It has been reported as the major pest of southern peas where it occurs in the Southeastern United States for well over a century. The distribution of the weevil in the Southeast has been reported roughly in the triangle from southern Texas to North Carolina and south to Florida.

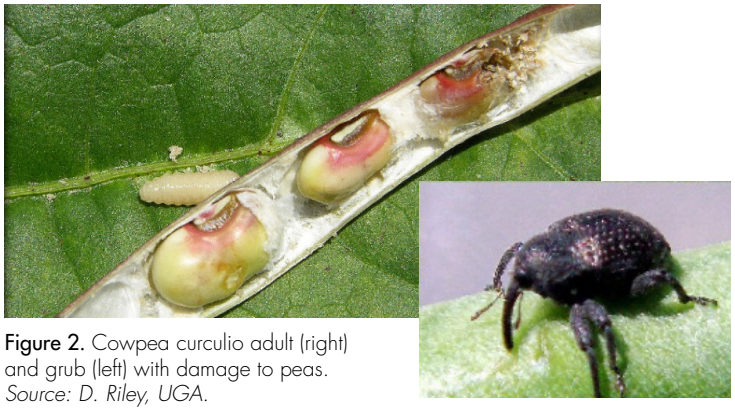

Figure 2. Cowpea curculio adult (right) and grub (left) with damage to peas. *Source: D. Riley, UGA.*

However, with the tremendous decline in southern pea acreage over the last 50 years, the distribution of this weevil is more scattered and tends to be reported more in traditional southern pea production areas of Alabama, Georgia, and South Carolina in recent years. Both larval and adult feeding causes damage to the pea and can make it unmarketable. Feeding and egg laying occurs in the developing pods producing a distinct, dark spot lesion or "sting" on the outside of the pod. Heavy feeding by adults can reduce the amount of flowering, therefore suppressing fruit set in the crop. The grub develops inside of the pod, feeding directly on the seeds and producing frass (insect excrement) inside of the pod (Figure 2). As much as 40 to 60 percent yield loss can be typical (Arant, 1938). The main cowpea plant resistance trait has been the thickness of the pod wall, such as in 'Green Acre' varieties, which also have a small pea and lower shell-out weights than a black-eyed pea or pink-eyed purple hull (Chalfant, 1997). Our recent data indicated that as little as 10 percent of "stung" peas resulted in losses of 42.6 bushels per acre based on an average of 150 bushels per acre expected yield. Above 30 percent of "stung" peas resulted in no marketable southern pea yield. The main control is frequent foliar sprays of pyrethroid insecticides, beginning at first bloom through harvest, so pollinators can be negatively affected. Currently, there are no labeled insecticides that provide adequate control if the curculio infestation is heavy. The only partially effective biological control tested to date has been *Beauvaria bassiana* commercial fungal sprays drenched into the soil during the soil phase of the curculio, but it is applied after harvest and after the damage has already occurred (Riley, unpublished data). For this reason, acreage is currently declining in heavily affected areas, and production is moving to regions that don't currently have curculios present. Unfortunately, curculios have been documented to establish throughout Georgia and across all Southeastern states if cowpeas are grown consistently in high acreage.

Stink bugs, specifically Southern green stink bug, *Nezara viridula*, and brown stink bug, *Euschistus servus* (Hemiptera), are common pests of cowpeas, feeding mainly on the pods during seed development (Figure 3). The external damage appears as a small lesion or "sting," smaller than that caused by the curculio, and the internal damage results in reduced seed weights, but no frass will be present. Stink bugs are highly seasonal and only cause significant damage when they occur in high numbers for short periods during the spring and

summer. Stink bugs are relatively easy to control with insecticides, which can be timed to scouting reports, eliminating any need for calendar sprays. Thus, the impact of control on pollinators can be much less than for curculio spray programs. Southern green stink bugs reach damaging levels at 4 stink bugs foot of row of southern peas in Georgia (Nilakhe *et al.*, 1981). Brown stink bugs are very common in cowpeas and according to McPherson (1982), two subspecies of E. servus exist, with *E. s. servus* (Say) being the most important in the Southeast. Brown stink bug can emerge as early as March in the Southeast. After wheat is harvested and *E. servus* moves to corn, it has already completed a generation, typically completing two generations a year (Herbert and Toews, 2012). Biological control is generally not used for these insects in cowpeas.

