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Cover Photo: Dr. Lynn Margulis, Symposium Keynote Speaker, describes the structure and ecology of living stromatolites. Some, visible as grayish mounds near her feet, line the shore of Storrs Lake whereas others occur farther out in deep water. (See paper by D. C. Edwards, this volume).

Back Cover Photo: Group photo of the 6th Symposium participants and speakers.

Photos by Paul Godfrey (Computer processed prints by Lanny Miller).

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HOST PLANT SELECTION BY THE SHIELD BUG *DIOLCUS IRRORATUS* (F.) (HEMIPTERA: SCUTELLERIDAE)

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ABSTRACT

On San Salvador, Bahamas, there are two closely related species of plants, *Croton linearis* Jacq. and *C. discolor* Willd., which produce similar secondary chemicals. A field survey showed that the shield bug *Diolcus irroratus* (F.) was more common on *C. linearis* than on *C. discolor*. To determine whether the insect distinguishes between the two species, we gave isolated individuals the choice between female shoots of each species and recorded where each occurred for an observation period of up to 36 hours. The experiment was repeated in May 1993 and January 1994. There was a significant preference for *C. discolor*.

INTRODUCTION

Plants and insects share a long coevolutionary history. Insects are the chief pollinators of many species, and plants are the major food source for many insects. Insect survival often depends on nutrient sources available from plants (eg. protein nitrogen) (Strong et al., 1984). Plants have evolved various forms of defense against herbivory. Physical defenses include sharp spines, such as those on the leaves of holly, or thickened or hairy cuticles, which prevent the insect from gripping the plant (Ehrlich and Raven, 1967). More importantly, plants produce secondary chemicals which repel or even kill most insect species (Ehrlich and Raven, 1967). Some insect specialists, though, are immune or even attracted to the secondary chemicals produced by certain plants.

Croton linearis, a plant common in the West Indies and subtropical America, produces several defensive chemicals. It is used medicinally in the Bahamas because of its production of the neurotransmitter gamma-aminobutyric acid (GABA) (White, 1987). Elsewhere it is used as an insecticide because it contains diterpenes which kill or paralyze insects, especially weevils (Alexander, 1991). Other alkaloids have also been recovered from this plant (Stuart and Woo-Ming, 1969). A closely related plant species, *Croton discolor*, which cooccurs with *C. linearis* on San Salvador Island, may have similar chemical properties, since the two plants are used interchangeably for medicinal purposes (White, 1987). *Diolocus irroratus*, a shield bug, had been found to occur commonly on *Croton linearis* bearing fruits (Elliott, 1987), but no information was previously available about its occurrence on *C. discolor*. The purpose of this study was to determine whether *D. irroratus* could distinguish the two species, whether it preferred one of them, and if a preference existed, the characteristics contributing to choice.

MATERIALS AND METHODS

In late May 1993, we surveyed a total of 118 *Croton linearis* at three different sites: on the main road between the Bahamian Field Station and the trail to Dump Reef, on the trail from the main road to Dump Reef, and on Jake Jones Road. Ten *Croton discolor* were surveyed at Sandy Hook as well. We collected 13 *Diolcus irroratus* and recorded the species on which each had been collected

The bugs were placed on filter paper in separate petri dishes. Each dish had a similar number of leaves, flowers and fruits of *C. linearis* on one side and of *C. discolor* on the other (Figure 1). We observed and recorded the positions and activities of *D. irroratus* every 5 minutes for the first hour. After the first hour we continued observations at longer intervals for up to 33 hours.

