

**ENDOCRINE AND CERTAIN ENVIRONMENTAL FACTORS INVOLVED
IN POLYMORPH DIFFERENTIATION AND CONTROL OF
THE APHID *Macrosiphum rosaeiformis* (DAS)
HOMOPTERA: APHIDIDAE**

ABSTRACT



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ABSTRACT

The present study was conducted to study some of the endocrine and environmental factor responsible for the phenomenon of polymorph differentiation in the aphid *Macrosiphum rosaeiformis* (Das). Apart from it, attempt was also made to evaluate the role of the anti-allatin Precocenes and pheromone 'Queen substance' in the control of aphids.

The present work is divided into five sections namely:

1. Life cycle and polymorph determination.
2. Juvenile hormone and polymorph differentiation.
3. Juvenile hormone and photoperiod in polymorph differentiation.
4. Neurosecretion.
5. Control of aphids.

1: LIFE CYCLE AND POLYMORPH DETERMINATION:

Observation was made on the occurrence of the various morph forms of the aphid *Macrosiphum rosaeiformis*.

Regular observation on the occurrence of the morphs was done periodically. Morph was identified based on their microscopic characters. The following morphs were observed during the course of this study:-

- i. Alate virginoparae
- ii. Apterous virginoparae.
- iii. Alate gynoparae.
- iv. Alate Oviparae
- v. Apterous Oviparae.
- vi. Intermediate alate/ apterous virginoparae.
- vii. Intermediate oviparous/virginoparous
- viii. Males.

Reproduction is by means of parthenogenetic means through out the year, but, the occurrence of sexual forms appears during the winter period.No sexual reproduction is however observed . The life cycle appears to be incomplete or intermediate between anholocyclic and holocyclic.

Study was made to observe the effect of photoperiod on the appearance of different morphs. It was observed that under short photoperoid treated individuals give rise to an increased percentage of alate forms. Apart form this, a sequence of morph production id observed with the short photoperiod. Treated parent virginoparous individuals under short photoperiod first give rise to increasing alate forms, these alate forms produced under short photoperiod are the gynoparae that produces the egg laying oviparae. The gynoparae resembles the alate virginoparae superficially but differ in the number of secondary rhinaria in the antennal segment, and differ in the reproductive physiology as well. Apart from these normal morph forms, some

intermediate forms were also observed, they exhibit both the features of either the alate/apterous or the virginoparous /oviparous forms.

The effect of photoperiod coupled with low temperature on the differentiation of alate morphs was also studied. It is observed that under a reduced photoperiod the percentage of alate progeny in the treated parents increased, indicating that a reduced photoperiod was responsible for the production of alate morphs under winter short day conditions. Further, the sequence of morph production was also studied. Under a reduced photoperiod and a low temperature the virginoparous forms give rise to the alate gynoparae, these alate gynoparae then give rise to the egg laying oviparae. The occurrence of these virginoparous as well as the egg laying sexual females indicates that *Macrosiphum rosaeiformis* is a Holocyclic species,

However, the lack of any eggs under natural conditions as well as the presence of parthenogenetic reproduction during the entire winter period strongly suggests that it exhibit an incomplete holocyclic mode of life cycle in this region.

2. JUVENILE HORMONE AND POLYMORPH DIFFERENTIATION.

Juvenile hormone has been implicated in the differentiation of polymorph forms in aphids. It is believed that juvenile hormone titer regulated by environmental condition determines the differentiation of morphs in aphids. However, the exact nature of the role of juvenile hormone in aphids is not yet known. This is due to the size and delicacy of these insects, since techniques like allatactomy cannot be performed, but, with the discovery of the anti-allatin i.e, precocenes, it has become convenient for the aphid physiologist to study the role of the juvenile hormone/corpora allata by using the compound precocene as a chemical allatactomy.

Therefore, the present experiment has been conducted on *Macrosiphum rosaeiformis* (Das) to study the role of juvenile hormone/corpora allata by utilising topical application of juvenile hormone-III and also, by using the anti-allatin precocene-I and II. Further, study was conducted to see the action of the cyclic AMP, which acts as second messenger, in hormone action. This was done with an aim to elicit a response if any, by mimicking the hormone action on morph differentiation.

