COMPARATIVE CYTOGENETICAL STUDIES ON THE LOCUSTS SCHISTOCERCA GREGARIA AND ANACRIDIUM AEGYPTIUM

A Thesis Submitted

By

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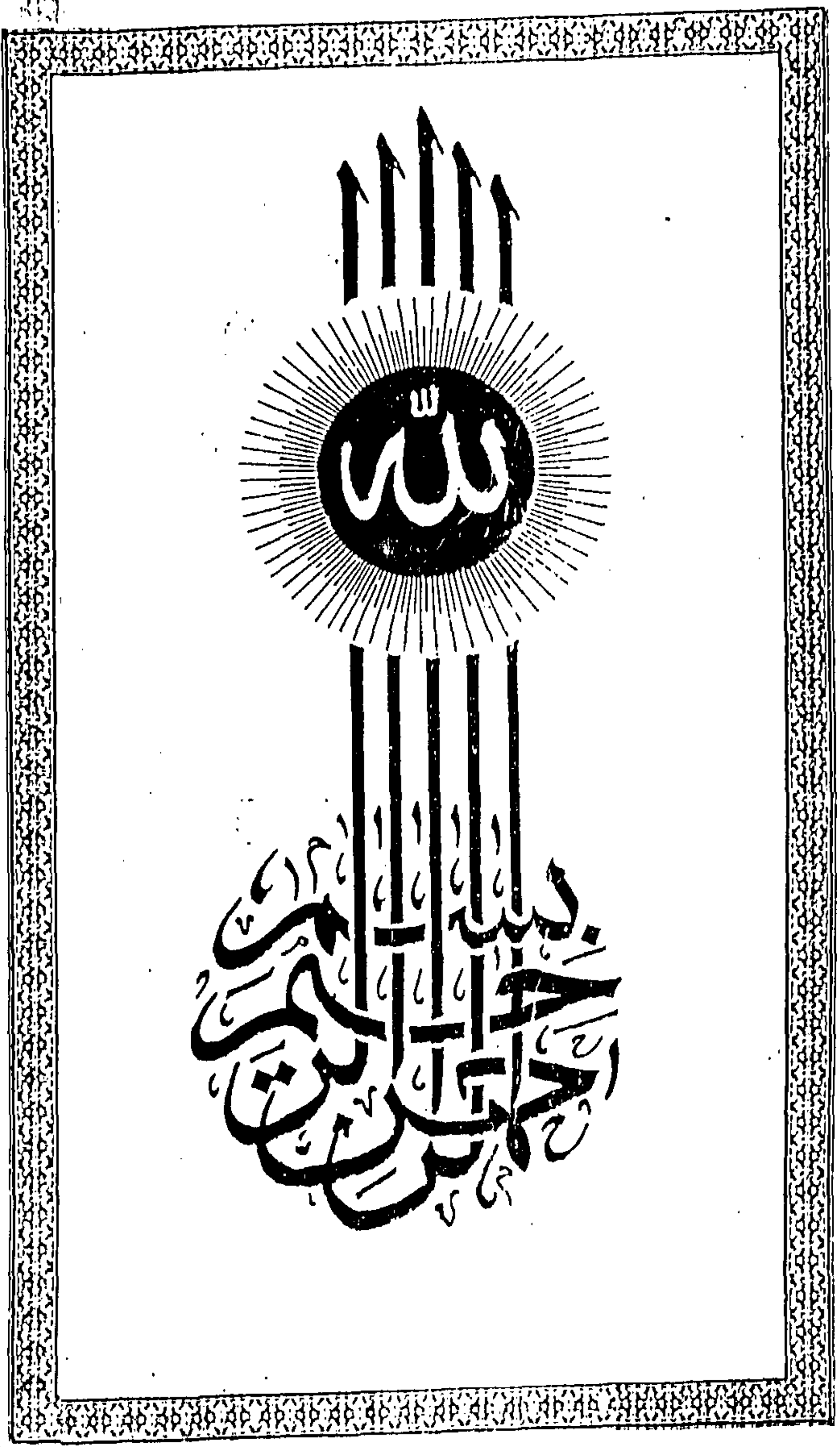
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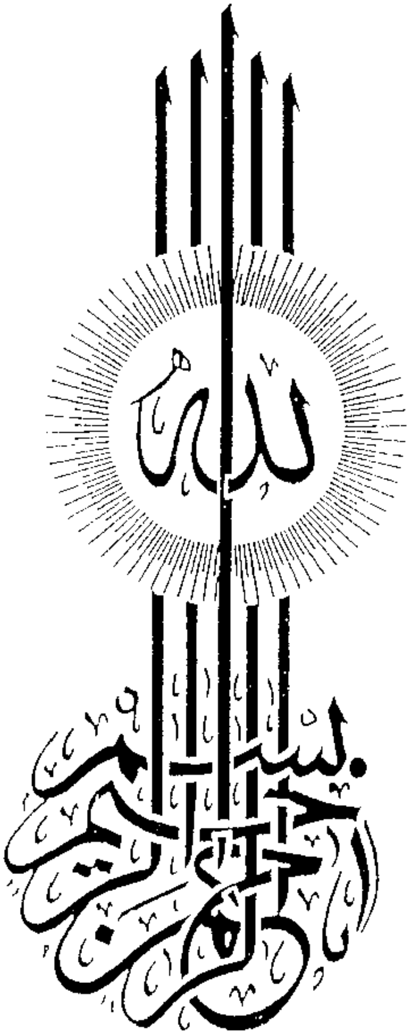
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INTRODUCTION
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AIM OF THE WORK

