STUDIES ON GROWTH REGULATING SUBSTANCES OF CERTAIN PLANTS OF CUCURBITACEAE

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This thesis has not been previously submitted for a degree at this or any other university.

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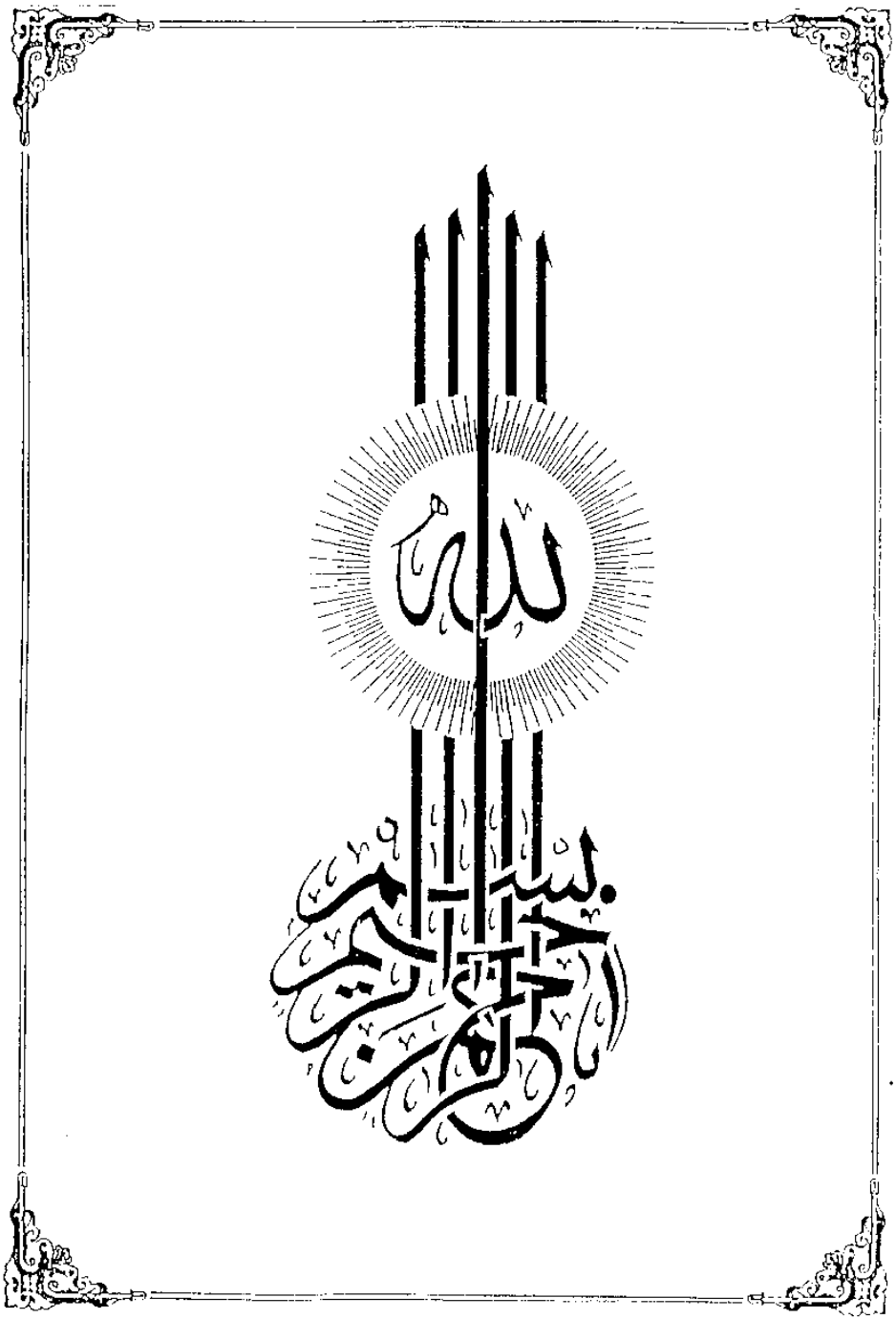

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PART I

- INTRODUCTION
- MATERIALS
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INTRODUCTION

The regulative systems of auxins, gibberellins and growth inhibitors in fruit development, seed development and germination have been recently a subject of major interest to many plant physiologists.

An account of the possible role of the different growth regulators in fruit development, seed development and germination will be given in the following sub-sections.

1. Fruit Development :

Several investigators studied the changes of growth regulating substances during fruit development. The classic researches of Gustafson, (1936 & 1939) have established that auxins are capable of causing the commencement of fruit development in many species without pollination. It appears that the normal process of fruit-set with pollination involves a release of large amounts of endogenous auxins.

