Table 3. The changes in dry weight of cotyledons and axis tissue of seedlings grown in the light.[z].

Days after planting	g dry wt	
	Cotyledons	Axis
1	1.1	---
3	1.0	0.1
5	0.8	0.2
7	0.7	0.3
9	0.7	0.5
11	0.8	0.8
13	0.8	1.4
15	0.8	2.0
18	0.8	3.8
21	1.1	6.0
24	1.2	12.0
27	1.1	24.0

[z]Plants emerged 5 days after planting.

planting, the cotyledon dry weight had increased to the initial weight of the dry seed.

The axis weight of all 3 treatments was similar up to 11 days after planting. The axis tissue grown in the light then increased rapidly (Table 3) and was always greater than axis tissue from plants whose cotyledons were covered (Table 2). This reduction in seedling growth could result in reduced fruit yields (6,8). Additional growth could offer these seedlings a competitive advantage by shading weeds and insect damage could have a lesser effect. These results show that shading of the cotyledons dramatically affect the growth of the axis tissue of the young pumpkin seedling.

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The Role of Volatile Principles in Nonpreference Resistance to Cowpea Curculio in Southernpea, *Vigna unguiculata* (L.) Walp.[1]

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Additional index words. cowpea, insect attractants, *Chalcodermus aeneus* (Boh.), host-plant resistance

Abstract. **Volatile extracts were isolated from pods of southernpea by vapor-phase ether extraction. In bioassays conducted with freshly emerged adult curculios *Chalcodermus aeneus* (Boh.), the insects were significantly more attracted to extracts of the susceptible 'California Blackeye No. 5' than to air with no extracts. Extracts of the breeding lines Ala. 963.8 and CR 22-2-21 were repellent to the insects as evidenced by directed travel away from the extracts towards air alone. Gas chromatographic profiles of the 3 extracts showed obvious qualitative and quantitative differences.**

Resistance of the southernpea to the cowpea curculio has been attributed to at least 3 factors: non-preference, antibiosis, and pod-factor. Some cultivars such as 'California Blackeye No. 5' (CB) were rated as susceptible by all 3 factors (3, 4). The breeding line Ala 963.8 (Ala) was rated as highly resistant by virtue of pod-factor mechanism and low in non-preference resistance by Cuthbert et al. (4). Rymal and Chambliss (8) found no difference in non-preference resistance between CB and Ala when fresh pod sections were used in laboratory bioassays. However, when ether extracts of the pods were used in place of the whole pods, Ala was intermediate between CB and the resistant breeding line CR 22-2-21 (CR). At the mature green stage, pods of Ala were shown to be intermediate in pod wall strength as well (9). Most authors have rated CR as highly resistant in non-preference resistance (4, 8).

Non-preference resistance to cowpea curculio in southernpeas was first recognized by Cuthbert and Davis (3) shown to be heritable by Fery and Cuthbert (5). This type of resistance has been attributed to extractable feeding stimulants (1, 2, 8) present in lesser quantities in resistant lines than in susceptible lines. Tannins occur in greater quantities in less preferred (resistant) lines (6) and may represent possible feeding deterrents. "Insects respond to the odors of their surroundings and are especially sensitive to biologically meaningful chemical signals such as received from food, prey, or a mate" (10).

The curculio susceptible southernpea cultivar CB and the resistant breeding lines Ala. and CR were grown in field plots in 1979. Bulk samples were hand harvested at the mature green stage, shelled, and the pods were processed the same day. Processing consisted of: cold water rinsing to remove seed fragments and soil, blanching at 100°C for 5 min in enough water to cover the pods, and freezing pods in blanch water at −10°C. After thawing at 4°C, 750g (drained weight) of pods were put into a 5 liter flask and blanch water was added to cover. The flask was connected to a vapor phase extraction unit as described by Likens and Nickerson (7) using 100 ml diethyl ether as solvent. Pods were extracted for 8 hr and ether-free extracts were stored at −10°C until used for bioassays or chromatography. Bioassays were conducted in the olfactometer apparatus shown in Fig. 2 Freshly emerged adult curculios were placed in plastic cages containing a sheet of filter paper moistened as a source of water for the insects. The number of insects placed in each cage varied from 70 to 116 depending on supply of insects. Vials containing 7.5 mg of ether-free extract were placed in the air inlet bottles at 1700 hr and the water aspirator (vacuum source) was turned on drawing 75 ml air/min through each cage of insects. One half of this air flow came through the pair of bottles used as the control (i.e. air inlet bottle and insect trap bottle containing no pod extract or, in one test, a different extract) and the other half came through the pair of bottles (air inlet and insect trap) containing a vial of pod extract. The air inlet tube was long enough to reach into the extract vial causing the inlet air to flow directly over the extracts. Insects crawling out of the cages countercurrent to

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the air flow and entering the glass tee, were forced to choose either to follow the air current alone or to follow the air current plus volatilized extract. After each 15-hr overnight period, the insects in the trap bottles were counted.

