HOST PLANTS OF BOLL WEEVIL ADULTS (COLEOPTERA: CURCULIONIDAE) IN THE MISSISSIPPI DELTA

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Abstract

Pollen types associated with boll weevils, *Anthonomus grandis grandis,* Boheman, were determined from adult boll weevils captured from March 1996 through January 1997 near Elizabeth (Washington Co.), Mississippi. Asteraceae pollen (sunflower family) dominated both the percentage of total pollen and the frequency of occurrence. Pollen from Asteraceae (62%) and Malvaceae (6%) represented the highest percentages of pollen grains recovered; whereas, Asteraceae (67%), Poaceae (45%), and Anacardiaceae (39%) pollen were found in the greatest number of samples. The number of pollen grains found in most samples was not evenly distributed among taxa that occurred within the samples.

Introduction

The boll weevil, *Anthonomus grandis grandis,* Boheman, is a destructive insect pest of cotton, *Gossypium hirsutum* C. Linnaeus, where it has not been eradicated. Over the last 30 years, much has been learned about the foraging resources of adult boll weevils. Cate and Skinner (1978) postulated that identification of pollen found in the boll weevil's gut could be used to determine the food sources of boll weevils. Rummel et al. (1978) used pollen analyses to verify that boll weevils seen feeding on yellow woolywhite (*Hymenopappus flavescens* A. Gray) (Asteraceae) actually ate yellow woolywhite pollen. Benedict et al. (1991) found pollen from 15 plant families in the guts of boll weevils captured in southern Texas and northeastern Mexico. Pollen from 24 species in 17 non-malvaceous families was identified in boll weevils captured in Brazos Co., TX (Jones 1997). Jones and Coppedge (1999) found pollen from 58 families, 97 genera and 46 species in 486 boll weevils captured at three different Texas locations.

Boll weevils active throughout the year cannot continuously forage on cotton, because cotton is not available year-round. Since boll weevils are primarily a pollen feeding insect (Cate and Skinner 1978), alternative pollen sources become important when cotton is not available (Jones et al. 1993). The purpose of this study is to determine the pollen types associated with boll weevil adults captured near Elizabeth (Washington Co.), Mississippi.

Materials and Methods

Adult boll weevils were captured in pheromone traps from March 1996 through January 1997 near Elizabeth (Washington Co.), MS. Hardee traps (Hardee et al. 1996) were placed on the east and west sides of a 10-ha cotton field, and at approximately 1.7 km intervals for 13 km along four lines radiating from the cotton field. Boll weevils were collected twice a week from March to September and once to biweekly from October to January (Hardee et al. 1999).

As many as ten boll weevils per trap per date were processed together (sample). Boll weevils were thoroughly rinsed, chemically reduced to a pollen residue (Hardee et al. 1999, Jones and Coppedge 1999), strained through a 450 μm screen, stained, and transferred to 2 dram vials. Vials were stirred well, and one drop of pollen residue was examined for pollen. Pollen identification was made using the USDA, Areawide Pest Management Research Unit (**APMRU**) Pollen Reference Collections.

Samples were combined into five sites: the cotton field (Core), and the four traplines: north (North), south (South), east (East), and west (West). Number of pollen grains per family was tallied monthly per site and re-totaled for a cumulative total (Jones and Coppedge 1999). Frequency of occurrence per family was calculated monthly and for a cumulative total (Jones and Coppedge 1999). One-way analysis of variance (**ANOVA**) was used to determine significant differences in the number of pollen grains among the sites and among the months. Species evenness was calculated using the modified Hill's ratio (Ludwig and Reynolds 1988). Evenness for three samples were assigned 0.0 because in the calculations the numerator was divided by 0.

Results and Discussion

Generally, a higher percentage of early-season samples (March, April, and May) contained pollen than did late season samples (November, December, and January) (Table 1). Significantly more pollen grains were encountered in samples collected during September than during other months ($F = 8.44$, df = 820, $P < 0.001$).

Overall percentage of pollen was dominated by Asteraceae pollen (Table 2). In addition, Asteraceae pollen dominated the percentage of pollen during the fall months (September, October, and November) and during January and March.

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Asteraceae pollen also occurred in more samples than any other plant family (Table 3). Although Malvaceae pollen (Fig. 3) occurred second in the overall percentage of pollen grains (Table 2), it was fifth in overall frequency of occurrence (Table 3).

Asteraceae pollen is commonly found in boll weevil samples (Benedict et al. 1991, Jones et al. 1993, Jones 1997, Jones and Coppedge 1999, Hardee et al. 1999). There are several reasons why Asteraceae pollen is frequently found in insect samples. First, it is usually easy to recognize to the family rank. Second, in most regions of the southern United States, Asteraceae species are in bloom throughout the year, even during winter months. Therefore, they are available as food when other plants are not. Finally, there are more species of Asteraceae in the southern United States than any other plant family. In Mississippi, there are approximately 300 Asteraceae species (Cronquist 1980), many of which (i.e., sunflower, goldenrod, and ragweed) have been previously reported in boll weevil studies (Benedict et al. 1991, Jones et al. 1993, Jones 1997, Jones and Coppedge 1999).