The researches of Muir, (1951) have indicated that tobacco fruit-set either by pollination or by auxin sprays, builds up high concentrations of auxins, much too high to

be accounted for in terms of the amounts of auxin in the spray or in the pollen. In normal pollination, an auxin-producing system is activated which results later in fruit-set. In the earliest stages of fruit growth, auxin production is essentially carried out in the ovary tissue surrounding the young embryos (Gustafson, 1939), whereas in later stages the major source of auxin is the young developing embryos (Wittwer, 1943, Luckwill, 1948, Mitchell et al., 1951).

Nitsch, (1950) analysed the auxin content of strawberry fruit at various stages of development and found that a large production of auxin occurred in the first 2 weeks of fruit development. Wright, (1956) studying the changes of the growth substances of black currant fruit, found 3 auxins and one inhibitor. One of these promoters increases gradually after fertilization and then decreases towards maturity. The other 2 promoters showed 2 peaks during the development of the fruit. The inhibitor, on the other hand, showed a gradual increase towards maturity.

Leopold (1964) stated that a low endogenous auxin level in the fruit appeared responsible for the period of depressed growth, since the rate was greatly accelerated

by the addition of exogenous auxins. Crane, (1964) was also of the opinion that auxins are the controlling factor in most fruit growth.

The correlation of fruit growth with endogenous auxin became clouded, however, when both grape (Nitsch et al., 1960) and fig (Crane et al., 1959) yielded evidences of an auxin increase only for the first growth period; the second period of fruit growth was not associated with a rise in auxin.

Coombe (1960) interpreted the situation in grape as evidence that the first growth period was controlled by auxin, whereas the second was not a consequence of growth substances but of an osmotic accumulation of carbohydrates. But in peaches even the first phase of growth has no associated rise in auxin (Stahly & Thompson, 1959); instead, the auxin content rises perceptibly only during the period of suspended growth. Three auxins were detected, and each showed the same characteristic peak at the period of least growth.

Brugovitzky et al., (1967) observed that the inhibitors present in Rosa conina fruits increase towards maturation.

While auxins are effective in causing fruit-set of tobacco, pepper, egg-plant, tomato, holly, okra, figs and numerous relatives of the cucumbers and melons, an estimated 80% of horticulatural species cannot be set with auxins (see Leopold, 1964). So, we must look to other growth substances as possible controls of the setting and development of fruits.

There is some experimental basis for implicating the gibberellins and possibly the kinins in development and setting of fruits. One of the first discovered sources of gibberellins in higher plants was developing fruits (Lang et al., 1957; Mitchell et al., 1951). Later, it was discovered that gibberellins would induce fruit-set in tomatoes (Wittwer et al., 1957; Gustafson, 1960). In addition, gibberellins can cause fruit-set in numbers of species which are not set by auxins, including some species of rose (Prosser & Jackson, 1959); several species of the genus Prunus including cherry, almond, apricot, and peach (Crane et al., 1960); grape (Weaver and McCune, 1958); apples and pears (Wittwer & Bukovac, 1962).

Endogenous gibberellin-like growth regulators are present in peach fruits as a result of pollination and

fertilization and they are involved not only in the development and sclerification of the endocarp but also in regulating cell division and enlargement in the mesocarp (Bardley & Crane, 1962; Crane et al., 1960; Crane et al., 1961). Ogawa, (1966) studying the changes of gibberellin-like substances in the seeds of Prunus persica, found that the increase in the amount correspond with fruit-growth.

It is noteworthy that auxin type compounds as well as gibberlin-like substances are found in abundance in the mature fruit. This fact contradicts previous findings that claim a marked decrease in the amount of growth promoters towards fruit maturity.

Considerable amounts of auxins and gibberellin-like substances were detected in all stages of orange fruit development (Goren & Goldschmidt, 1970; Jackson, 1968; Herzog & Monselise, 1968). The same authors show that the level of gibberellin-like substances is high in all stages of orange fruit development, and in the mature fruit this level somewhat exceeds the amount detected in younger fruit, where an additional peak is found at low R_F values.

The interesting possibility that gibberellins may contribute to the endogenous control of fruit-set remains to be worked out.

The possible involvement of kinins in fruit-set is even less clear, although they have been found in newly set fruits of apple (Goldacre & Bottomley, 1959; Letham & Bollard, 1961).

Van Overbeek, (1962) was of the opinion that auxins, gibberellins and kinins may be concerned in a sequential manner in the growth and development of fruits.

2. Seed Development :

Young embryos are known to produce large amount of auxins. Nitsch, (1950) and Luckwill, (1949) have shown that young embryos are the principal site for auxin production in strawberry and apple fruits during fruit growth. In the seeds, the embryos are also considered to be the major source of auxins (Hemberg, 1955).

It has been stated that the auxin content of a number of cereal grains is greatest before maturity and gradually falls as this process proceeds (Hatcher & Gregory, 1941; Avery et al., 1942; Hatcher, 1943;