Gas chromatographic profiles (Fig. 1) were obtained by direct injection of the extracts since they were totally volatile. The instrument and instrument parameters used were as follows: Hewlett Packard 5710A, 25 M glass capillary column coated with Silar 10°C, oven temperature programmed from 70° — 250° at 4°C per min, sample size, 1 ul. The extract sample concentrations for injection were adjusted on the basis of the amount of extract from 1 g of pods as follows:

'California Blackeye No. 5': 0.2902 mg extract/g pods
Ala. 963.8: 0.0728 mg extract/g pods
CR 22-2-21: 0.0483 mg extract/g pods

In the first test, in which the extract from pods of the susceptible CB was used, the greatest number of insects responded to the extract (Table 1). Significantly less remained in the cage and the least number was found in the control (air) trap. When the extract of the breeding line Ala. which was shown to be intermediate in feeding stimulant non-preference resistance (8) was tested, a significantly greater number of insects responded to the control than to the extract. The number remaining in the cage was not significantly different from the number in the extract trap. In the third test, in which the extract of the most reistant breeding line CR (4, 8) was used, significantly fewer insects responded to the extract than to the control. The largest number of insects remained in the cage but not significantly more than responded to the control. Test number 4, in which no pod extracts were used, indicated that without any attractant present insect movement was random. In the last test, in which extracts from susceptible and resistant pods were compared with each other, the extract of the susceptible CB attracted significantly more insects than that of the most resistant CR. The number of insects remaining in the cage was not significantly different from the number that moved towards the extract of the resistant line. Insect response in this test was similar to the response when the same extracts were compared with air separately, as in tests 1 and 3.

Extracts from both resistant lines were significantly less attractive than the control and extracts from the susceptible cultivar were significantly more attractive than the control. Thus, curculios showed greater preference for air alone than for extracts of resistant lines. In other words, the travel of the insects was directed away from the volatile principles of the resistant lines indicating that pods of resistant lines contain substances which are repellent to curculios. However, it must be recognized that the repellency shown here may have been an artifact of the extraction procedure and may not have existed in the intact pods before harvest. If this were the case, the same thermally induced artifact could have been overridden in the CB extract by the attractive component.

