Thrips Species Composition on Onions in the Vidalia Production Region of Georgia[1]

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Abstract Thrips are the key arthropod pest of onions in Georgia. Historically, this pest complex has been reported to consist primarily of tobacco thrips, *Frankliniella fusca* (Hinds), western flower thrips, *F. occidentalis* (Pergande), and onion thrips, *Thrips tabaci* Lindeman, with < 1% reported as onion thrips. Onion thrips, however, has become a greater concern in this region because this species is the primary vector of Iris Yellow Spot Virus (IYSV), which was detected in commercial fields in 2003, and both onion thrips and IYSV were detected in culled onions imported from Peru into the Vidalia region in 2003. Surveys were conducted from 2004 through 2010 in commercial onion fields in the 2 primary counties where Vidalia onions are produced to determine whether onion thrips were becoming more prominent within this region. From 2004 through 2006, *F. fusca* was the predominant pest species collected in this region. Onion thrips were detected and were widely distributed at levels within historical indications. In 2007, onion thrips were detected in commercial fields at levels well above historical levels, representing 49.4% of all pest thrips collected with samples exceeding 90% in some fields. This percentage has steadily declined since 2007, with onion thrips only 1.4% of the total pest thrips collected in 2010 and a maximum of 9.6% in any field. Several factors may have contributed to this shift in species composition including introduction of a more competitive biotype of onion thrips and insecticide resistance within the onion thrips.

Key Words Thysanoptera, *Thrips tabaci*, *Frankliniella fusca*, onions, vegetable IPM

Onions are a key economic vegetable crop in Georgia, with the majority of the crop sold at a premium as sweet Vidalia® Onions. Federal Marketing Order No. 955 and state law specify a region of production in southeast Georgia that is allowed to participate in this market. From 2000 through 2008, onion acreage in Georgia has varied from a low of 4,986 ha (12,322 acres) to a maximum of 7,056 ha (17,435 acres), with an average of about 6,030 ha (14,900 acres) annually (Boatright and McKissick 2009). In 2008, 4,986 ha (12,322 acres) were grown with a farm gate value in excess of 139 million dollars (Boatright and McKissick 2009). Whereas 13 counties and portions of 7 other counties may participate in this marketing order, 2 counties typically produce the majority of these onions. In 2008, Toombs and Tattnall counties grew 70.3% of the onion hectarage in Georgia (Boatright and McKissick 2009).

Onions have relatively few arthropod pests in Georgia, and thrips are the key pest (Sparks and Riley 2008). Thrips can occur in the crop from plant emergence in the seed beds until harvest; however, they are typically a late-season pest in Georgia,

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with populations building as temperatures rise near harvest time in March and April. Frequently, much of the crop escapes direct damage as bulbs mature before thrips populations build to damaging levels. In some years thrips populations increase early and can require multiple insecticide applications to prevent direct damage. In addition, the potential vectoring of a variety of diseases is of concern and leads to use of insecticides at levels well below typical thresholds for direct damage.

Historically, the thrips complex on onions in the Vidalia production region has been reported to consist of 3 species: tobacco thrips, *Frankliniella fusca* (Hinds), western flower thrips, *F. occidentalis* (Pergande), and onion thrips, *Thrips tabaci* Lindeman (Riley and Batal 1998). Of the 3 species, the onion thrips has been of little consequence in this region and reportedly constitutes less than 1% of the population (Riley and Batal 1998). Capinera (2001) indicated that whereas onion thrips is the most important insect pest of onion and is the dominant thrips species on onion in the USA, it is sometimes supplanted in the southeastern states by western flower thrips and possibly by tobacco thrips. Why onion thrips has not contributed more to the thrips complex in the Vidalia production region is unknown, but may result from competitive exclusion.

In the fall of 2003, Iris Yellow Spot Virus (IYSV) was detected in commercial onion fields in the Vidalia production region (Mullis et al. 2004). In addition, both IYSV and adult onion thrips were detected in culled onions that had been imported from Peru into packing sheds within the Vidalia production region. Onion thrips is the primary vector of this virus throughout the world (Cortes et al. 1998, Kritzman et al. 2001, Nagata et al. 1999). The culled onions were dumped into fallow fields near the shed, where they regrew tops, and presented a potential source of both virus and vector. With the introduction of both the virus and a potential new biotype of onion thrips, concerns existed that the introduced thrips might avoid or overcome the current unknown limiting factor for this species in the region and proliferate and readily spread IYSV, thus, representing a severe threat to the Vidalia onion industry. To monitor the potential establishment and spread of onion thrips within the Vidalia production region, commercial fields were sampled to determine the thrips complex composition over time.

