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Morphological abnormalities induced by plant extracts on development stages of *Spodoptera litura*

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Abstract

The present work was intended to evaluate the Morphological abnormalities induced by plant extracts on development stages of *Spodoptera litura* which develops on cabbage plant. Second instar larvae of *S. litura* were treated with the leaf and seed extracts of *Azadirachta indica*, *Catharanthus roseus* and *Ocimum sanctum* at the concentrations of 0.01, 0.05, 0.1, 0.5% and their development was observed till the emergence of adults. Larvae were observed daily and data pertaining to any morphological abnormality induced in developing larvae, pupae and emerging adults was recorded. Larval body became dark and spotted losing its usual characteristic pattern. It became thin and stretched and was ruptured at various regions of larval body. Most of the abnormalities were due to abortive moultings. Adult emerged from treated larvae showed several deformities like short body, deformed wings, legs, mouth parts and genitalia. Strong growth regulating effect was shown by *A. indica* and *C. roseus*. The growth was significantly retarded at all the concentrations however at higher concentrations development was abnormally prolonged. *O. sanctum* showed very little growth disrupting property.

Keywords: *Spodoptera litura*, Morphological abnormalities, leaf and seed extracts, Larvae.

1. Introduction

Plants being co-evolved with insects and other animals have been equipped with plethora of chemical defences against them. Aware of this effect, the mankind has used plant parts or extracts to control insects since ancient times. Plant-derived products have been receiving increasing attention from the scientists and recently more and more plants have been screened for the insecticidal properties.

Growth disrupting effect of azadirachtin induce morphogenetic abnormalities especially during larval-pupal transformations as was reported by Jagannadh and Nair (1992) [3] in *Spodoptera maurita*. Effects of Margosan-O, a commercial product of neem on the development of Egyptian leafworm *Spodoptera littoralis* was observed by Meisner and Nemny (1992) [5]. Growth inhibitory and antifeedant effect of azadirachtin on six noctuid moths was evaluated by Isman (1993) [2] Role of neem in agriculture was reviewed by Parmar and Singh (1993) [7]. Mordue and Blackwell (1993) [6] evaluated the oviposition deterrent effect of neem-based insecticides against several insects.

Plants evaluated in the present study, namely, *Azadirachta indica*, *Catharanthus roseus* and *Ocimum sanctum* have been reported earlier for their strong biological activities against several insect pests and out of these plants, neem has been successfully commercialized as an insecticide. However, there is little literature on the effect of these plants on the development of *Spodoptera litura* feeding on host plant cabbage.

The present work was intended to evaluate the Morphological abnormalities induced by plant extracts on development stages of *Spodoptera litura* which develops on cabbage plant.

2. Material & Method

The effect of plant extracts on moulting and resulting morphological abnormalities was studied. Second instar larvae of *S. litura* were treated with the leaf and seed extracts of *A. indica*, *C. roseus* and *O. sanctum* at the concentrations of 0.01, 0.05, 0.1, 0.5% and their development was observed till the emergence of adults. Larvae were observed daily and data pertaining to any morphological abnormality induced in developing larvae, pupae and emerging adults was recorded. In the experiments conducted to evaluate growth inhibition activity, dead larvae, pupae and emerging adults were observed daily for any morphological abnormality induced.

3. Result

Growth regulating effect of plants besides causing prolongation of developmental period and reducing adult emergence also show effects like morphological abnormalities in developing larvae, pupae and emerging adults. Out of three plants evaluated, *A. indica* and *C. roseus* showed strong growth disrupting activity against developmental stages of *S. litura*. Both the plants affected growth and development and most of the abnormalities induced were during moulting process. The effect was dose-dependant and at higher concentrations the frequency of abnormal larvae, pupae and adults was higher compared to lower concentrations. Some of the common abnormalities observed on treatment with *A. indica*, *C. roseus* and *O. sanctum* are as follows:

3.1 Abnormalities induced in Larvae

1. Darkening of larval body to uniform dark grey colour and disappearance of spotted characteristic pattern found in normal larvae.
2. Larval body becomes very thin and stretched.
3. Death during moulting is observed in which larvae remain entangled in old exuviae i.e. abortive moulting occurs.
4. Rupturing of cuticle at various regions of the body occurs in later stages of each larval instar. The effect was more pronounced in fifth and sixth instar larvae.
5. Almost all the later larval instars showed abnormal colour pattern or spots on their body.
6. Fifth and sixth instar larvae showed swollen thoracic region.
7. At higher concentrations of 0.1 and 0.5%, larval body became transparent and internal organs became visible through the thin cuticle.

3.2 Abnormalities induced in Pupae

1. When second instar larvae of *S. litura* were treated with leaf and seed extracts of *A. indica* and leaf extracts of *C. roseus* and *O. sanctum* developing pupae also showed several abnormalities. Some of the common abnormalities observed were as follows:
2. In pre-pupal stage body of sixth instar larva appeared swollen abnormally at dorsal thoracic region.
3. Abnormal swelling of abdominal region was observed in some larvae at pre-pupal stage.
4. Death during larval-pupal intermediate stage was observed.
5. Pupal body showed pigmentation and dark spots appeared all over body.
6. Pupal body was wrinkled and deformed.
7. Loosening of appendages occurred in late pupa.

3.3 Abnormalities induced in Adults

Adults emerging from pupae showed several deformaties and died after few hours of emergence. Some of the common abnormalities are as given below:

1. Body smaller in size and deformed compared to normal adult.
2. Entire integument was shrunk and crumpled.
3. Legs were delicate and coiled.
4. Wings were not spread uniformly and were crumpled at several areas. Wing venation was poor and incomplete.
5. Mouth parts were weak and adults were unable to feed.
6. Pupal exuviae remained attached to anal extremity of abdomen.
7. External genitalia deformed.

4. Discussion

Due to growth disrupting properties, *A. indica* and *C. roseus* induced several morphological abnormalities in developmental stages of *S. litura*. These abnormalities were mostly related to defective moulting and included death during moulting, incomplete removal of old cuticle or exuviae, abnormal stretching of body, rupturing of cuticle, larval-pupal intermediates, blackening of larval and pupal body and loosening of appendages in pupae, deformed adults etc. Abnormalities like darkening of cuticle and different levels of cuticular melanisation have been reported earlier by Koul *et al.* (1987) ^[4] in azadirachtin treated *Bombyx mori* and they associated these symptoms to changes in the levels of ecdysteroids and juvenile hormones (Hori *et al.* 1984) ^[1]. Morphological deformaties like deformed wings and mouthparts were also observed by Schluter *et al.* (1985) ^[9] in *Manduca sexta*. Rao and Subramanyam (1987) ^[8] observed the abnormalities like attachment of exuviae to the abdomen and deformed wings in *Spodoptera litura* treated with azadirachtin. Abnormalities induced showed a positive correlation with the concentration and at higher concentrations frequency of deformaties was higher. Also at higher concentrations (0.1 and 0.5%) abnormalities appeared earlier during the development whereas at 0.01 and 0.05% abnormalities appeared only after fourth instar larvae.

5. Conclusion

From the results it is evident that crude extracts of plants *A. indica*, *C. roseus* and *O. sanctum* are highly effective against *S. litura*, an important agricultural pest. Although azadirachtin, the active compound isolated from *A. indica* have been successfully commercialized as an insecticide, but several factors such as short supply of raw material of neem fruits, high cost of isolation, possibility of resistance development due to continuous use, difficulty in its synthesis due to its complex structure etc. make it economically less desirable. High potency shown by crude extract suggest that although azadirachtin content is low in crude extract but other chemical compounds present show cumulative effect and show high insecticidal, growth regulating and behaviour disrupting activities.

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