The chromatograms showed many qualita-

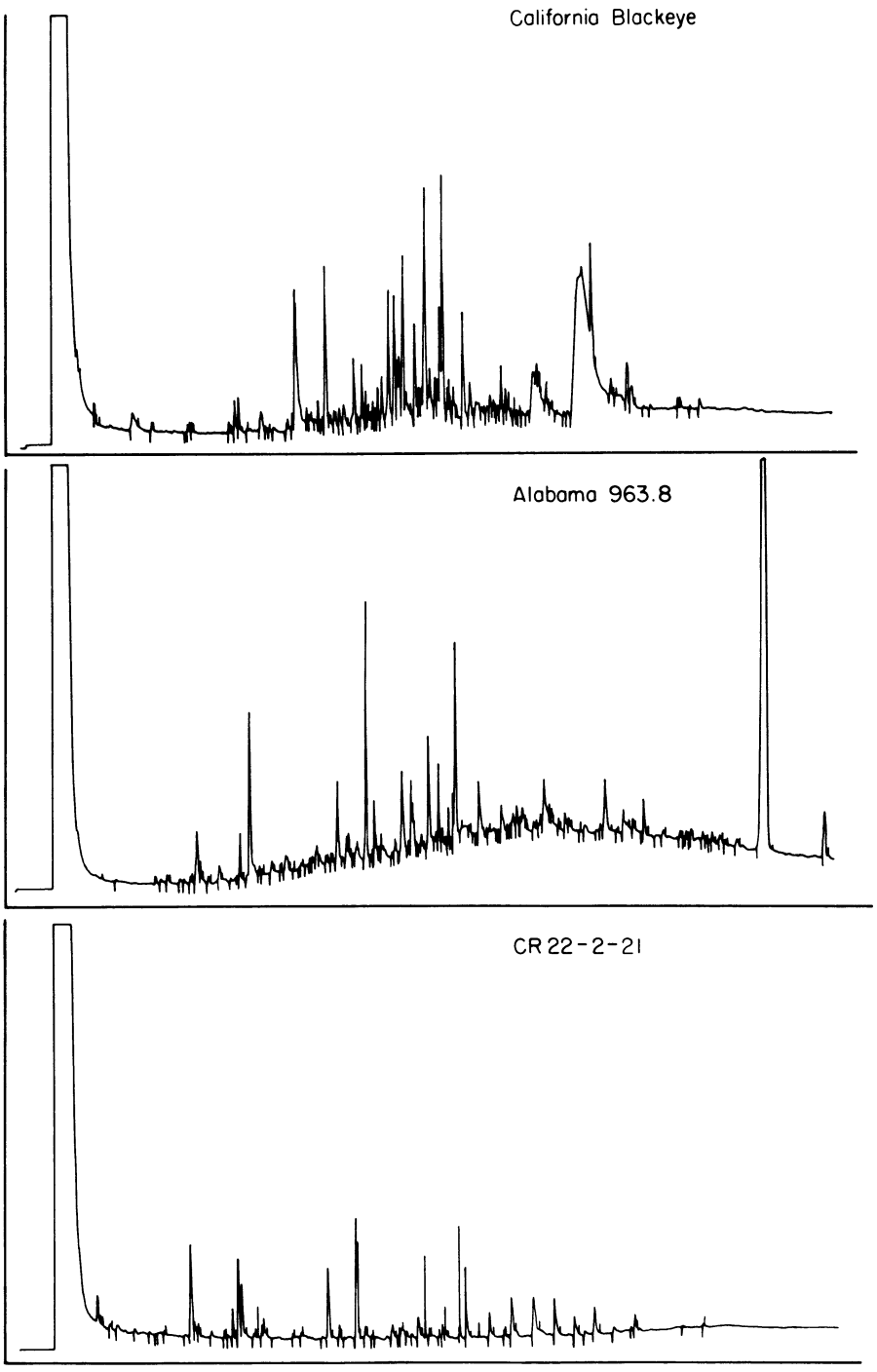

Fig. 1. Gas chromatographic profiles of vapor phase extracts of southernpea pods. Hewlett Packard 5710A, 25 M glass capillary column coated with Silar 10C, oven temp. programmed from 70° – 250°C/min, sample size 1 µl.

Table 1. Response of adult cowpea curculio to volatile extracts from pods of a susceptible cultivar and 2 resistant breeding lines of southernpeas.

	Avg. no. and percent of insects which had moved to traps or remained in cages at termination of tests[z]									
	Test/extract									
	1 Calif. Blackeye No. 5		2 Ala. 963.8		3 CR 22-2-21		4 Check[y]		5 CB No. 5* vs. CR 22-2-21**	
Trap/cage	no.	%	no.	%	no.	%	no.	%	no.	%
Extract	44a[x]	56a	18b	18b	10b	13b	26a	33a	59a*	64a
Control[x]	8c	10c	55a	56a	29a	38a	27a	34a	16b**	17b
Cage	27b	34b	25b	26b	37a	49a	26a	33a	18b	19b

[z]Each trial was initiated with 70 to 116 adult curculios per cage depending on supply of insects. Insects which died during a trial were not included in the counts.
[y]A check for random movement without olfactory stimulus. No extract was used in this test.
[x]Control for test 1 through 4 was air only. Control for test 5 was extract from the resistant line CR 22-2-21.
[w]Mean separation in columns by Duncan's multiple range test, P = 5%.

tive and quantitative differences between the 3 extracts (Fig. 1). These differences will require further study for elucidation.

The bioassays conducted in this study indicate for the first time that susceptible cultivars of southernpeas have volatile feeding attractants which lure the insects to the pod, while the pods of some resistant lines appear to possess lesser quantities of volatile attractants or volatile components that function as repellents. The chromatographic profiles confirm that there are wide differences between the volatile constituents of pods from susceptible and resistant cultivars.