We repeated the experiment in January

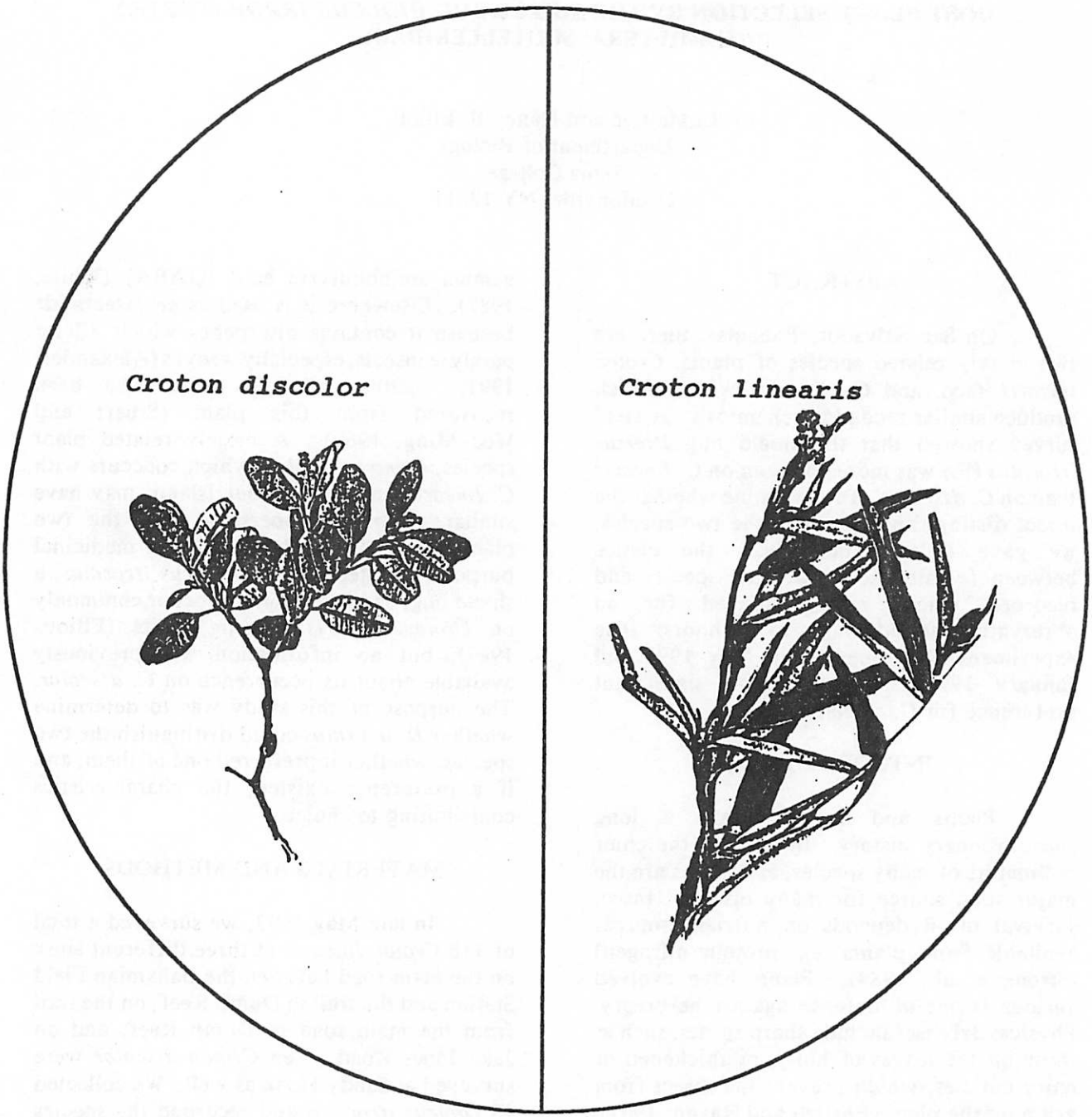

Figure 1. Illustration of experimental chambers. Thirty-seven individuals of *Diolcus irroratus* were given the choice between *Croton linearis* and *Croton discolor* on either side of a a petri dish. Positions on either species were noted at intervals for up to 36 hours. (Both species are photocopied from specimens in the Hoysradt Herbarium of Hartwick college).

1994 using 20 *D. irroratus* collected from *C. linearis* along the main road between the Bahamian Field Station and Dump Reef, and four from *C. discolor* along the main road on the east side of San Salvador opposite the trail to Thumb Beach. This time the bugs were observed approximately every two hours for 36 hours.

We determined the proportion of the observations during which each bug occurred

occurred on each species; results are reported as mean + standard error for all individuals. We calculated a chi square comparing the actual occurrence on each species, with the prediction that equal time would be spent on each.