Figure 3. Southern green stink bug (left) and brown stink bug (right). *Source: Bugwood.*

Figure 4. Beet armyworm on pigweed. *Source: UT Crops.com.*

Armyworms, *Spodoptera* spp. (Lepidoptera), and in particular, beet armyworm, *S. exigua*, can cause noticeable damage to the foliage of cowpeas, generally during the summer (Figure 4). It has not been documented whether armyworm damage actually results in significant yield loss because the cowpea plant tends to compensate for some foliar damage, but the assumption is that the treatment threshold is around 15 percent foliage loss from two weeks prior to flowering and until pods have filled, similar to what is recommended for soybean. Thus, scouting and the limited use of insecticides greatly reduce possible negative impacts of insecticide sprays on pollinators. *Bacillus thuringiensis* insecticides can further reduce impacts on beneficial arthropods in the cowpea crop.

Figure 5. Cowpea weevil, stored dry seed pest. *Source: D. Riley, UGA.*

Cowpea weevil, *Callosobruchus maculatus* (Coleoptera), is a stored-grain pest of cowpea that only affects the dried cowpea seed in Georgia, not the fresh frozen product or any field production (Figure 5). Thus, there are currently no field recommendations for control. Storing dried seed at near-freezing temperatures can eliminate the weevil in the seed bags.

Other insects that can cause damage to the plant, but generally occur in low levels, are the banded cucumber beetle, *Diabrotica balteata* (Coleoptera) which is a defoliating pest; kudzu bug, *Megacopta cribraria* (Hemiptera), which can feed on stems and pods like stink bugs; cowpea aphid, *Aphis craccivora* (Hemiptera), which can transmit mosaic viruses and rarely cause damage on their own without the virus; leafhoppers, *Empoasca* spp. (Hemiptera), a sporadic pest; corn earworm, *Helicoverpa zea* (Lepidoptera), which rarely causes problems in cowpeas in Georgia; American serpentine leafminer, *Liriomyza trifolii* (Diptera), which causes mining in the leaves, but rarely warrants control in Georgia; and chrysomelid beetle, *Cerotoma ruficornis* (Coleoptera), which is sporadic.

Disease Agents

The cowpea plant pathogens (Patel, 1985) listed here are ranked from the most important and common diseases in Georgia, with an emphasis on southern Georgia, where the majority of the production occurs. Most pathogens currently have good chemical control options in Georgia cowpeas.

Figure 6. Cercospera leaf spot.
Source: ICAR Research Complex, India.

Cercospora leaf spot (*Mycosphaerella cruenta*) causes circular leaf spots that are not generally restricted by veins (Figure 6). Lesions often have light-brown to gray centers with a reddish border. In time, chlorosis of the entire leaf occurs and blighted areas coalesce to become necrotic. The primary source of inoculum is crop debris or susceptible legumes in the region, as spores are airborne. Although there are effective fungicides available, the low profit margin of cowpeas makes the use of fungicide an unattractive option in Georgia.

Figure 7. Choanephora pod rot.
Source: Bugwood.

Choanephora pod rot (*Choanephora cucurbitarum*) generally follows cowpea curculio or other physical damage on the pods. Initial symptoms are darkened, water-soaked lesions on the pots (Figure 7). In time, developing seeds and the entire pod succumb to a rather wet, slimy rot. Fungal hyphae will develop and produce dark sporangia and sporangiospores, giving the infected area a "fuzzy" appearance. The disease is similar to Choanephora rot of squash and other cucurbits. Damage by cowpea curculio predispose the pods for *Choanephora* infection. Hence, curculio management helps in managing this pathogen.