As species evenness values approach zero, a single species becomes more and more dominant (Ludwig and Reynolds 1988). Samples from the North trap line during April and the East trap line during April and May had the most even distribution of pollen grains (Table 4). Samples for those lines contained a few pollen grains that were divided into almost as many taxa as the number of pollen grains.

Summary

Pollen from a wide variety of plant families was found associated with boll weevils captured in Mississippi. How much foraging actually occurs on all of the pollen taxa identified is unknown. Although alternative food sources are not a factor in reproduction, they may be an important factor in boll weevil survival. Pollen from both entomophilous (insect-pollinated) and anemophilous (wind-pollinated) taxa contains many of the building blocks for life including proteins, amino acids, sugars, and other ingredients (Todd and Bretherick 1942, Stanley and Linskens 1974, Farag et al. 1978, Kauffeld 1980, Shuel 1992). In addition, pollen has a high vitamin content (Dadd 1973). Therefore, the food value available from pollen should supply adult boll weevils with the nutrients needed to survive regardless of the time of year. Feeding on pollen from non-cotton taxa may nutritionally enhance adult boll weevils and increase their life expectancy so that they can overwinter and "wait" until cotton is available. If this is true, knowledge of the non-cotton foraging resources and their role in boll weevil survival is necessary for improved management of the boll weevil eradication procedures.

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Table 1. Monthly and overall total of the numbers of samples, boll weevils examined, and identification, Elizabeth, Mississippi, 1996-1997.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
# samples												
Core	1	10	18	15	6	10	21	6	0	1	0	86
North	0	1	14	38	15	60	81	40	12	3	6	270
South	0	4	10	6	6	14	65	34	14	3	1	157
East	0	2	2	8	5	16	56	30	6	2	1	128
West	2	2	5	12	5	32	65	37	12	3	3	178
Total	3	19	49	79	37	132	288	147	44	12	11	821
# BW processed												
Core	1	30	119	38	15	31	155	67	0	1	0	457
North	0	1	49	160	31	489	750	331	62	14	26	1,913
South	0	4	17	6	12	25	477	260	79	18	2	900
East	0	2	3	10	5	72	425	203	34	11	1	766
West	2	2	10	19	8	122	528	280	67	3	4	1,045
Total	3	39	198	233	71	739	2,335	1,141	242	47	33	5,081
% with pollen*												
Core	100	100	94	100	83	88	95	67	0	100	0	92
North	0	100	93	84	93	98	86	90	83	67	33	83
South	0	100	100	50	100	86	91	79	64	100	0	77
East	0	100	50	88	80	83	96	63	50	100	100	81
West	100	100	100	92	100	78	89	78	83	33	67	84
Total	100	100	94	86	92	89	91	78	73	75	45	87
# pollen grains												
Core	3	321	1,017	543	21	133	3,157	113	--	5	--	5,313
North	--	5	349	1,992	369	1,782	10,740	573	116	129	7	16,062
South	--	41	173	28	114	117	4,557	500	96	95	0	5,721
East	--	9	10	53	52	491	7,676	295	43	16	1	8,646
West	13	37	79	82	65	343	4,193	518	165	1	2	5,498
Total	16	413	1,628	2,698	621	2,866	30,323	1,999	420	246	10	41,240

* Percentage is rounded off to the nearest whole number

Table 2. Monthly and cumulative percentage (Total) of total pollen grains (rounded to nearest whole number) of plant families with a percentage greater than 15%.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
Asteraceae	63	8	5	5	15	17	77	61	44	7	40	62
Brassicaceae		1	1	1	1			1	1	59		1
Caprifoliaceae			1	33	43	11						4
Euphorbiaceae		1				1	1	1	5	23		1
Fagaceae	6	29	26	5	2	3	1	1				2
Malvaceae				1	15	12	7	3				6
Poaceae		15	23	13	6	22	2	4	16	4	20	5
Scrophulariaceae				17	1	1						1

Table 3. Monthly and cumulative (Total) frequency of occurrence* for plant families occurring in 50% or more of the samples during at least one month.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
Anacardiaceae			48	27	1	17	67	47	13			38
Asteraceae	100	57	59	69	4	28	95	88	78	56	80	67
Cheno-Am**		21	15	15	2	21	59	31	38		20	34
Fagaceae	33	89	74	66	3	18	6	1				20
Malvaceae				12	4	25	50	15				27
Oleaceae		42	50	31	1	6	3					9
Poaceae		21	78	79	7	37	44	27	59	22	40	45
Salicaceae		63	43	31	1	7	4		9		20	10

* Frequency of occurrence values are not additive because pollen from the same family can occur in many samples.
** No differentiation was made between Chenopodiaceae and *Amaranthu*s pollen grains.

Table 4. Monthly and cumulative totals for species evenness by site (Core, North, South, East, and West).

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
Core	0.0*	0.1	0.1	0.2	0.4	0.2	0.2	0.2	--	0.6	--	0.1
North	--	1.5	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.8	0.8	0.1
South	--	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.0*	0.1
East	--	1.9	2.0	0.4	0.2	0.1	0.2	0.1	0.3	0.2	--	0.2
West	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.3	--	0.0*	0.2
Total	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.8	0.1

* Due to the calculations in the modified Hill's ratio (division by 0) these samples were assigned 0.0