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Effect of Solasodine against Last Instar Larvae of *Tribolium confusum*

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ABSTRACT

Solasodine, a glycoalkaloid exhibited growth regulating activity in the last instar larvae of *Tribolium confusum*. The larvae were treated with 0.1, 0.25, 0.5, 0.75, 1, 1.5, 2, 2.5, 3% concentrations of Solasodine in solvent acetone. Solasodine resulted in marked growth and developmental disruption and inhibition of metamorphosis. The larval development to adults was greatly reduced resulting in the formation of mosaics, deformed pupae, deformed adults due to interference of Solasodine with moulting process and adult eclosion. The resultant forms were ruled out from further development and reproduction. Our results suggest that Solasodine inhibits growth and development of *T. confusum*, suggesting its potential as an effective insect growth regulator in integrated pest management modules.

Keywords: Solasodine, *Tribolium confusum*, Insect Growth regulator, Morphogenetic deformities.

1. Introduction

Tribolium confusum is one of the most serious pests in stored grain and related products. It is considered a secondary pest, which can easily infest damaged or broken kernels and apart from grain, it is particularly destructive to flour and other processed grain products. Control of storage pests by synthetic insecticides has resulted in health hazards, residual effects on stored grain, pest resurgence and environmental pollution. Moreover they are highly persistent accumulating themselves at various concentrations in different levels of ecosystem and are carcinogenic [10]. The growing awareness of hazards associated with the large scale use of synthetic insecticides has evoked a worldwide interest in pest control agents of plant origin. These pesticides aim to exploit the insect hormonal systems, affecting metamorphosis and resulting in deformed progenies incapable of further reproduction. They are comparatively less toxic, biodegradable, have no residual effects and hold great promise as insect growth regulators [11].

During the last two decades phytochemicals from plant bioresources have been heralded as desirable alternative to synthetic chemical insecticides for pest management because they pose little threat to the environment or human health [3].

In this regard an attempt has been made to study the effect of Solasodine, a glycoalkaloid extracted from the green fruits of *Solanum aviculare* (Solanaceae) on cosmopolitan stored grain pest, *T. confusum*.

2. Materials and methods

The *T. confusum* were reared on mixed flour of wheat and jowar at a temperature of 27 ± 1 °C and $60 \pm 5\%$ relative humidity. A commercial glycoalkaloid, Solasodine extracted from the green fruits of *S. aviculare* (Solanaceae) purchased from sigma chemicals was used for this study. Different concentrations of Solasodine (0.1, 0.25, 0.5, 0.75, 1, 1.5, 2, 2.5, and 3%) were prepared in acetone. Thirty freshly moulted last instar larvae were segregated and 1 µl of the concentrations was applied topically on the abdominal region with a Hamilton micro syringe. The experiments were replicated five times. Parallel controls treated with 1 µl of acetone were maintained. The treated larvae were transferred to the diet and observed daily to note changes.

3. Results

Severe morphogenetic deformities were observed in Solasodine treated resultant insects, at various concentrations (Table 1). At lower concentrations (0.1 and 0.25%) the larvae developed into apparently normal adults. But these forms died within a few hours after moulting. At higher concentrations (0.5% to 3%) Solasodine induced varied morphological deformities in the treated larvae. The percentage of various deformities produced and the percent inhibition of adult emergence varied with each concentration.

Solasodine resulted in inhibition of pupation (figure 2a) formation of mosaics, abnormal pupae and deformed adults. The larvae which failed to pupate ultimately died. The intermediates (Figure 2b) formed failed to develop further. The deformed pupae failed to emerge into adults exhibiting ecdysial failure. In deformed adults the pupal case was often seen attached to the posterior end of the body which prevented the insects from defaecation, mating and oviposition (Figure 2c).