Cowpea mosaic virus can be seedborne and transmitted mechanically by aphids. The virus has a wide host range and infects many members of the Chenopodiaceae and Fabaceae families. Symptom expression can vary depending on the host infected. In cowpea symptoms are typical of those caused by mosaic viruses, namely chlorotic spots with rings. When severe, leaf distortion, necrosis, and plant collapse can occur. Some varieties develop necrotic local lesions. No widespread outbreaks of the virus have been observed in recent years, so no current control actions have been needed.

Bacterial blight and canker of cowpea (*Xanthomonas axonopodis* pv. *vignicola*) symptoms range from angular, vein-restricted lesions to large wedge- or pie-shaped blighted areas that extend to the leaf margin. Lesions often have a chlorotic (yellowing) halo. Infections produce abundant levels of ethylene, which leads to leaf abscission (shedding) and defoliation (loss of aboveground plant material). In Georgia, the cream and crowder types are more prone to developing stem cankers and plant lodging. The primary source of inoculum is contaminated seed. This was of major importance when Georgia growers produced their own seed, as regional environmental conditions favored seedborne development.

Southern blight (*Sclerotium rolfsii*) is a soilborne fungus that has an extremely wide host range, at greater than 500 plant species. The fungus is favored by warm, humid, or wet conditions. Infections generally occur in lower stems near the soil surface. Soft rot symptoms develop, and the fungus girdles the stem. Infected plants wilt, lodge, and eventually die. Characteristic signs of infection include a fluffy, white mycelial mat and the presence of mustard-seed like sclerotia clustering on infected tissues.

Rhizoctonia stem canker or damp-off is another soilborne fungus favored by warm, wet conditions. In Georgia, *Rhizoctonia* is generally associated with damping-off of young seedlings. In older plants, reddish-brown stem cankers can appear and can result in plant lodging.

Other diseases to look out for include root-knot nematodes, *Meloidogyne* spp.; cowpea severe mosaic virus; anthracnose; Colletotrichum; Fusarium wilt, *Fusarium oxysporum*; cowpea chlorotic mottle virus; Pythium stem rot, Pythium spp.; Pod rot, Botrytis spp.; Septoria leaf spot, *Septoria* spp.; Rust, *Uromyces appendiculatus*; Powdery mildew, *Ersyphe polygoni*; and target spot, *Corynespora cassicola*.

Weeds

Weeds are a major pest group of any vegetable crops, and cowpeas grown as vegetable crops are no exceptions. Since cowpeas are typically grown in bareground production systems during the warmest part of the year, similar to snap beans, the types of weeds affecting cowpeas are similar to the weed complex in other summer legume crops in the Southeastern United States. These include morning glory, pigweed, nutsedge, sicklepod (Figure 8), and others. Growers usually cultivate southern peas until the plants become too large to pass easily through the cultivator. Later in the growing season, if weed control is still needed, herbicides become the main tool for weed management. Weed management of grasses and broadleaf weed species are common, but yellow nutsedge and larger-seeded broad leaves might be needed. A pictorial guide to common weeds can be found at http://nfbfg.ifas.ufl.edu/documents/WeedsoftheSouthernUnitedStates.pdf, accessed April 2017. The months of cowpea production tend to be between April and October, so winter weeds are almost never an issue. For specific recommendations beans for the Southeast, see the "Crop Profile for Beans (Snap) in Georgia" at https://ipmdata.ipmcenters.org/documents/cropprofiles/GAsnapbeans.pdf

Figure 8. Sicklepod in abandoned cowpea field.

Chemical Controls

Review pesticides recommended for insect, disease and weed management in the *Georgia Pest Management Handbook*, available at http://www.caes.uga.edu/departments/entomology/extension/pest-management-handbook.html, accessed April 2017.