RESULTS

Most of the individuals of *D. irroratus* were found on *C. linearis* in the field at sites on the northern end of the island. A few were collected from *C. discolor* at sites on the southern end of the island. In laboratory observations, individuals of *D. irroratus* occurred on *C. discolor* during 0.63 + 0.05 of the observations, and on *C. linearis* during 0.37 + 0.05 of the observations (Figure 2). These results were significantly different from the predicted ($p<0.01$).

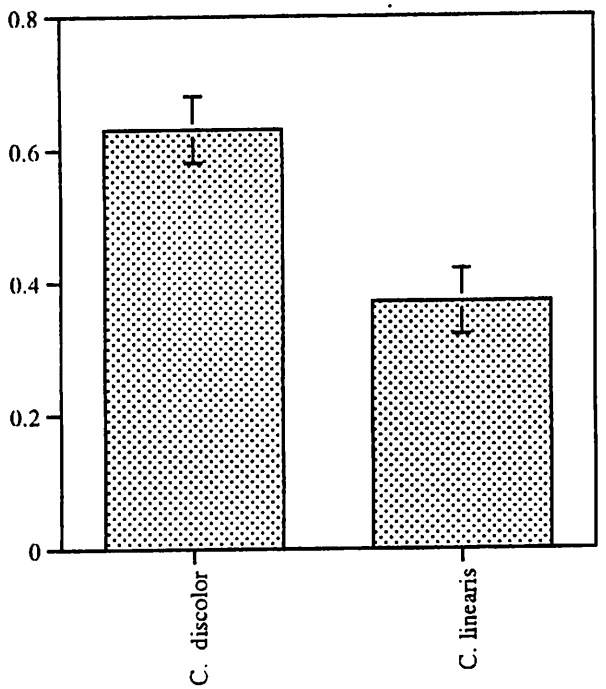

Figure 2. Proportion of visits to *Croton discolor* and *C. linearis* by *D. irroratus*; mean + SE. The chi square value comparing observed frequencies of occurrence with those predicted if equal time was spent on each species was significant; $p<0.01$.

DISCUSSION

Individuals of *D. irroratus* were found more often on *C. linearis* in the field, but spent significantly more time on *C. discolor* in the laboratory. The results of the field survey may be due to the greater abundance of *C. linearis* on the island. Since *C. discolor* is used interchangeably with *C. linearis* as a medicinal plant (White, 1987), we assume it has similar chemical properties and also contains GABA. The preference shown by *D. irroratus* for *C. discolor* suggests that there are some chemical differences between the two plants. Perhaps others of the secondary chemicals which occur in *C. linearis* such as other alkaloids mentioned by Stuart and Woo-Ming (1969) or its insecticidal diterpenes (Alexander et al., 1991) do not occur in *C. discolor*. Structural differences may also be important. The broader leaves of *C. discolor* may present a better substrate for the bug's activities. Leaves of *C. linearis* appear to have a thicker cuticle than do those of *C. discolor*. The tendency of these leaves to curl is further evidence of a thicker cuticle (R.R. Smith, personal communication). A thicker cuticle would make feeding more difficult (Ehrlich and Raven, 1967).

Perhaps future research including a histological comparison of leaf morphology and a chemical analysis of *C. discolor* will help determine the exact nature of the preference for *C. discolor* by *D. irroratus*.

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LITERATURE CITED

Alexander, I. C., K. O. Pascoe, P. Manchard, L. A. D. Williams. 1991. An insecticidal diterpene from *Croton linearis*. Phytochemistry 30: 1801-1803.

Ehrlich, P. R. and P. H. Raven. 1967. Butterflies and Plants. Scientific American 216(6): 104-113.

Elliott, N. B. 1987. Hemiptera associated with several Bahamian shrubs. *In* Smith, R. R., ed. Proceedings of the Second Symposium on the Botany of the Bahamas. Bahamian Field Station. Pp. 1-5.

Strong, D. R., J. H. Lawton and R. Southwood. 1984. Insects on Plants. Community Patterns and Interactions. Harvard Univ. Press, Cambridge MA. Pp. 313.

Stuart, K. L. and R. B. Woo-Ming. 1969. Alkaloids from *Croton plumieri*. Phytochemistry 8: 777-780.

White, V. 1987. Medicinal plants of San Salvador, the Bahamas. *In* Smith, R. R., ed. Proceedings of the Second Symposium on Botany of the Bahamas. Bahamian Field Station. Pp. 55-64.