Integrated Pest Management of Cotton Aphid Aphis gossypii Glover in Myanmar

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Name　：ヌ　ヌ　イ　NU NU YI

Title　：Integrated Pest Management of Cotton Aphid *Aphis gossypii* Glover in Myanmar
（ミャンマーにおけるワタアブラムシ属 *Aphis gossypii* Glover の統合的病害虫管理）

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Thesis Summary

Cotton aphid (*Aphis gossypii*) has been known as a principal pest of cotton in the world and is also a major pest of Myanmar's cotton. It is essential to control major insect pests to attain stable production of cotton through integrated pest management techniques. Integration of various management strategies to avoid overreliance on pesticides allows to reduce the risks associated with pesticide use, to protect beneficial organisms, and to create sustainable agriculture. The objectives of the present study were; (1) to reduce the use of pesticides in cotton production while aphid control was maximized; (2) to examine the usefulness of IPM practices combining transgenic bollworm tolerance (Bt) cotton and botanical pesticides with an intercropping system; (3) to evaluate the effectiveness of IPM in term of pest control, natural enemy conservation and cotton production; (4) to determine the efficacy of the ladybird beetle *Menochilus sexmaculatus* as a predator of the cotton aphid; and (5) to evaluate the effective release number of *M. sexmaculatus* for suppressing the cotton aphid population.

First, field experiments were carried out in Myanmar in three consecutive planting seasons to investigated whether intercropping and botanical neem pesticides could be feasible in cotton pest management. The density of cotton aphids and other major pests were examined. Also, natural enemy complex was monitored to assess the degree of biological control and their conservation status. Cotton yield and quality were finally evaluated to elucidate the usefulness of IPM practices in cotton production. The density of cotton aphids was significantly much lower in IPM cotton fields than conventional control fields with chemical pesticide application. Moreover, the cotton aphid density with IPM practice was kept below the action threshold level for pesticide application (< 10 aphids per leaf or 10% damaged or infested plants) throughout the experimental seasons. The densities of natural enemies of cotton aphids, *i.e.*, coccinellid beetles, lacewings and spiders, were significantly much higher in IPM fields than in the conventional control fields. The results suggested that the low aphid density was at least partly thanks to natural enemies. The use of botanical neem pesticides, particularly early in the cotton season, appeared to reduce cotton pests without the use of chemical insecticides and help conserve numerous natural enemies. Cotton yields were not different between IPM and conventional fields. Thus, combination of the IPM components applied here was effective enough to manage cotton aphids, conserve natural enemies, and reduce chemical pesticide use, while keeping cotton production.

The experiments were also conducted to examine the usefulness of the ladybird beetle *Menochilus sexmaculatus* (Fabricius), a major predator of cotton aphids, for conservation biological control of cotton pests. For this purpose, greenhouse experiments were carried out in Myanmar. The effective predator/prey

ratio was examined using larval and adult *M. sexmaculatus*. The results showed that *M. sexmaculatus* could suppress the aphid populations on cotton plants to a sufficient level though the efficacy of suppression depends on the number of predators released. When the ratio was 1/50 with adult ladybirds, the time required until aphid populations had reached zero was 16 days. As the ratio increased, aphid populations decreased at a greater rate. Although the days taken were longer when test was made with 1st instar of *M. sexmaculatus*, the density of cotton aphids reached zero until 20 days of initiation of the test, regardless of the ratios. In contrast, aphid density became double or nearly triple larger when no predator was present until 20 days. The sharp increase of cotton aphids caused a heavy damage on the experimental cotton plants while such damage was not detected in predator-released cotton. These results confirmed that the predator *M. sexmaculatus* suppressed cotton aphids and, as the result, protected cotton plants. Predator/aphid ratio had a significant effect on aphid density, and higher ratio resulted in faster decrease of aphids. *M. sexmaculatus* is an effective natural enemy of the cotton aphid was resulted. A predator-prey ratio of 1:50 was considered an effective ratio suitable for control of the aphid under field conditions. Augmentative release of a number of *M. sexmaculatus* would provide satisfactory control for the pest. Conservation of this predator via IPM practices could also provide a satisfactory control of the cotton aphid.

The present study has given evidence for a combined positive influence of botanical pesticides and intercropping in pest management and natural enemy conservation. The presence of these natural enemies should then help suppress cotton aphid populations. Taken together, IPM with a combination of transgenic bollworm tolerance (Bt) cotton, botanical neem pesticides and cotton-green gram intercropping is a feasible effective approach for cotton aphid management. The results also demonstrated that one *M. sexmaculatus* per plant, regardless of the developmental stage (first instar larva or adult), was enough to suppress *A. gossypii* populations on the cotton plant, suggesting that *M. sexmaculatus* has promising potential for biological control of *A. gossypii*. The ladybird beetle can also help make the critical decision on whether it is time to spray pesticides and can serve economic savings and eco-friendly management. Thus, the IPM system with a monitoring practice using the predatory natural enemy will help realize the sustainable, eco-friendly cotton production in Myanmar.