Fig 1: a. Control Larva



b. Control Pupa



c. Control Adult



Fig 2: a. Larva failed to pupate



b. Larval-Pupal intermediate



c. Deformed adult with pupalcase attached to the posterior end

Table 1: Morphogenetic effects of Solasodine against last instar larvae of *T. confusum*

S. No.	Concentration	Dose	No. of insects	Larvae failed to pupate (%)	Mosaics (%)	Deformed pupae (%)	Deformed Adults (%)	Adults (Failed to survive %)	Adults (Survived %)
1	0.1	1	30	0	0	0	0	60	40
2	0.25	1	30	0	0	0	0	63.33	36.66
3	0.50	1	30	20	30	6.66	10	0	33.33
4	0.75	1	30	20	26.66	16.66	3.66	0	30
5	1.00	1	30	23.33	30	16.66	6.66	0	23.33
6	1.50	1	30	26.66	36.66	16.66	3.33	0	16.66
7	2.00	1	30	36.66	40	23.33	3.33	0	6.66
8	2.50	1	30	40	40	16.66	0	0	3.33
9	3.00	1	30	40	46.66	13.33	0	0	0
10	Control Acetone	1	30	0	0	0	0	0	100

4. Discussion

The present study reveals that application of Solasodine prevented normal development of the last instar larvae of *T. confusum*. The degree of effectiveness was found to vary with the concentration. Application of lower concentrations resulted in the formation of adults that survived only for a few hours and therefore were not able to mate or oviposit. Similar observations were noticed with other insect growth regulators [4, 9]. Increase in dosage of Solasodine resulted in interference in ecdysis, inhibition of pupation, formation of mosaics (larval-pupal, pupal-adult intermediates), deformed pupae and deformed adults. These forms

were ruled out from further development and reproduction.

The inhibition of pupation in Solasodine treated last instar larvae of *T. confusum* may be due to disturbance in ecdysteroid regulation shortly before ecdysis as observed in *Helicoverpa armigera* [5]. The larval- pupal and pupal- adult intermediates (mosaics) formed exhibited ecdysial failure and failed to undergo further development.

Most of the deformed pupae failed to eclose into adults, those which managed to develop into adults failed to survive for a long time. In Solasodine treated larvae the delicate balance involved in the timing of secretion of prothoracico tropic hormone and

secretion and disappearance of juvenile hormone in the prepupal stage might be disturbed so that prothoracic glands are not induced to release the major surge of ecdysteroids as also reported by ^[7] in *Callosobruchus maculatus*. The inability of the insects to extricate from the old exuvium during ecdysis, is one of the most common effects, associated with juvenile hormone action on morphogenesis. Such inhibition is of considerable practical significance since most of the insects which fail to ecdyse, are ruled out from further reproduction.

In most of the deformed adults pupal case was often seen attached to the posterior region of the body preventing the insects from defaecation, mating and oviposition. These deformed adults failed to survive for long time. These deformities are very similar to those caused by the action of juvenile hormone analogues ^[8]. Using peel oils of lemon, grape fruit and naval orange against *Culex pipiens*, observed abnormal adults which were not able to survive. According to ^[2] this suggests the presence of high juvenile hormone levels in the larvae.

Solasodine resulted in marked growth and developmental disruption and inhibition of metamorphosis.

This disruption involved a number of effects including inhibition of growth, induction of permanent larvae, death during moulting, inhibition of pupation, deranged larval-pupal and pupal-adult transformation, prevention of adult eclosion and reduction in adult emergence.

The growth and development inhibition in *T. confusum* by the action of Solasodine in the present study may be a result of blocked release of morphogenetic peptides causing alteration in ecdysteroid and juvenoid titers as also reported by ^[1] in azadirachtin treated *Heliothis virescens* (Fabr.). Also, some possible effects on tissues and cells undergoing mitosis may have occurred as observed in *Schistocerca gregaria* treated with azadirachtin ^[6].

Application of Solasodine to the last instar larvae of *T. confusum* prevented subsequent development to adult stage, thus reducing the reproductive potential of the pest. Solasodine can prevent or reduce progeny production by influencing development of immature stages. Moreover, the inhibition of metamorphosis would prevent subsequent generations from maturing.

5. Conclusion

It is evident from the present investigation that the topical application of Solasodine inhibits growth and development in *T. confusum* suggesting its potential as an effective insect growth regulator in integrated pest management modules against this stored grain pest. Solasodine as an effective insect growth regulator in integrated pest management programmes against insect pests is worthy of further investigation.

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