INTRODUCTION

Locusts and grasshoppers represent potential polyphagous pests creating a serious threat to virtually all kinds of vegetations. They can consume and destroy the vegetations within a certain area much faster than any other pests (Baloch, 1978).

The above worker reported that these insects occur in very large numbers, or swarms, in the localities which are favourable to them, causing tremendous damage and widespread devastation of the different types of plants. In this respect, he also pointed out that the swarms of locusts inhabit a total area of more than 20% of the total land surface of the world.

Nowadays, there is a great awareness concerning the dangerous impacts of these vigorous insects, and hence, the locust problem has become an open challenge to agriculturists, in general, and the acridologists in particular.

One of these harmful insects is the Egyptian locust <u>Anacridium aegyptium</u>, which is mostly prevailing in the Mediterranean coast, the Middle East, South Europe, West Asia, North Africa and some Atlantic Islands (Popov and Ratcliffe, 1968; Baloch, 1978; Lodos et al., 1978).

According to Volkonsky (1943), <u>A. aegyptium</u> is an extremely stable species existing mainly as isolated individuals and is not liable to variation, even if it was densely crowded, and the attempts to obtain a gregarious phase from them had failed.

Another famous species in this concern is the Desert Locust Shistocerca gregaria which usually invades extensive areas in the Middle East, some regions of Africa and India (Nolte, 1967).

Contrary to the above locust (A. aegyptium), the individuals of S. gregaria are usually found as a gregarious phase or migratory swarms, but nonetheless, they could occur as solitarious phase or isolated ones, under certain circumstances, as postulated by Nickerson (1956) and Lodos et al. (1978).

Thus, the widespread prevalence of these insects and their gracious mode of feeding, particularly of the useful and economic crops, warrant particular concern from various angles to provide some information which could be effective in controlling these dangerous pests, and thus eliminating or, at least, minimizing their dangerous impacts.

AIM OF THE WORK

In an attempt to achieve the goals already marked in the introductory remarks, regarding the keen search for a thorough knowledge which could be of value in locust control, the present work was designed in the following manner:

A comparative survey between the Egyptian Locust Anacridium aegyptium and the Desert Locust Schistocerca gregaria attempting to find out the cytogenetical reasons of phase transformation, from the case of isolated individuals to the migratory swarms in S. gregaria, as well as revealing the cytogenetical factors which could be probably responsible for the body colour polymorphism in the nymph of A. aegyptium.

Noteworthy is that this work was to be emphasized on the male individuals in view of the fact that the cytogenetical problems, in general, are more easily and appropriately followed during spermatogenesis rather than oogenesis.

