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Value of Plant Resistance for Reducing Cowpea Curculio Damage to the Southernpea (*Vigna unguiculata* (L.) Walp.)[1]

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Additional index words. insect resistance, *Chalcodermus aeneus*

Abstract. **The results of 2 years of field tests indicate that the level of cowpea curculio (*Chalcodermus aeneus* Boheman) resistance found in 2 southernpea (*Vigna unguiculata*) breeding lines was more effective in reducing curculio injury than the currently recommended insecticide toxaphene. No evidence was obtained that the insecticide's effectiveness could be increased by altering the plant type.**

The cowpea curculio, *Chalcodermus aeneus* Boheman, is a major pest of southernpea, *Vigna unguiculata* (L.) Walp., throughout the southern and eastern United States. In the principal production areas, insecticides are routinely applied for control, but in spite of these efforts the insect is responsible for extensive losses each year. Plant resistance to curculio has been investigated by several workers (2, 3, 4, 5, 6, 11, 13). These studies have identified germplasm with varying levels of curculio resistance and have indicated good potential for using resistance as a means of reducing curculio losses. To further assess potential, studies are needed that will define available resistance in practical terms. We report here a comparison of the control observed using the best levels of resistance found to date and the insecticide currently recommended for curculio control.

Materials and Methods

Two field tests were conducted at the U. S. Vegetable Laboratory, Charleston, South Carolina, during 1974 and 1975, using breeding lines CR 17-1-13, CR 22-2-21, and CR 5-1-21-B and the cultivar California Blackeye No. 5 (CBE). CR 17-1-13 is resistant to the curculio because of the presence of a pod factor that inhibits pod-wall penetration by feeding and ovipositing adult curculios (3, 4, 7, 9). CR 22-2-21 is one of the best available sources for a nonpreference resistance factor that reduces the number of attempted feeding and ovipositional punctures per pod (3, 4, 8). CR 5-1-21-B, a breeding line characterized by small determinate plants with an intermediate level of resistance, was included in this study to determine whether insecticide applications would be more effective on small determinate plants having the pods located well above

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the foliage than on cultivars such as CBE of which the plants are larger and the pods borne within the foliage canopy. CBE, a leading commercial cultivar, is highly susceptible to the curculio (4, 7).

A split-plot design with 4 replications in 1974 and 3 replications in 1975 was used. Four insecticide treatments (toxaphene at dosage rates of 0.0, 0.7, 1.4, and 2.8 kg active ingredient per ha) were replicated within each block and the 4 southernpea entries were replicated within each insecticide main-plot. Each sub-plot consisted of a single row 15 m long by 1 m wide with the plants spaced about 12 cm apart in the row. The last 2 plants at each end of each sub-plot and 2 untreated (no insecticide) barrier rows of a late fruiting southernpea line were used between each plot to minimize possible interplot influence. The plots were seeded May 1 in 1974 and April 24 in 1975. Toxaphene was applied as an emulsion spray with hand-operated knapsack sprayers at a spray rate of 467 liters per ha. Three applications were made at 2 to 4 day intervals beginning at first bloom. Pods were harvested from all plants as they reached the fully developed green stage. All of the harvested pods were examined for external curculio punctures and the number of punctures was recorded. Additionally, duplicate 25 pod samples from each sub-plot were held in wax-paper cups and the number of emerging larvae was recorded.

Results and Discussion

Curculio injury to the susceptible cultivar CBE was moderate to heavy in both 1974 and 1975 (Fig. 1). The highest dosage of toxaphene significantly reduced the number of punctures per pod in CBE both years and the number of emerging larvae per 100 pods in 1975. The numbers of larvae emerging from pods of the 2 resistant lines, CR 17-1-13 and CR 22-2-21, were quite low even in the absence of insecticide applications and no benefit from the use of toxaphene on these lines was detected. In 1974, untreated pods of both of these lines produced significantly fewer larvae than CBE pods from all except the highest dosage of toxaphene. Additionally, no evidence was obtained that plant type influences efficiency of insecticide applications. CR 5-1-21-B exhibited the intermediate level of resistance expected and responded to the toxaphene sprays in the same way as the other lines.

Within each line, the numbers of emerging larvae corresponded reasonably well with the numbers of punctures on the pods. There were, however, differences between the lines in this respect. Since resistance in CR 17-1-13 is based partly on a failure of the adults to penetrate the pod walls, the ratio of pod punctures to larvae was, as expected, higher in this line than in the others. The number of larvae per pod puncture in CBE pods from untreated plots in 1974 was atypically low. We have no explanation for this, but larval mortality from a parasite or predator that was destroyed by toxaphene in the treated plots may have been responsible. Although we did not record the prevalence of natural enemies, we did observe that the parasite *Myiophasia globosa* Townsend was abundant in the planting. Normally this parasite does not kill curculio larvae until after emergence from the pea pods. Thus our data do not reflect the impact of *M. globosa* on larval populations of the curculio unless superparasitism or some other factor caused a significant amount of premature mortality.

