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Sampling of the cowpea curculio, *Chalcodermus aeneus*, with traps in southern peas

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ABSTRACT

The cowpea curculio, *Chalcodermus aeneus* (Boheman) (Coleoptera: Curculionidae), is the key pest of southern pea or cowpea, *Vigna unguiculata* (L.), in Georgia and elsewhere in the southeastern USA. There has never been an effective trapping method reported for this pest. We developed a modified Tedder's trap that was tested against standard boll weevil traps and yellow sticky traps. The new trap detected *C. aeneus* adults earlier and in greater numbers than the other trapping methods. The new trap was used to monitor weekly movement of *C. aeneus* adults for two annual cycles in 2012 and 2013 at multiple locations. The detection of adults was consistent with early spring movement from overwintering sites followed by a summer generation and a fall generation. No adults were collected in traps from the end of December to the end of March. The temporal distribution of *C. aeneus* in traps over the season suggests three distinct periods of adult activity from mid-April to mid-June, late-July to early-October and then mid-November to mid-December. The utility of monitoring *C. aeneus* for regional management strategies is discussed.

1. Introduction

The cowpea curculio, *Chalcodermus aeneus* (Boheman) (Coleoptera: Curculionidae), is the key pest of southern peas or cowpea, *Vigna unguiculata* (L.) in the southeastern USA (Chalfant 1985). One of the earliest mentions of weevils attacking cowpea in the USA was in Kansas with reference to the cowpea weevil (TenEyck and Call 1909). However, it is not clear if this was *Callosobruchus maculatus* (Fabricius) if the currently approved ESA common name was used correctly, or *C. aeneus*. Ainslie (1910) clearly places the distribution of *C. aeneus* in the USA in 1910 in eastern Texas, Louisiana, Alabama, Florida, Georgia, South Carolina, North Carolina, and less frequently in Oklahoma, Maryland, and Missouri, stating that, "the distribution of this weevil probably coincides with that of the cowpea". The one clear exception to this statement was the lack of *C. aeneus* in California where cowpeas were grown by 1920 (Morse 1920) yet this pest has never been reported as a problem in California (Hall and Frate 1996). More recently, the distribution of *C. aeneus* has been summarized for Latin America: México, Belize, Guatemala, Honduras, and Nicaragua (Jean-Michel and O'Brien 1990), and for *Chalcodermus* sp. in Brazil and Jamaica (Daoust et al. 1985). One thing is clear from these reports; where it occurs, *C. aeneus* has always been a key pest of southern peas.

The cowpea curculio is a small (4.8–5.5 mm in length), shiny, dark weevil with deeply pitted elytra and punctate thorax. The life cycle for this insect is approximately 30–40 days from egg to adult (Capinera 2001). Adults feed on the pods and oviposit on pods or directly into the seed through the pod wall. The egg hatches within the pod and the larva goes through four developmental instars as it feeds on the peas causing severe damage. The 4th instar reaches a length of 7 mm and then chews out of the pod, falling to the ground, and burrowing 2.5–7.6 cm into the soil where it creates a pupal cell in the soil and pupates. The duration of the pupal stage is 5 to 19 days, at which time the non-overwintering adults emerge from the soil, mate, and begin laying eggs in the same or subsequent southern pea plantings (Arant 1938). If green peas are harvested before the larva exits the pod, the grubs become a contaminant in mechanically harvested peas, which causes further quality loss besides the direct loss of marketable peas. The main management tactic for the control of this pest is the use of insecticides applied twice weekly during the pod development stage of the crop. Destruction of alternate or overwintering hosts or crop residue has been the main cultural control recommended and no effective commercial biological controls have been demonstrated (Capinera 2001). In Georgia, both destruction of crop residue and rotation away from heavily infested sites have been emphasized, but the efficacy of these recommendations has not been quantified.

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Vigna unguiculata is a drought-tolerant (Ewansiha and Singh 2006), economically important (Coolong et al. 2012), and highly nutritious crop (Ng and Marechal 1985). In Georgia, southern pea acreage was 57,465 ha in 1951 with a price of $4/bushel (Anon, 1957). This acreage declined to a low of 1,745 ha in 1997 despite higher prices (Adams and Riley 1997). Cowpeas are produced primarily as a food crop and the inability to consistently control the cowpea curculio is one of the main reasons for the decline in fresh frozen pea production. There is a near zero tolerance for curculio-infested peas in the frozen pack process (C.T. Harvey, Fresh Frozen Inc., personal communication). The number of cowpea hectares in Georgia have increased from 2,146 in 2007, to 2,779 in 2008, and 3,299 in 2009 (Anon, 2010). Prices paid to growers for cowpeas have increased from ~$0.19/0.454 kg (lb) of shelled fresh southern peas in 1975 to $0.30 in 2008 and then to $0.50 in 2014 (C.T. Harvey, Fresh Frozen Inc., personal communication). The farm gate value of the crop in 2009 in Georgia was over $12 million (Anon, 2010). With the increased acreage and demand for southern peas, have come increased concerns of *C. aeneus* damage. In 2010 and 2011, multiple consultant reports of *C. aeneus* outbreaks and field control failures were the incentive to conduct new field tests on this key pest. Based on our recent field observations and previous studies (Chalfant 1996), *C. aeneus* tolerance to pyrethroid insecticides (N'Guessan and Chalfant 1990) is a potential problem in Georgia. Pyrethroids are currently the only effective labeled insecticides used against *C. aeneus* in Georgia (Sparks and Riley 2012).