Application of juvenile hormone -III (Cis-10,11-Epoxy-3,7,11-trimethyl-trans ,trans -2,6-dodecadienoic acid methyl ester) to the pre-alate III and IV instars leads to production of individuals showing different grades of morphological responses. There, is a degeneration of the wings, lack of

sclerotisation of pterothorax, lack of marginal sclerites. In case of the third instar nymphs treatment of JH-III also leads to production of supernumerary forms, but, not in case of the IV instar. These individuals shows sign of apterisation by, their morphological similarities with the apterous forms. These results therefore shows that, juvenile hormone is involved in the differentiation of alate morph. Treatment of the anti-allatin precocene-I and II has been found, not to increase the percentage of alate progeny, both in the long day alate and the apterous parent. It indicates that, either, there are factors other than juvenile hormone involved in the determination of alate morphs under long day conditions or there is an apparent juvenile agonistic effect of precocene, which leads to the apparent increased percentage of apterous progeny rather than the alates. Cyclic AMP treatment has been found to have no effect on the morph differentiation.

3. JUVENILE HORMONE AND PHOTOPERIOD IN MORPH DIFFERENTIATION:

The alate gynoparae that are produced by short day photoperiod by the virginoparae are essentially the alate virginoparae that, produce the egg laying oviparae. Study was conducted to see whether, juvenile hormone is involved in its differentiation. When alate and apterous virginoparous parent are treated under short day photoperiod at a low temperature, it is seen that maximum percentage of progeny consists of the alate forms, but when treated with Juvenile hormone-III, the percentage of alate progeny decreases

significantly, whereas, the control batch without hormone treatment shows as usual an increased alate progeny. Further, the study on the corpora allata volume and cytoplasm/ nuclear ratio indicates that the corpora allata activity is more in case of the long day forms than in case of the short day forms. This result therefore, suggests that, the alate gynoparae are produced under short day by an apparent diminishing level of juvenile hormone titer in the parent, brought about by the reduced activity of the corpora allata.

4. NEUROSECRETION:

The neurosecretory cells in the brain was mapped by using the technique of selective stain with Paraldehyde fuschin (PAF). After PAF staining, neurosecretory cells attain deep purple coloration depending upon the contents of the perikaryon. Based upon these four groups of neurosecretory cells in the brain was identified, viz, Group I, Group II, Group III and Group IV. The Group I is the most prominent and lies at the region on either side of the protocerebral cleft. It consists of 4-5 cells. The group I cell have been implicated in the photoperiodic regulation of morph differentiation in the aphid *Megoura*. In this present study it was found that the secretory activity as revealed by the amount of stainable nuclear granules in the perikryon of the Group I cells are dependent upon the photoperiod. Under Long day photoperiod the contents of the stainable paraldehyde positive material is less

than that of the short day. Further, the corpora allata neurosecretory cells also shows similar activity under short and long day photoperiod.

Thus, these results indicate that, the corpora allata activity is determined by the photoperiod via the neurosecretory cells. This leads to the change in the titer of the juvenile hormone, which ultimately brings about a change in the morph production.

5.APHID CONTROL:

Attempt was made to evaluate the anti-allatin Precocene-I (7-methoxy-2,2-dimethyl chromene) and -II(6,7-dimethoxy-2, 2-dimethylchromene) and the honebee phermone' Queen substance'(9-oxodec-trans-2-enoic acid) as an aphid control agent. Application of precocene-I and II has been found to lead to severe morphological aberrations in the developed insects. The developed insects had severely crumpled wings as well as deformed appendages. They were incapable of flight. The response obtained was dose dependent. Mortality as well as aberrant forms increased with higher doses. 'Queen substance' when applied to the alate and the apterous virginoparous leads to a reduction in the progeny born by the treated parents. Thus, the use of these compounds as a control agent is demonstrated.

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