However, the main aspects of this study are thereafter pointed out:

- Body colour polymorphism.
- Karyotypes.
- Mitosis and meiosis.
- Scoring and analysis of chiasma frequencies.
- C-banding patterns.
- G-banding patterns.
- C- and G-banding polymorphism.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Rearing and Body Colour Polymorphism:

The phenotypic characteristics of nymphal instars and adults of the Egyptian locust Anacridium aegyptium were studied by El-Zoheiry (1937), Volkonsky (1937), Colombo (1951), Colombo and Mocellin (1956), Norris (1965), Popov and Ratcliffe (1968), Baloch (1978) and Lodos et al. (1978). The work carried out by Popov and Ratcliffe (1968), in particular, had indicated that the life cycle of this insect included 6 or 7 nymphal instars when reared in groups, whereas those reared isolately had 7 or 8 instars. Baloch (1978) counted 5 and 6 instar nymphs in the developing males and females respectively. The same researcher also mentioned that he had previously noticed body colour dimorphism in the nymphal instar of A. aegyptium, during rearing them in Izmir province in Turkey in 1977.

Nevertheless, the number of nymphal instars was marked by some workers to be obviously affected by the high temperatures. In this concern, Popov and Ratcliffe (1968) postulated that exposure of insects to 40℃ had considerably raised the number of nymphal instars in A. aegyptium whereas this number became very low in case of S. gregaria.

Karyotypes:

The stability of the karyotype in family Acrididae, in general, is obviously not settled and is not yet accurately defined, proposingly due to various changes which might have taken place in their chromosomal organization during evolution, as pointed out by John and Hewitt (1966).

Noneetheless, the number of chromosome complements in the genera belonging to subfamily Cyrtacanthacrinae of the family Acridiae is: 2N = 22 + XO (m)/XX (f), as deetermined by Roberts (1941). The same researcher sub-divided the eleven pairs of autosomes into three groups: long (L), medium-sized (M) and short chromosomes (S) using their length as the only criterion in this respect. These chromosomes comprised: three pairs of long chromosomes (L_1-L_3), five pairs of medium-sized members (M_4-M_8) and three pairs of short ones (S_9-S_{11}).

Subsequently, similar results were obtained in S. gregaria by John and Naylor (1961), John and Henderson (1962), Fox (1966a, b, 1973), Fox et al. (1973), Jones (1977), Croft and Jones (1986) and Jones and Croft (1986).

As regards the sex chromosome of S. gregaria, several investigators included it among the long chromosome group (John and Naylor, 1961; John and Henderson, 1962; John and Hewitt, 1966; Fox, 1966 and 1973 and Fox et al., 1973). Within this domain, John and Naylor (1961) and El-Alfy (1989) considered the sex chromosome to be nearly equal in length to L_2-autosome whereas Fox et al. (1973) proposed that its length is equal to L_3-member.

Furthermore, John and Naylor (1961), Fox (1966, 1973), John and Hewitt (1966), Brown and Wilmore (1974) and Jones (1977) mentioned that all chromosomes of male S. gregaria were of the telocentric type, though some workers were in agreement that the centromeres are not strictly terminal (White, 1935; Darlington, 1936; Coleman, 1943). However, this viewpoint had been challenged by Makino and Momma (1950) who argued in favour of the existence of strictly terminal centromeres.

In a communication issued by John and Hewitt (1966), they marked certain clear differences in the chromosome length of the short group of chromosomes of three species of Schistocerca, in which case they were found to be relatively much shorter in cancellata and paranensis than they are in gregarina.

From another angle, John and Naylor (1961) and John and Henderson (1962) elucidated that the nucleolus organizers, which could be cytologically represented as secondary constrictions, were located on the long (L_3) and medium-sized (M_6) chromosomes of male S. gregarina. Subsequently, Fox (1973) was of the opinion that secondary constrictions exist only in about 50% of (L_3) and (M_6) bivalents, being particularly detectable in the diplotene stage, and thus they could not be used consistently as a permanent and specific criterion. Moreover, Fox (1966) and John and Hewitt (1966) declared that (M_8) chromosome of male S. gregarina had only a secondary constriction.

Mitosis and Meiosis:

The mitotic and meiotic divisions of the majority of orthopteran species were presumed by White (1952) to follow, in general, the typical course of other known animals.

With regard to the mitotic process, Swanson et al. (1982) had