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SCREENING FOR HOST PLANT RESISTANCE TO COTTON FLEAHOPPER

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Abstract

The cotton fleahopper, *Pseudatomoscelis seriatus* Reuter, is a key pest in much of the cotton growing regions of Texas and Oklahoma. While progress in eradicating the boll weevil has eliminated the need to apply early-season insecticides for boll weevil, these early season treatments are yet needed to protect squaring cotton from cotton fleahopper. The development of cotton varieties resistant to cotton fleahopper offers an opportunity to further reduce the need for early season insecticide applications and benefit from the associated cost savings and the preservation of natural enemy populations which suppress insect pests. We recently initiated a project to identify resistance to cotton fleahopper in current genotypes and in intro- and intraspecific introgressed populations of cotton developed through a cooperative program at the Texas A&M Cotton Improvement Laboratory. Field and insectary methods using choice and no-choice methods, respectively, were developed and showed promise as efficient methods for screening cotton for resistance to cotton fleahopper.

Introduction

The cotton fleahopper (CFH) is one of the key insect pests of cotton in the US today. As with the tarnished plant bug, the relative importance of the cotton fleahopper has increased in recent years as losses to boll weevil and bollworm/budworm have declined due to the success of the boll weevil eradication program and the adoption of Bt transgenic cotton, respectively. Cotton fleahopper is especially important in Texas and Oklahoma and widespread outbreaks elevated the cotton fleahopper as the most damaging cotton insect pest across the cotton belt in 1999 (Williams 2000). Treatment with insecticides is the only tactic available to cotton producers for control of cotton fleahopper. The development of plant resistance to CFH would provide economic savings from reduced insecticide use and preserve populations of beneficial insects important in suppressing other cotton pests.

Cotton fleahopper nymphs and adults feed on small squares and leaf buds. Symptoms of damage include abortion or "blasting" of small squares, excessive vegetative growth, suppression of fruiting branches and shortening of internodes. Damage delays crop development and reduces yield.

Several researchers working in Texas investigated host plant resistance in cotton to CFH in the 1970s. High gossypol, smooth leaf surfaces and a nectariless character have been reported to reduce density of cotton fleahopper compared to normally pubescent, glanded or nectaried cotton (Niles 1980). Studies by Walker et al. (1974) demonstrated that although smooth genotypes reduced the number of cotton fleahoppers, many of these smooth genotypes were highly sensitive to fleahopper feeding and suffered significant damage. Some very hairy genotypes host large numbers of cotton fleahopper yet suffer little damage. Pilosity or hairiness character in cotton has not been used in developing commercial cultivars as the "Pilose" allele has pleiotropic effects and is associated with short and coarse fiber, which makes them unsuitable for use in the textile industry (Simpson, 1947). While early research did not lead to the development of CFH resistant cultivars, it did demonstrate that cotton genotypes varied in their response to cotton fleahopper.

The goal of this project is to identify genetic sources of resistance to cotton fleahopper and it is part of an effort to identify insect resistant traits in current and new intro- and intraspecific introgression populations of cotton in cooperation with the Texas A&M Cotton Improvement Laboratory and other researchers and plant breeders. The initial objective is to develop rapid and reliable field and greenhouse screening methods to evaluate genotypes for resistance to cotton fleahopper.

Materials and Methods

Field and caged-terminal techniques were developed and evaluated in 2002 and 2003 for the efficiency in screening for resistance to cotton fleahopper. Studies used 16 genotypes, including several commercial cultivars, with a range of trichome density, and one line of *G. arboreum*. Two screening methods were evaluated: 1) field plots exposed to field infestations of CFH with insecticide checks and 2) individual plants with fleahoppers caged on terminals in an insectary. A third method under development used excised squares presented to fleahoppers in small plates.

Field Screening Method. Genotypes were planted in replicated single row plots at the Texas A&M Research and Extension Center at Dallas. Weedy hosts of cotton fleahopper were planted around the plots to serve as a source for this pest. These plants, *Monarda* and *Croton*, were periodically mowed to force the fleahoppers into the test plots. One set of plots was

treated periodically with Orthene insecticide to eliminate cotton fleahopper damage and the second set of plots was left untreated. This allowed a direct measurement of fleahopper damage independent of the effects of weather and plant physiology on square loss. The number of fleahoppers and the number of squares and blasted squares was counted in each genotype during the first three weeks of squaring in June and lint was harvested.

Screening for Oviposition Preference. The same 16 genotypes were planted in a second replicated field study and sampled twice to determine the number of cotton fleahopper eggs per plant. As eggs are difficult to find, the presence of recently emerged CFH nymphs were counted to estimate the original number of eggs. Plants were cut from field plots and placed in a plastic bag inside in an insectary. The number of immature CFH emerging from eggs was counted every two days.

Caged Fleahoppers on Individual Plant Method. This method used small cages fastened to the terminal of the plant. Four CFH adults were placed in the cage and the caged plants held in an insectary with controlled temperature and humidity. Fleahoppers were removed after three days and square injury was recorded. This method is not subject to error due to plants escaping infestation in the field due to non-preference or chance.

Results and Discussion

Small plot field studies were effective in identifying resistance to cotton fleahopper. Densities of CFH per genotype in field plots varied from 5 to 110 per 100 plants, suggesting CFH show a preference for certain genotypes. Cotton fleahopper was almost totally absent in the Orthene treated plots. Percent square loss (corrected for physiological square loss in the insecticide-treated control) among genotypes due to CFH ranged from 6 % to 91 %. Trichome density (plant hairiness) appeared to have little relationship to square damage. A very hairy genotype, pilose, had the greatest number of CFH in the field, the greatest number of CFH nymphs (eggs) yet suffered the least amount of square damage, suggesting this genotype is tolerant to CFH feeding. The number of fleahopper eggs, as measured by the number of first instar nypmphs, ranged from 5-60 nymphs per plant among the different genotypes. The *Gossypium arboretum* selection was highly sensitive to cotton fleahopper and was identified as the susceptible check.

Results from caging cotton fleahoppers on cotton terminals yielded similar data as from the field studies. Genotypes again displayed a wide range of square damage, as some genotypes suffered no squares loss and the susceptible *G. arboreum* suffered 68% loss. The caged plant method is a reliable method but very tedious do to the need to collect, hold and handle CFH, which are very delicate and easily killed or injured. Also, a large space is needed in an insectary or greenhouse to accommodate all of the plants needed for a replicated study.

Studies were conducted to determine the feasibility of using excised squares for screening against CFH. Pin-head, match head and one-third grown squares were removed from plants and placed on a medium in a small, plastic plate. Four CFH adults were placed in each plate and allowed to feed for 48 hours and then removed. After an additional 24 hours, each square was cut in half and the internal tissue examined for CFH feeding damage. Control plates were the same except no CFH were present. Evidence of brown areas along the anthers and brown and shrunken pollen sacs were considered evidence of CFH feeding. Fleahopper damage was most evident on pin-head size squares, a few of the match-head sized squares were damaged and none of the one-third grown squares were damaged. However, there was also some damage in the control squares, suggesting some of the damage attributed to CFH was due to physiological reasons associated with excision. This damage in the control can probably be reduced by improvements in the medium and handling of the squares.

Future studies will refine and further evaluate the small plate screening method and determine if the results correlate well with those from field and small cage studies. Methods for rearing CFH year round are needed to provide a uniform and reliable source of insects for screening. Screening of some ca. 115 converted race stocks will begin in 2004.

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