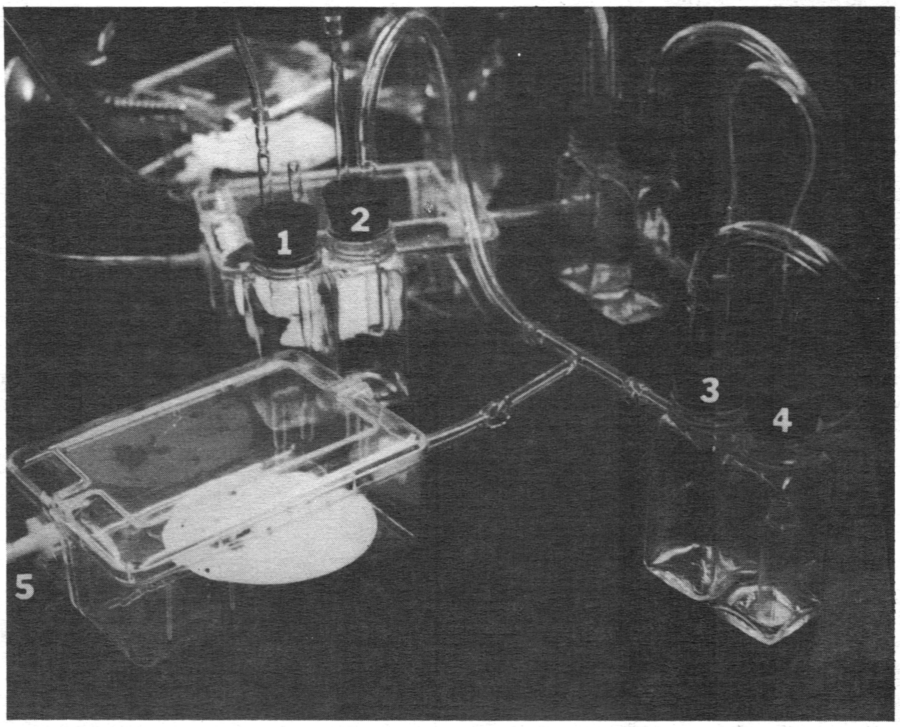

Fig. 2. Bioassay apparatus used to test the attractancy of southernpea pod volatile extracts for the adult cowpea curculio. 1. Air inlet bottle. 2. Insect trap bottle, control side. 3. Insect trap bottle, extract side. 4. Air inlet bottle with extract vial. 5. Vacuum source on plastic cage containing insects and moistened filter paper.

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Effects of pH on Growth and Quality of *Iris germanica* L.[1]

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Abstract. **Highest quality of plants of greenhouse-grown 'Captain Gallant' iris as measured by plant growth and root and foliar quality were produced at pH levels of 8.0 and 9.0 in hydroponic culture and at pH levels of 7.0 to 9.5 using field soil. Plant foliage appeared to increase in quality with increases in alkalinity.**

Optimal soil pH range for tall bearded iris has never been adequately determined although it has been suggested that irises can adapt to practically any pH level (1). Most published cultural recommendations, however, specify a pH range from 6.0 to 8.0 (2, 4, 7). A light application of limestone has been shown to be beneficial to growth of many iris species (5).

Two greenhouse studies were undertaken from January 20 - April 20 to acquire information on the effects of pH. Rhizome clumps of 'Captain Gallant' iris were obtained in August 1979 from an established field planting at the Arkansas Experiment Station at Fayetteville. Daughter rhizomes were separated from the mother rhizomes, plant foliage and roots pruned, and young rhizomes cured in open trays in a clear glass greenhouse at a mean temperature of 24°C for 2 weeks. Rhizomes were surface sterlized for 5 min in a 10% solution of sodium hypochlorite prior to placing into the hydroponic apparatus. Three rhizomes of uniform size and condition were set per container in a support medium of sterilized river sand. Growing containers were standard 15 cm hard rubber pots. Five pH levels (4.5, 5.5, 6.8, 8.0 and 9.0) were established and maintained by using HCl and hydrated lime, $CA(OH)_2 \cdot Mg(OH)_2$, in water solutions. An automatic injector was used to circulate appropriate solutions for a 5 min period every 6 hr. Pots were arranged in a randomized complete block design with 2 replications. Plants were grown in a clear glass greenhouse at a mean temperature of 26°C (+ −1°C) under long days. All treatments received 5g of 14N-6.OP-11.6K slow release fertilizer (Osmocote) and 0.8g of micronutrient fertilizer (Esmigran) applied to the medium surface following planting.

At termination of this study tissue analyses were determined for roots and leaves. Tissue samples were dried, ground and digested according to Lindner (3), phosphorus was determined colormetrically by Shelton-Harper procedures (6), and all other elements were determined in Lindner extract by atomic absorption procedures.

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