The lack of a sampling method for *C. aeneus* that can detect movement of adults or that can quantify movement in the cowpea landscape has been lacking since the beginning of cowpea cultivation in the USA. We currently know that *C. aeneus* overwinters on various weed hosts such as the following: narrow-leaved vetch, *Vicia sativa* ssp. *nigra* (L.), purple cudweed, *Gnaphalium pupureum* L., heartwing sorrel, *Rumex hastatulus* L., cutleaf evening primrose *Oenothera laciniata* L., and moss verbena *Verbena tenuisecta* Briquet, as early as mid-April and seems to move into cowpeas by mid-May based on sampling date collected with sweep net and direct visual sampling of plants (Sudbrink et al. 1998). The potential for early outbreaks of *C. aeneus* could be assessed if an effective trapping method for adult movement could be developed, as has been done with other curculio species (Tedders and Wood 1994, Braman et al. 2003). In May and June, *C. aeneus* can reproduce on snapbean pods, *Phaseolus vulgaris* L., before southern pea plants bloom so nearby plantings of snap bean can exacerbate the problem. Later during the southern pea growing season *C. aeneus* can be found on sicklepod, *Senna obtusifolia* (L.). Cowpea curculio can also produce an overwintering generation on the beans of *Strophostyles* plants (Sudbrink et al. 1998). An effective trapping method could provide more efficient quantitative evidence of the movement and development of curculio populations in the landscape.

The objectives of this study were to develop an effective trapping method for *C. aeneus* adults and to use this method to detect possible adult movement. Boll weevil trapping and eradication programs indicate that *C. aeneus* can be collected in boll weevil traps (Jones and Williams 2001). Previous pepper weevil (*Anthonomus eugenii* Cano) trapping studies suggest that weevils can be captured on unbaited sticky traps (Riley and Schuster 1993). Thus, we compared standard boll weevil or Leggett traps (Leggett and Cross 1971) and a modified Tedders trap (Tedders and Wood 1994) to a simple, unbaited yellow sticky trap. The null hypothesis was that there would be no difference between traps. We then used the modified Tedders trap to survey *C. aeneus* activity across Tift County, Georgia in southern pea fields. We expected that initial trap counts in the spring would correspond to previously published dates of first *C. aeneus* activity in the southern pea crop in Georgia.

2. Materials and methods

2.1. Trap comparison

A new trap design was tested for early detection of *C. aeneus* in 2011 and 2013 at the University of Georgia Lang/Rigdon Farm located in Tifton, Georgia (Latitude 31.515864, Longitude −83.545132). The new *C. aeneus* trap design was modeled after the Tedders trap (Tedders and Wood 1994) (Fig. 1). The modification of the Tedders trap consisted of a standard Leggett style (Leggett and Cross 1971) boll weevil trap (Great Lakes IPM, Vestaburg, MI) baited with extended release 25 mg Grandlure baits (baits provided by the Boll Weevil Eradication Foundation of Georgia Inc., Quitman, GA; Grandlure EPA Pesticide Chemical Code 112404; (E)-(3,3- Dimethylcyclohexylidene) acetaldehyde; (Z)-(3,3-Dimethylcyclohexylidene)acetaldehyde). This trap was attached to the top of two, perpendicular, light yellow, 1-cm thick plastic corrugated triangular sheet fins (CorrugatedPlastics.Net, Hillsborough, NJ) measuring 122 cm × 122 cm × 55 cm base with a 1.5 m × 0.95 cm diameter iron rebar staked into the ground and tied with zip ties to withstand strong wind. In the trap comparison study, a standard Grandlure-baited boll weevil trap was compared with the modified Tedders trap described above and a non-baited 7.6 cm × 12.7 cm yellow sticky card (Great Lakes IPM, Vestaburg, MI) attached to the top of a 30 cm wooden stake. The non-baited sticky trap was similar to what was used in previous pepper weevil trapping studies (Riley and Schuster 1993). Grandlure baits were renewed monthly in the boll weevil and modified Tedders trap.

In 2011, the traps were adjacent to a newly planted southern pea field with 7.6 m between traps. The traps were arranged in a randomized complete block design for two experiments that consisted of 4 replicates each (8 total replications). In 2011, traps were placed in the field on 14 June. *C. aeneus* adults were counted from 17 June to 9 September at an average interval of 2.4 days (range 1–6 days). In 2013, the same trap designs used in 2011 were compared in a randomized complete block design containing 8 replicates located adjacent to a newly planted southern pea field. However, in 2013 we only used 2 m between traps and 60 m between replicates. This was to accommodate field operations. In 2013, traps were placed in

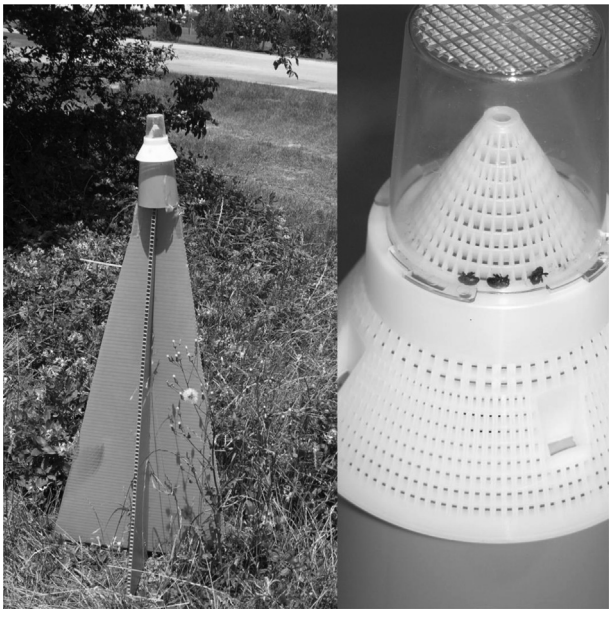

Fig. 1. Modified Tedders trap for *C. aeneus* adults baited with Grandlure (left) and close-up of captured *C. aeneus* adults (right).