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Cotyledon Shading and Seedling Growth of Pumpkin[1]

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Additional index words. Cucurbita moschata

Abstract. **Pumpkin (*Cucurbita moschata* Poir, cv. Dickinson Field) seedlings were grown in the light, in the dark, or in the light with the cotyledons covered. Cotyledons kept in the dark or covered, lost a fourth of their dry weight to support axis tissue growth and were dead 25 days after planting. Dry weight of light-grown cotyledons decreased initially but by 25 days after planting equaled their initial dry weight. Dry weight of dark-grown axis tissue increased for 9 days and then remained constant. The weight of axis tissue of plants grown in the light at 25 days was 4-fold greater than axis tissue from plants whose cotyledons were covered. The data show that shading of the cotyledons dramatically affect the growth of the axis tissue of the young pumpkin seedling.**

Ungerminated pumpkin cotyledons contain 30% of their dry weight as lipid, 26% as protein and most of the remainder as starch (2). After planting, the cotyledons emerge, synthesize chlorophyll in the presence of light, and function as leaves (3). The cells in the cotyledons expand (5) and the stored material is transferred to the axis tissue (2,7). The dry weight of the cotyledon is so large that only a portion of this reserve is used by the time the axis has emerged from the soil (7,8). Thus, the remaining reserve material is available to increase axis growth after the seedling has emerged. The carbon material synthesized from photosynthesis by the cotyledons may also be transported to the axis tissue (7). This report shows the contribution the stored material and the effect of shading the cotyledon have upon growth of the axis tissue of a young pumpkin seedling.

Seeds of 'Dickinson Field' were sown in a glasshouse on June 1 of 1978 and 1979. Temperatures fluxuated between 27° and 32°C and normal sunlight received (16 hr photoperiod). The experimental design was a randomized complete block of 3 treatments with 3 replications of 10 plants in each treatment. Seedlings emerged in 5 days and one group of plants was covered and kept in the dark. The contribution that the stored material in the cotyledons make toward axis growth was determined with this group. The cotyledons of a second group of plants were covered with aluminum foil 2 days after emergence (7 days after planting) while the axis was exposed to light. The contribution that the stored material from the cotyledons and phytosynthesis of the axis tissue make toward axis growth was estimated with this group. A third group of plants was allowed to grow normally in the light. The cotyledons of these plants could contribute both stored material and photosynthate toward axis growth.

At various times after planting, the plants were removed from the soil, separated into axis (shoots, roots, and leaves) and cotyledons and dried at 60°C for 24 hr after which the parts were weighed.

When plants were kept in the dark, the cotyledon dry weight decreased for 15 days and then remained constant (Table 1). Concurrently, the axis dry weight increased for 13 days. After 13 days, no additional growth of the axis occurred. The plants were dead 25 days after planting. At this time, the total dry weight (axis plus cotyledons) had decreased 25% from the initial seed weight of 1.2g (excluding the seed coat). The material lost was utilized to support growth and development of the seedling (1,2,4,7).

The loss of dry weight from cotyledons which were covered with aluminum foil (Table 2) followed a pattern similar to cotyledons kept in the dark. The cotyledons lost weight for 9 days, the weight remained constant for an additional 9 days and then decreased and were dead at 27 days. Both cotyledons which were covered and those grown in the dark decreased to a final dry weight of 0.3 g. This decrease in dry weight is similar to results obtained with peas (1,4), where the storage reserve remains below ground and does not function as leaves or produce photosynthate.

The axis of plants whose cotyledons were covered grew at a linear rate for 15 days and then increased rapidly (Table 2). Axis tissue grown in the dark increased to a maximum of 0.6 g dry weight and this value was attained 11 days after planting by axis tissue whose cotyledons were covered. The remaining increase in axis dry weight can be assumed to be due to photosynthesis by the axis tissue.

When the plants were allowed to grow normally, the plants emerged in 5 days and by 9 days the cotyledons had stopped decreasing in dry weight (Table 3). The cotyledon weight remained constant for the next 9 days and then increased in dry weight. By 27 days after

Table 1. The changes in dry weight of cotyledons and axis tissue of seedlings grown in the dark.[z].

Days after planting	g dry wt	
	Cotyledons	Axis
1	1.1	---
3	1.0	0.1
5	0.8	0.2
7	0.6	0.3
9	0.5	0.4
11	0.5	0.5
13	0.4	0.6
15	0.3	0.6
18	0.3	0.6
21	0.3	0.6
24	0.3	0.6
25	Dead	Dead

[z]Seedlings emerged after 5 days.

Table 2. The changes in dry weight of cotyledons covered with aluminum foil and axis tissue which was exposed to light.[z].

Days after planting	g dry wt	
	Cotyledons	Axis
1	1.1	---
3	1.0	0.1
5	0.8	0.2
7	0.6	0.3
9	0.5	0.4
11	0.5	0.6
13	0.5	0.7
15	0.6	0.8
18	0.5	1.2
21	0.4	3.0
24	0.3	4.0
27	Dead	6.0

[z]Seedlings emerged 5 days after planting, and cotyledons were covered after 7 days.

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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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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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