The effect of nitrogen fertilization on the cotton aphid, *Aphis gossypii* Glover, in cotton

THESIS

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Summary

The cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) is a polyphagous pest of many wild and cultivated plants, particularly in the Malvaceae and Cucurbitaceae families. In cotton, the aphid often attacks the young plants in the spring. Later in the season, the populations usually collapse. This early spring infestation does not cause irreversible damage to the plants, which are usually able to recover thorough compensatory growth later in the season. However, sometimes spring populations do not crush, but outbreak. These eruptive populations cause severe economic damage, particularly due to honeydew secretion and sooty mold development on it, both contaminating the lint. The causes for such population outbreaks are not clear. As a result, fields are often sprayed with insecticides as a preventive measure, although there is no certainty that the aphid population will indeed erupt. Such spraying not only increases production costs and harms the environment, but also negatively affects natural enemies of the cotton aphid and other arthropod pests of cotton.

The goal of the present study was to examine the effect of nitrogen fertilization on several parameters that influence the population biology of the cotton aphid. Specifically, the effect of nitrogen fertilization on the aphid's fecundity, rate of population increase, morph formation (size and color) and within plant distribution were studied. In addition, the influence of nitrogen fertilization on leaf nitrogen content and the distribution of nitrogen in the plant were examined.

A significant positive correlation was found between nitrogen fertilization and nitrogen content in the leaves. It was found that nitrogen level was significantly higher in leaves at the top and middle thirds of the plant than in those at the bottom third.

Moreover, the differences in nitrogen level between plant parts were smaller when the plants received a high rate of nitrogen fertilization. When plants were fertilized with excess nitrogen there was no significant difference in nitrogen content between plant parts. The effect of nitrogen fertilization on leaf nitrogen content was more pronounced in leaves at the bottom third than at the middle third. There was no such effect in leaves at the top third of the plant. Finally, nitrogen level did not differ between various areas of the leaves and did not alter phosphorus and potassium levels in the foliage.

Nitrogen fertilization rate significantly affected aphid population size on the plant. The effect was significant on both adult and nymph numbers, although most of the difference in the population size between nitrogen treatments was due to differences in nymph count. There was also a significant effect of nitrogen fertilization on aphid population density (number of aphids per leaf area unit). Nitrogen fertilization rate was correlated with aphid fecundity - high levels of nitrogen resulted in higher nymph production per aphid compared with nitrogen deprived aphids. This effect of nitrogen fertilization on aphid fecundity occurred also when the nymphed stages were fed on well fertilized plants. Finally, there was a significant positive correlation between nitrogen fertilization rate and the intrinsic rate of population increase (r_m) of the aphids.

Data show that aphids which developed on nitrogen-fertilized plants were larger (both longer and wider) and had a darker color. Significant positive correlations were found between the aphids' body length, head width and darkness level. Nitrogen fertilization rate of plants on which the parents' generation developed, had a larger effect on the size and color of the daughters than did the quality of the daughters' host plants. These results suggest that

nitrogen fertilization rate may be an important factor that causes morph change characterisic to the outbreaking populations.

Aphids that fed on well-fertilized plants were more likely to remain on the part of the plant which they initially infested. On plants with no nitrogen fertilization, the aphids tend to leave the initial infestation site.

Results of this study indicate the potential contribution of nitrogen fertilization to the outbreaks of cotton aphid populations in cotton. It is therefore recommended that, to optimize nitrogen fertilization, nitrogen levels in the soil be tested before and during the cotton growing season. Cotton leaf nitrogen levels could be monitored during the growing season, and results should be coupled with the routine monitoring of aphid populations. Finally, it is recommended that when aphid populations are monitored, their morph be recorded and used as an additional control decision making tool.