Materials and Methods

Commercial onion fields were sampled within Toombs and Tattnall counties from Spring 2004 through Spring 2010. In each year, fields were selected that were scattered throughout these 2 counties. From 2004 through 2006, multiple fields were selected in each county and were sampled on multiple dates. Sampling conducted early in the year (January and February) typically provided little or no data as thrips populations are extremely low at that time in the season; these data are not included in this report. In 2004, 8 fields were sampled, with 4 in each county, with data from 3 dates (3 and 17 March, 7 April). In 2005, 10 commercial fields were sampled, with 5 fields in each county, over 5 dates (11 and 22 February, 14 March, 4 and 27 April). In 2006, 9 fields were sampled, with 4 in Toombs Co. and 5 in Tattnall Co. These fields were sampled 5 times (19 January, 7 and 27 February, 16 and 28 March). Results from the first 3 years of this monitoring program provided little indication that *T. tabaci* was emerging as a dominant species, and the program was modified to sample more fields, but with intentions of a single visit to each. Sampling was delayed until later in the season when thrips populations had increased and adults were easier to collect.

In 2007, 11 fields were sampled on 13 March. Based on the results from these fields, additional sampling of 18 fields from 2 through 10 April was conducted to further document an increase in *T. tabaci*. In 2008, 16 fields were sampled between 8 and 11 April. In 2009, 14 fields were sampled on 25 March. In 2010, 18 fields were sampled on 6 May.

In each field on each sample date, plants were visually observed for thrips and adults were aspirated off plants and placed in vials of alcohol. Each field was sampled for 30 min when populations were low to moderate. If thrips populations were high and adequate numbers of adults were collected, sample time was reduced. All thrips were transported to the laboratory for identification. Thrips were preliminarily identified and counted under a dissecting microscope. Subsamples of each species were slide mounted for verification. Voucher specimens were sent to the University of Georgia Museum of Natural History. Whereas multiple species were collected during this monitoring program, only the common pest species are included in this manuscript. These pest species represented over 97% of all thrips collected each year.

Results and Discussion

In the 7 years of this study, no western flower thrips were collected from commercial onion fields, and from 2004 - 2006, the thrips complex was predominantly tobacco thrips (Table 1). This was a change from the 23% *F. occidentalis* reported for onions in Georgia by Riley and Batal (1998), but even in that early survey *F. fusca* was the dominant species.

The first 3 years of the monitoring program provided data on onion thrips abundance similar to the reported historical occurrence, with a maximum of 1.6% in 2005 (Table 1). In 2005, onion thrips appeared widely dispersed in the region with detection of this species in 5 of the 10 fields (Table 2). Three fields had populations that slightly exceeded the reported historical average of less than 1%; however, detection within these fields was inconsistent across sample dates, and nearby fields frequently contained no onion thrips. Thus, it was assumed that these populations likely fell within the normal variation for this species and did not represent an increased contribution

Table 1. Composition of the thrips complex on onions in commercial production fields, by year, in the Vidalia production region of Georgia.

Year	Number of adult thrips collected			Percent of total, *T. tabaci*
	F. fusca	*F. occidentalis*	*T. tabaci*	
2004	608	0	1	< 0.1
2005	1568	0	26	1.6
2006	685	0	2	0.3
2007	711	0	694	49.4
2008	710	0	262	27.0
2009	590	0	123	17.3
2010	1552	0	22	1.4

Table 2. Composition of the thrips complex on onions in commercial production fields by county, field location, and date in Georgia.

	Percent *Thrips tabaci* (total number of pest thrips)				
Field location	2005*	March 2007	April 2007	2008	2009
			Toombs County		
North	1.2 (83)		10.0 (30)	8.8 (45)	
Central	0.0 (145)	40.0 (10)	10.3 (78)	3.2 (63)	44.8 (29)
Central	4.8 (125)	28.6 (14)	18.8 (32)	26.0 (77)	4.0 (50)
Central		8.3 (24)	8.8 (80)	68.6 (70)	52.3 (65)
South	0.0 (232)	44.4 (9)	6.1 (49)	43.1 (58)	1.9 (52)
South	0.0 (192)	0.0 (4)	25.5 (47)	9.6 (52)	11.6 (69)
South		0.0 (6)	38.9 (36)	1.8 (55)	22.6 (53)
South			17.1 (41)	58.0 (100)	10.7 (28)
South			92.3 (91)	1.3 (80)	45.7 (46)
			Tattnall County		
North		14.3 (14)	2.8 (71)	21.4 (56)	
North			0.0 (71)	0.0 (18)	
North			10.7 (75)		
Central	4.7 (148)	88.9 (27)	92.5 (133)	19.0 (42)	16.7 (30)
Central	0.0 (104)	81.8 (11)	96.7 (150)	83.3 (60)	18.6 (59)
Central			89.9 (79)	16.7 (84)	0.0 (58)
South	6.3 (158)	62.1 (37)	58.5 (41)	15.3 (59)	8.1 (62)
South	0.0 (214)	35.0 (20)	68.7 (67)	9.4 (53)	5.8 (52)
South	1.0 (193)		91.2 (57)		

*Number of thrips summed across five sample dates.

to the pest complex. This conclusion was supported in 2006, when only 2 onion thrips were collected.

