POLLEN FEEDING IN BOLL WEEVILS

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Abstract

Overwintering adult boll weevils were captured in pheromone traps in Brazos Co., TX, between February and May 1999. Collected boll weevils were starved for 50-58 hours, then allowed to feed freely for 24 hours on catkins or flowers of mossy-cup oak (*Quercus macrocarpa* A. Michaux), dandelion [*Taraxacum laevigatum* (C. von Willdenow) A. P. de Candolle], wine-cup [*Callirhoë involucrata* (T. Nuttall *ex* J. Torrey & A. Gray) A. Gray var. *involucrata*], Mexican palo verde (*Parkinsonia aculeata* C. Linnaeus), and cotton (*Gossypium hirsutum* C. Linnaeus). Boll weevils were sacrificed and the gut was removed and examined. A total of 699 boll weevils were examined for pollen. Pollen from all taxa tested was found in the guts of the boll weevils. Cotton pollen was found in the greatest and Mexican palo verde pollen in the least percentage of the boll weevils. Significantly more cotton pollen and significantly less *Parkinsonia* pollen was found in the samples than pollen from other taxa. There was no significant difference in the number of pollen grains between the sexes.

Introduction

Today, the boll weevil, *Anthonomus grandis* Boheman (Coleoptera: Curculionidae), is still a major insect pest on cotton, *Gossypium hirsutum* C. Linnaeus, where it has not been eradicated. In the last 10 years the list of potential pollen sources for adult boll weevils includes numerous non-malvaceous taxa (Rummel et al. 1978, Benedict et al. 1991, Jones et al. 1993, Jones 1997, Jones and Coppedge 1999, Hardee et al. 1999). 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 boll weevils captured at three Texas locations. In boll weevils captured in Mississippi, Hardee et al. (1999) identified pollen from 82 families 132 genera, and 28 species.

It is not known if boll weevil adults actively forage on pollen from all of the taxa reported. Some reported taxa are anemophilous (wind-pollinated) (i.e., *Quercus* spp., oak, and *Pinus* spp. pine) (Benedict et al. 1991, Jones et al. 1993, Jones 1997, Jones and Coppedge 1999). Other reported taxa are entomophilous (insect-pollinated) (i.e., *Helianthus* spp., sunflower, and *Sambucus* spp., elderberry).

Most anemophilous taxa do not "encourage" pollinators with rewards such as nectar, but rely on the wind for pollination. Thus, when pollen from anemophilous taxa are encountered, the question arises are those taxa contaminants or actively fed on. Entomophilous taxa found in low numbers may also be contaminants. Flowers can become contaminated with pollen from other taxa when pollen grains are "dropped" by various pollinators onto the "preferred" flower. As a preliminary study to ascertain if boll weevil adults actively eat pollen from the variety of taxa reported, several common spring species were examined to see if their pollen was consumed.

Methods and Procedures

Overwintering adult boll weevils were captured in pheromone traps in Brazos Co., TX, between February and May 1999. Boll weevils were fed and kept at room temperature (about 23˚ C). When there were enough boll weevils to test, they were sexed, placed into separate cages and starved for 50-58 h. As a control, 25 boll weevils were sacrificed and dissected immediately after starvation of 50 h to determine if any pollen remained in the gut.

Catkins or flowers were collected the morning or each test, and were checked to ensure that they contained fresh pollen. Leaves and pedicels were removed. After 24 hours of feeding freely on the catkins or flowers, the boll weevils were sacrificed. Boll weevils were rinsed with 95% ethyl alcohol to remove external pollen. The gut was removed, placed onto a glass slide, stained with safranin 0, and covered with a cover slip. The cover slip was sealed to the slide by painting the peripheral edge of the cover slip with nail polish. The gut was flattened by gently squashing the top of the cover slip with the eraser end of a pencil.

One anemophilous taxon and four entomophilous taxa were tested for pollen consumption. *Quercus macrocarpa* A. Michaux (mossy-cup oak) was the anemophilous taxon. The entomophilous taxa were winecup [*Callirhoë involucrata* (T. Nuttall *ex* J. Torrey & A. Gray) A. Gray var. *involucrata*], Mexican palo verde (*Parkinsonia aculeata* C. Linnaeus), dandelion [*Taraxacum laevigatum* (C. von Willdenow) A. P. de Candolle], and cotton. Cotton was used as a standard to compare the other taxa.