Although toxaphene is the principal insecticide used for curculio control by commercial growers, it was not particularly effective in these experiments. The 2.8 kg/ha dosage treatment reduced the number of pod punctures on CBE pods by 46 and 52% and the numbers of larvae emerging from the pods by 5 and 86% in 1974 and 1975, respectively. As mentioned, the numbers of larvae emerging from untreated CBE pods in 1974 were lower than expected on the basis of adult punctures in the pods. Because of this, a more realistic measure of larval control by the 2.8 kg/ha treatment of toxaphene in 1974 is the 55% reduction of injury in the plots receiving the 0.7 kg/ha dosage. Our figures do not differ greatly from those reported by Wolfenbarger and Schuster (14) and Wolfenbarger (12) who obtained 92 to 40% reductions of the

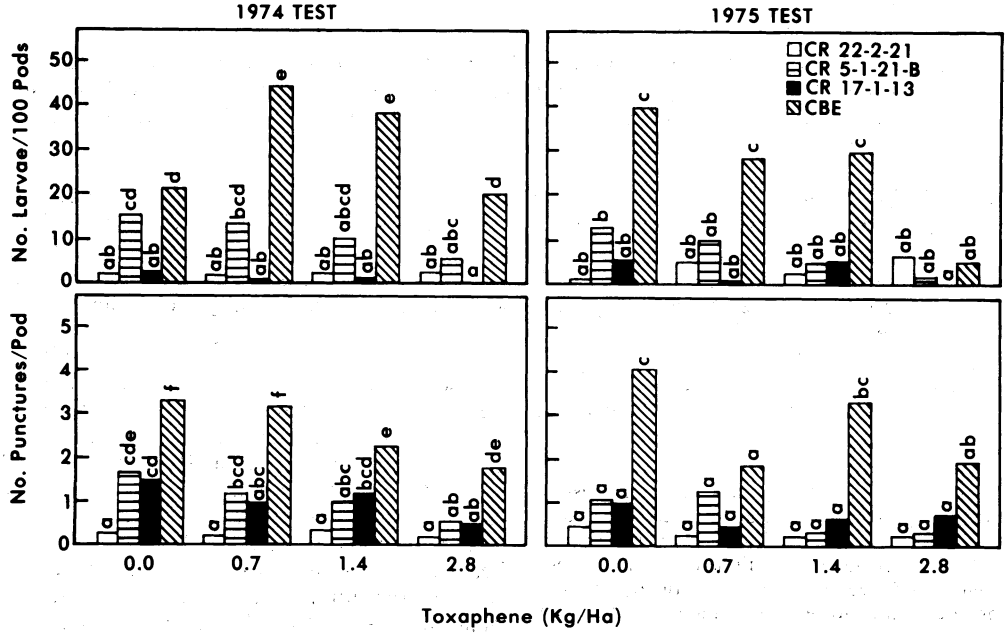

Fig. 1. Number of cowpea curculio larvae per 100 pods (above) and number of curculio adult punctures per pod (below) for the southernpea breeding lines CR 22-2-21, CR 5-1-21-B, and CR 17-1-13 and 'California Blackeye No. 5' (CBE), 1974 and 1975 tests. Each entry was evaluated at 4 toxaphene dosage rates (0.0, 0.7, 1.4, and 2.8 kg active ingredient per ha). Letters on bars indicate mean separation by Duncan's multiple range test, 5% level.

curculio or curculio damage in Texas. They reported decreased effectiveness of toxaphene in commercial use and suggested resistance to the insecticide as the possible cause. In a series of tests in Georgia, Chalfant (1) reported that control of the curculio with toxaphene ranged from 100 to 34% and averaged 66%. He concluded that the relatively slow killing action of toxaphene (10) made control difficult and confounded small plot research. Our observations in similar studies support this conclusion. We attribute the relatively poor control obtained in this study to the presence of untreated areas and barrier rows between plots. It is likely that adults moving from untreated into treated plots were able to oviposit before being killed. The results of this test are considered to be typical of what could be expected in plantings subject to a continuous influx of adults.

Conclusions

The results of this study indicate that plant resistance to the curculio can be a valuable adjunct to chemical control. Although a high degree of control was provided by the resistant germplasm tested, additional protection with insecticides will probably be required when curculio populations are high because peas grown for processing must be virtually free from insect injury and contamination. The substitution of curculio resistant southernpea cultivars for the susceptible cultivars now being grown would probably result in a significant reduction in local populations of the insect – a benefit not accounted for in our study. Such substitutions might also make it possible to reduce the dosage and frequency of insecticide applications or to use a less effective but environmentally more compatible insecticide.

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Growth and Nutrient Removal by Broccoli[1]

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Additional index words. Brassica oleracea (Italica group), nitrogen, phosphorus, potassium, plant analysis

Abstract. **The accumulation of N, P, and K in various stages of the cultural cycle of 'Medium Late 423' broccoli (*Brassica oleracea* L. (Italica group) was determined in an experimental field in southern Italy. Plant samples were obtained every two weeks beginning at transplanting and continuing for a 173 day period. Broccoli plants removed 559 kg N, 23 kg P and 723 kg K/ha. Total growth was 1,484 q/ha fresh material and 168 q/ha dry matter. The fresh material included 128 q/ha of main heads and 195 q/ha of secondary heads.**

Broccoli is an important fresh market and processing vegetable crop in many parts of the world. Little information is available, however, on its growth pattern and nutrient requirements on which to base management and fertilizer application decisions. This study was undertaken in Italy where the crop has long been grown and is increasing in importance. The results reported are part of a broader study involving many aspects of broccoli culture.

Materials and Methods

This research was conducted during the cultural year of 1975-76 in experimental fields of the Agronomy Institute of the University of Bari located in Policoro (Matera) using 'Medium Late 423' broccoli. Transplants weighing about 7 g and 13 cm tall were planted at spacings of 50 × 100 cm (20,000 plants/ha) on September 10, 1975.

The tests were conducted on a very deep alluvial soil containing 22.9% clay, 37.4% silt and 39.7% sand. Soil characteristics were 7.70 pH; organic matter, 4.34%; total N, 2.02%;

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