Biological Controls

The only biological controls that might be useful for cowpea pest management are the use of foliar-sprayed *Bacillus thuringiensis* products for the control of Lepidopteran foliage feeders, such as armyworms, and post-harvest soil treatment with the fungal insecticide *Beauveria bassiana* strain gha products to reduce the survival of cowpea curculio stages in the soil phase (late instar larvae, pupae and newly emerged adults). Even though recent research shows there may be some promise to biological control techniques, neither of the above biological controls has been proven using commercial-sized plots and a partial budget analysis to be economically viable in the current cowpea production regions of the Southeast. Insecticides, such as pyrethroids, that are harsh on beneficial soil arthropods like predacious ants and beetles, should be avoided because they may increase the survival of cowpea curculio stages in the soil phase.

Cultural Controls

Planting dates and resistant varieties are the main cultural practices with potential to reduce pest pressure on southern peas. Planting dates can affect the types of weeds present in the crop and can potentially affect the impact of insects and diseases. For example, morning glory and nutsedge are generally more prevalent in the late summer than in the early spring. Cowpea growers have observed less damage from cowpea curculio in the fall, even though the populations of cowpea curculio are always higher in August than in late spring. This is likely due to the weevil going into diapause, which limits reproduction in the pods (Riley, unpublished data). Host-plant resistance to viruses (e.g., cowpea mosaic virus, cowpea severe mosaic virus, cowpea aphid-borne mosaic virus, cowpea chlorotic mottle virus) is critical to production in many parts of the world (Hampton et al. 1997, Lima et al. 2011). Fortunately, we typically don't see mosaic viruses affecting cowpeas in the field in Georgia, so resistant cultivars are not needed. Cowpea resistance mechanisms to the cowpea curculio have included pod-wall thickness (Cuthbert and Fery 1975), pod-wall toughness (Chambliss and Rymal 1980), and volatile substances that affect curculio behavior (Chambliss and Rymal 1982), but these were never proven to be economically viable. The newest approach to host-plant resistance in *V. unguiculata* is through the development of genetically modified (GM) organisms. Genetic engineering has been used to transfer the gene coding for the α-amylase inhibitor α AI-1, a bruchid beetle resistance factor from the common bean (*Phaseolus vulgaris* L.), into other grain legumes including pea (*Pisum sativum* L.), azuki bean (*Vigna angularis* or Wildenow), chickpea (*Cicer arietinum* L.) and cowpea (Lüthi *et al.*, 2013). α –Amylases are important enzymes for starch digestion and have been shown to be vital for weevil development (Napoleão *et al.*, 2013). Recently, a GM line expressing high amylase inhibitor effects was developed by Higgins et al. (2013). However, this line has not been reported to be tested against the cowpea curculio.

Physical and Post-Harvest Controls

Figure 9. Cowpea curculio in packing house trash bin.

The only physical control program that is potentially relevant for the cowpea is the destruction of pest-contaminated residue. This is true in cases where cowpeas are being mechanically harvested, and pests like the cowpea curculio are prevalent in the post-harvest trash produced after peas are cleaned and bagged (Figure 9). In this case, the recommended practice would be to burn the residue to try to eliminate the weevils coming out of this material, which serves as a pest source for subsequent plantings of the crop. This also pertains to post-harvest pest control activities to try to reduce overwintering sources of pests and pest-contaminated residue. Post-harvest controls for cowpea

curculio include the physical elimination of residue, but without controlling the post-harvest curculios that have entered the soil, the benefit of this approach is very limited for reduction of this field pest. The stored seed post-harvest pest that can require treatment in Georgia is the cowpea weevil. As previously stated, storing dried seed at near freezing temperatures can eliminate the weevil in the seed bags. Fumigation is rarely used.

Alternative Controls

For extremely difficult-to-control, production-limiting pests, like the cowpea curculio, the eventual goal is to conduct regional eradication programs. However, this would require more effective pest management tools and greater cowpea grower coordination than is presently available to attempt such an approach in Georgia. Regional coordination and support for cowpea pest management is needed.

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