Cotton was tested with two sets of boll weevils and the other taxa were tested with three sets. When possible, 25 female and 25 male boll weevils were considered a set and tested for each taxon.

The number of pollen grains was totaled. One-way analyses of variance (ANOVA) was used to determine differences in

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the number of ingested pollen grains between sexes and among the taxa.

Results and Discussion

A total of 699 boll weevils were examined (Table 1). More females were examined than males (Table 1).

A greater percentage of boll weevils fed cotton contained pollen (Table 2) than those fed other taxa. Conversely, fewer boll weevils fed *Parkinsonia* contained pollen (Table 2). The initial 25 control boll weevils contained no pollen after starvation. A greater percentage of females contained pollen than did males.

The number of boll weevils containing wine-cup pollen was low. Boll weevils have been reared on wine-cup buds (Walker 1959), but wine-cup scored low in feeding tests by Parrott et al. (1989). Jones (1997) found that boll weevils survived longer on oak pollen than on wine-cup pollen.

The number of pollen grain per taxon varied from 16 to over 6,500 (Table 3). Significantly more cotton pollen grains were found ($F = 3.75$, $df = 671$, $P = 0.005$), and significantly fewer *Parkinsonia* pollen grains were found ($F = 12.55$, $df = 572$, $P = 0.001$). It is not known why there was so little *Parkinsonia* pollen, and why so few boll weevils contained *Parkinsonia* pollen. In many *Parkinsonia* fed boll weevils there was debris packed in the hind gut. The shape of the debris was similar to *Parkinsonia* pollen, and occurred in large numbers. Because the debris lacked the diagnostic characteristics of *Parkinsonia* pollen, it was not determined as *Parkinsonia* pollen.

The ornamentation of *Parkinsonia* pollen is different from cotton pollen. *Parkinsonia* pollen has a reticulate (net-like) ornamentation but cotton pollen has spine-like processes. Although cotton pollen breaks easily, it is still recognizable because of its processes. *Parkinsonia* pollen is not as recognizable as cotton pollen when broken. In addition, the exine (outside layer) of *Parkinsoni*a pollen may degrade easily. Without the exine layer, pollen identification is difficult.

More pollen was found in males than in females (Table 3). However, there was no significant difference in the number of pollen grains between the sexes ($F = 1.36$, $df = 671$, $P = 0.245$).

Although oak pollen was found in greater numbers than dandelion pollen (Table 3), more boll weevils contained dandelion pollen (Table 2). This may be due to the ornamentation of the pollen grains or to the longevity of pollen in the gut. Dandelion pollen, like cotton pollen, contains spine-like processes, although different to those on cotton. Also like cotton pollen, dandelion pollen is easy to recognize when broken. Oak pollen, like *Parkinsonia* pollen, has a relatively smooth ornamentation. Pollen grains with smoother exines may degrade more easily or may pass through the gut more readily than grains with processes.

Summary

In this study, pollen from all of the taxa tested, anemophilous and entomophilous, was found in the guts of the boll weevils. *Parkinsonia* pollen was found the least and cotton pollen the most. The lack of *Parkinsonia* pollen in the gut may be a result of many factors including "selectivity" by boll weevil adults, the pollen grains themselves, or longevity of various pollen types within the gut.

Pollen from non-cotton taxa may supply adult boll weevils with the nutrients needed to survive until cotton is available. Research is needed to determine the longevity of pollen within the gut and the nutritional value of non-host pollen for adult boll weevils.

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Table 1. Number of female and male boll weevils examined for pollen.

	females	males	total
control	13	12	25
Quercus	71	63	134
Callirhoe	69	75	144
Taraxacum	75	75	150
Parkinsonia	74	72	146
Gossypium	50	50	100
Total	352	347	699

Table 2. Percentage (rounded to nearest whole number) of female and male boll weevils with pollen.

	females	males	total
control	0	0	0
Quercus	55	54	54
Callirhoe	37	25	31
Taraxacum	76	56	66
Parkinsonia	22	14	18
Gossypium	90	88	89
Total	54	45	50

Table 3. Number of pollen grains ingested by female and male boll weevil adults by taxon.

	females	males	total
Quercus	1,415	2,546	3,961
Callirhoe	382	614	996
Taraxacum	786	753	1,539
Parkinsonia	54	16	70
Gossypium	5,409	6,528	11,937
Total	8,046	10,457	18,503