SUMMARY

*Atractomorpha crenulata* is a polyphagous pest. AZA is one of the most biologically active compound to the insects. In view of these facts, the effect of AZA on feeding, growth, reproduction in relation to biochemical and histological changes of male *A. crenulata* were studied.

The salient features of the summary of results are:

1. AZA showed considerable antifeedancy to different nymphal instars of *A. crenulata*. This has been confirmed by antifeedant bioassay test. AZA strongly inhibits feeding, primarily through chemoreception but also through a reduction in food intake due to toxic effects. The growth disrupting effects caused by AZA could be due to their antifeeding action, as antifeedants can also cause developmental deviations that may suggest disturbance of neuroendocrine system.

2. Feeding experiments revealed severe reductions in food consumption, relative growth rate and nutritional efficiency measures, which clearly demonstrates that feeding deterrence was the principal mode of action responsible for reduced growth. This conclusion is corroborated by the results of direct bio-assay test, leaf disc choice and no-choice test resulting in a substantial feeding inhibition on treated leaf-discs. The food consumption and dietary efficiency measures were reduced by AZA treatment suggesting that reduction in growth may result from both behavioural and physiological (post-ingestive toxic) effects.
Results presented in this study confirms that the effect of AZA on food utilization efficiency was dosage-dependent, and that the consumption and conversion efficiency were highly correlatable with the gut enzymes activity of *A. crenulata*. The decrease in the digestive enzyme activities in the midgut is due to a reduced rate of passage of food through the gut. The reduction of food consumption and decreased nutritional efficiency measures by AZA may block the bioavailability of the nutrients and subsequent inhibition of growth and survival of insects.

AZA treated leaves fed nymphal instar of *A. crenulata* prolonged the intermoult stage or prevented adult moult. The nymphal duration was extended and adult longevity was reduced in AZA treated insects. Reduced longevity and growth were due to reduced allocation of assimilated food for growth and reproduction.

In the present study, AZA caused various malformations and deformities in the nymphs and adults and also caused the occurrence of black patches on the cuticles and disrupts the complete sclerotization and pigmentation of new cuticle which can be attributed to disruption of endocrine events. Higher dose leading to death of insects suggest the toxic effects of AZA.

A decrease in faecal pellet production in AZA treated insects was due to the slow rate of feeding and decreased rate of passage of food through the gut suggesting the higher level of accumulation of allelochemicals in the gut which obstruct the digestive physiology of insects.

The decrease in the activities of ATPase in the gut region by AZA treatment suggest reduced metabolism in the insect which is due to the toxic
effects of AZA on membrane permeability especially in the gut epithelium and it has been clearly demonstrated by histological investigation. The reduced levels of ACP and ALP in gut of AZA treated insects suggests that AZA had decreased the absorption of ions and transportation of metabolites. Absence of triacylglycerol in the insects treated with higher concentration suggest that AZA inhibit the synthesis of triacylglycerol and phospholipids in the midgut mucosa.

8. The histological and ultrastructural studies of midgut of AZA treated *A. crenulata* showed changes in columnar epithelial cells, loss of microvilli and swollen mitochondria indicating the toxic effect of AZA. Swelling of cell organelles, necrosis of epithelial cells associated with blockage of mitosis caused disruption of midgut tissue function such as enzyme secretion and nutrient absorption.

9. During nymphal development, the concentration of proteins, carbohydrates and lipids declined in whole body of AZA treated *A. crenulata*. DNA and RNA level was significantly reduced at higher dose of AZA treatment which suggest that AZA may be interfering with the nucleic acid synthesis and protein metabolism.

10. The concentration of proteins, carbohydrates, lipids, cholesterol, fructose and amino acids declined in reproductive organs of AZA treated insects.

11. AZA altered the qualitative proteins, lipids and amino acids in the fat body, haemolymph and accessory reproductive glands of adult *A. crenulata*. Neutral lipids such as monoacylglycerol, diacylglycerol, free cholesterol, triacylglycerol and esterified cholesterol were absent in the haemo-
lymph of AZA treated insects. In insects treated with AZA, the phospholipids such as phosphatidyl inositol, phosphatidyl choline, sphingomyelin, phosphatidyl ethanolamine, and phosphatidic acids were found to disappear in the haemolymph. Absence of phosphatidyl serine, phosphatidyl choline, phosphatidyl ethanolamine and cardiolipin in ARG of AZA treated insects were evident. Lipids such as inositol and choline are important for spermatogenesis and sperm maturation in insects. Absence of phosphatidyl inositol and choline due to AZA treatment may be the reason for the reduced egg output.

12. Amino acids such as proline, glutamic acid, alanine, aspartic acid and serine were absent in ARG of AZA treated insects. Free amino acids such as cysteine, serine, glutamic acid, proline, glycine, alanine, cystine, isoleucine, tyrosine, phenylalanine, lysine were absent in haemolymph of AZA treated insects. Absence of amino acids such as proline, glutamic acid, alanine, aspartic acid and serine in the ARG of AZA treated insects reveals that these amino acids are important for spermatophore formation and mating process.

13. Electrophoretic studies revealed 7 protein bands in 10 day old normal insect haemolymph whereas AZA treated insect haemolymph showed only 2 protein bands. The male specific protein band was absent in AZA treated insect. ARG of AZA treated insect showed only 2 protein fractions whereas control insects showed 6 bands suggesting that AZA may inhibit the specific protein fraction for male accessory secretion.
14. Reduced activities of ACP, ALP and LDH in the reproductive organs of AZA treated insects may be due to the inhibitory role of AZA on spermatogenesis.

15. The histological changes in the apical region of the testicular tubule as well as the loss of spermatocytes in the zone of growth by AZA treatment suggest that AZA directly inhibited the spermatogenesis and sperm maturation process.