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IDENTIFICATION OF THE FREE AMINO ACIDS OF NEMATODE RESISTANT AND SUSCEPTIBLE SOYBEANS

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INTRODUCTION

The search for a chemical basis for disease resistance has followed many patterns. Resistance to diseases caused by nematodes has been studied in relation to mechanical barriers and chemical factors. This is a part of a study in which a chemical basis for resistance to soybean cyst nematode is being sought. Analyses are being made of various chemical components of resistant and susceptible varieties at the site of penetration and at the stage of plant development at which penetration is most readily accomplished. Larvae of the soybean cyst nematode penetrate both resistant and susceptible plants but fail to develop in the resistant plant. This suggested that nutrients, such as amino acids, might be lacking in the resistant plant. The part of the study reported here involves the readily extractable, ninhydrin positive compounds of which amino acids make up the greater part.

The free amino acid pool in the roots of soybeans has been studied previously in relation to the variation with age (2). Comparisons between varieties had not been studied and no information was available on varieties resistant to soybean cyst nematode.

This study was undertaken to determine what free amino acids occur in the roots of selected soybean varieties, including varieties susceptible and resistant to the soybean cyst nematode.

MATERIALS AND METHODS

Soybean varieties and lines used in these studies were Lee, Peking. Arksoy, Harosay, Hood, B1[2], R58-82, R54-168, and P. I. 88788. All are susceptible to soybean cyst nematode except Peking, P. I. 88788, and B1; the latter is a breeding line segregating for resistance.

Plants were grown in sand in the greenhouse until the desired stage of development was attained. Samples were taken when plants were in the cotyledon, unifoliate, first or second trifoliate stages. In one test, half of the plants in the four stages of growth were inoculated with soybean cyst nematode eggs and

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[2]Lines B1, R58-82 and R54-168 were obtained from Dr. C. E. Caviness, soybean breeder, Agronomy Department, University of Arkansas.

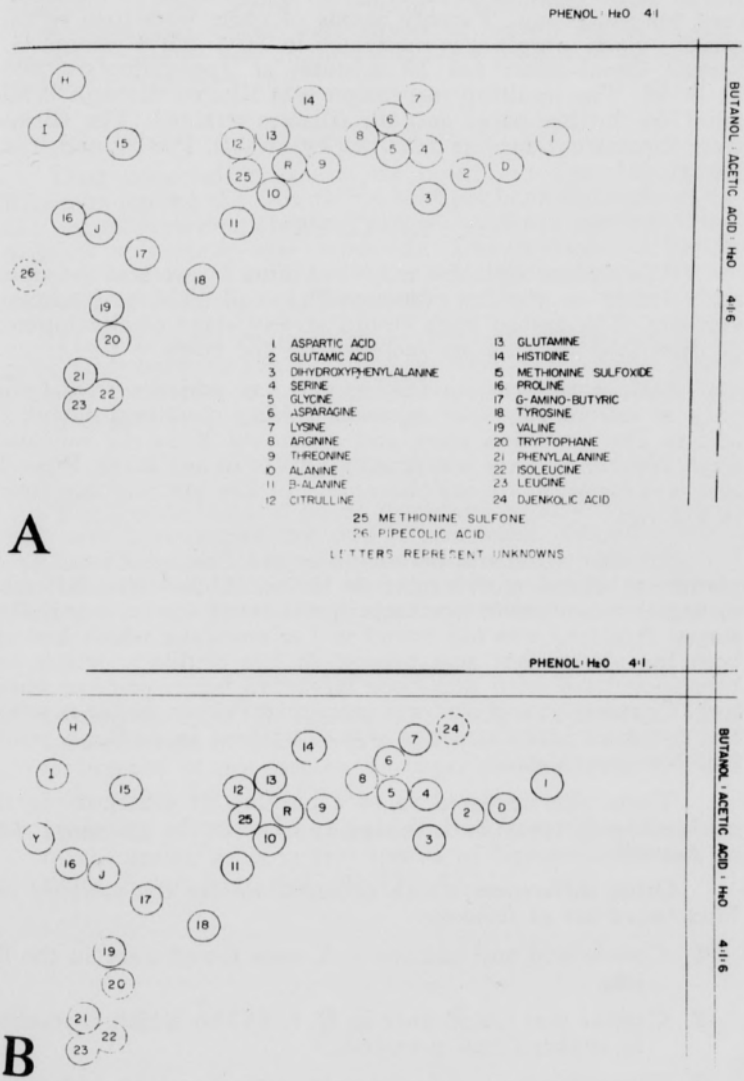

Figure 1. Representative chromatograms of amino acids from: A) Lee, and B) Peking varieties of soybeans.

larvae 48 hrs. prior to harvest for analysis. Roots were washed free of sand, wrapped in paper toweling and taken to the laboratory for processing. Twenty grams of roots were used in each sample. Each sample was macerated in 80% ethyl alcohol in a Servall Omni-mixer for 30 minutes at approximately 8000 R. P. M. The resulting suspension was filtered through Whatman No. 1 filter paper and the filtrates retained. The filtrates were chromatogramed as described by Grable, Presley and Templeton (1).

RESULTS

The chromatographic maps in Figure 1 represent the amino acids found in the Lee (susceptible) and Peking (resistant) varieties. The amino acids found at any stage of development of these two varieties are included on the maps.

Differences between Peking and Lee varieties were found only at certain stages of growth. Peking contained Djenkolic acid in the cotyledon stage and unknown Y in the unifoliate stage. Neither of these was detected in Lee in any stage. Pipecolic acid was found in the trifoliate stage of Lee but was not found in Peking.

Another difference between Lee and Peking showed up in plants inoculated with nematode larvae. This was a difference in arginine content of seedlings in the cotyledon and unifoliate stages. Arginine was not found in Lee seedlings which had not been inoculated, but was present in Lee seedlings which had been inoculated with nematode larvae 48 hours prior to sampling. Conversely, arginine was present in Peking seedlings which had not been inoculated but was not found in seedlings which had been inoculated.

There also appeared to be a buildup of glutamine in inoculated seedlings of both Peking and Lee in the unifoliate stage of growth.

Other differences which occurred among the varieties and lines tested are as follows:

1. Cysteic acid and unknown A were found only in the B1 line.
2. Cystine was found only in P. I. 88788 which is resistant to soybean cyst nematode.
3. Ethanolamine was found only in the line R54-168, a susceptible line.
4. Unknown E was found only in Anderson which is susceptible to soybean cyst but resistant to root knot nematode.

Every variety tested contained alanine, aspartic acid, asparagine, - amino butyric acid, glutamic acid, glutamine, glycine, isoleucine, leucine, serine, threonine, tryptophan, and valine. Tryptophan and valine were absent in certain stages of some varieties. Histidine and unknown H were present in all varieties and lines except R54-168.

DISCUSSION

Data obtained in this study point out some qualitative differences among the free amino acid pools of the various varieties tested. However, these differences were not correlated with resistance to soybean cyst nematode. The explanation for the variation in arginine content of Lee and Peking inoculated and non-oculated plants is not immediately evident.

There is some evidence of quantitative differences in free amino acids between Peking and Lee. Alanine is always present in higher quantities in Lee and other susceptible varieties than in Peking and P. I. 88788 which are resistant.

SUMMARY

The free amino acid pools of various soybean varieties and lines were investigated by two dimensional chromatographic methods. Comparisons were made between soybean cyst nematode resistant and susceptible varieties. No consistent qualitative differences were observed and exact quantitative measurements have not been made yet.

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