The monitoring program was almost abandoned after 2006 because of the results indicating minor or no change in the thrips complex during the first 3 years. However, because of funding provided by the Vidalia Onion Committee, a modified monitoring program was conducted in 2007. Initial plans were to sample 8 - 10 fields near harvest time to verify the *status quo*. However, samples collected in March of 2007 detected onion thrips in 9 of 11 fields sampled, with onion thrips > 25% of the population in 7 of these fields and > 60% in 3 (Table 2). This was obviously well beyond the historical average and triggered additional sampling. In April, an additional 18 fields were sampled, and onion thrips were detected in all but 1 and were > 50% of the population in 7 fields (Table 2). The greatest concentration of onion thrips was detected in south and

central Tattnall Co., with onion thrips being the predominant species in all 6 fields sampled.

Results from 2007 prompted continued monitoring in 2008 and 2009. In these 2 years, onion thrips remained at levels well above the historical average, but appeared to decline relative to 2007 (Table 1). Onion thrips was widely distributed, with detections in 15 of 16 fields in 2008 and in 12 of 13 fields in 2009, but exceeded 25% of the population in only 5 of the 16 fields in 2008 and 3 of 13 fields in 2009 (Table 2). In 2009, onion thrips was the predominant species in only 1 field. This decline continued into 2010 with onion thrips detected in only 6 of 18 fields and only 1.4% of the total pest thrips collected (Table 1). Onion thrips exceeded 3% of the population in only 2 fields in 2010, with 9.6 and 7.5%. These 2 fields were both in Tattnall Co., but were more than 40 km apart, and the nearest sampled fields contained no onion thrips. Thus, the 2010 distribution and abundance of onion thrips appeared to be relatively low and random, similar to historical indications.

The results of this monitoring program indicated an obvious shift in the pest thrips complex. In the 7 years of this study, western flower thrips was not detected in any of the commercial onion fields, and the tobacco thrips was the predominant species. The last observation of large numbers of western flower thrips in Georgia onions was at a single location in Tift Co., which is outside the Vidalia production region, in 2000 when 65% of the adults sampled were western flower thrips (Riley 2001) but declined to only 9% the following year (Riley 2002). In the Vidalia region a major shift in species composition occurred in 2007, with a dramatic increase in onion thrips' contribution to the pest complex followed by a general decline since 2007, and onion thrips apparently returning to historical levels in 2010.

A combination of factors may have contributed to the observed trends. It is likely that a new biotype of the onion thrips established in this region. Genetic analyses of IYSV in the Vidalia region indicated that Peru is the most likely source of its introduction (Nischwitz et al. 2007). Likewise, genetic analyses of onion thrips from the Vidalia region after the population shift indicated a possible relationship to onion thrips from Peru (Babu Srinivasan, pers. comm.). Competition studies conducted with this thrips biotype have indicated the potential to successfully compete with the tobacco thrips (Chitturi 2010). Competitive exclusion by tobacco thrips is one possible explanation of the historical low contribution of onion thrips in this region and establishment of a more competitive biotype may have contributed to the observed population shift; however, the decline in onion thrips prevalence since 2007 would suggest other factors are involved. Insecticide resistance may have also played a role in the population shift. Organophosphate tolerance in the tobacco thrips and western flower thrips detected in the early 2000s (Riley 2001) resulted in a shift in insecticide use toward pyrethroid insecticides. Onion thrips is well known for pyrethroid resistance in much of its range (MacIntyre Allen et al. 2005, Martin et al. 2003, Shelton et al. 2006), and field trials conducted in the Vidalia region in 2007 verified poor performance against the onion thrips and continued good efficacy against tobacco thrips (Sparks 2008). In conjunction with this resistance, concerns over the potential impact of IYSV had lead to increased reliance on insecticides for control of the thrips vector in 2006 and 2007. Thus, the increased use of pyrethroid insecticides in the region may be partially responsible for the observed shift. In 2008, a decline in pyrethroid efficacy against tobacco thrips was noted in field trials (Sparks, unpubl. data) and this, in combination with reduced use of insecticides, may have removed part of the competitive advantage of the onion thrips and contributed to the shift toward the historical pest complex composition. More than likely, the observed shift is a result of the combination of these

factors, establishment of a new biotype of onion thrips, and insecticide use that favored this species.

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