PHYSIOLOGICAL STUDIES ON DEVELOPMENT AND GERMINATION OF CERTAIN SEEDS

By

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

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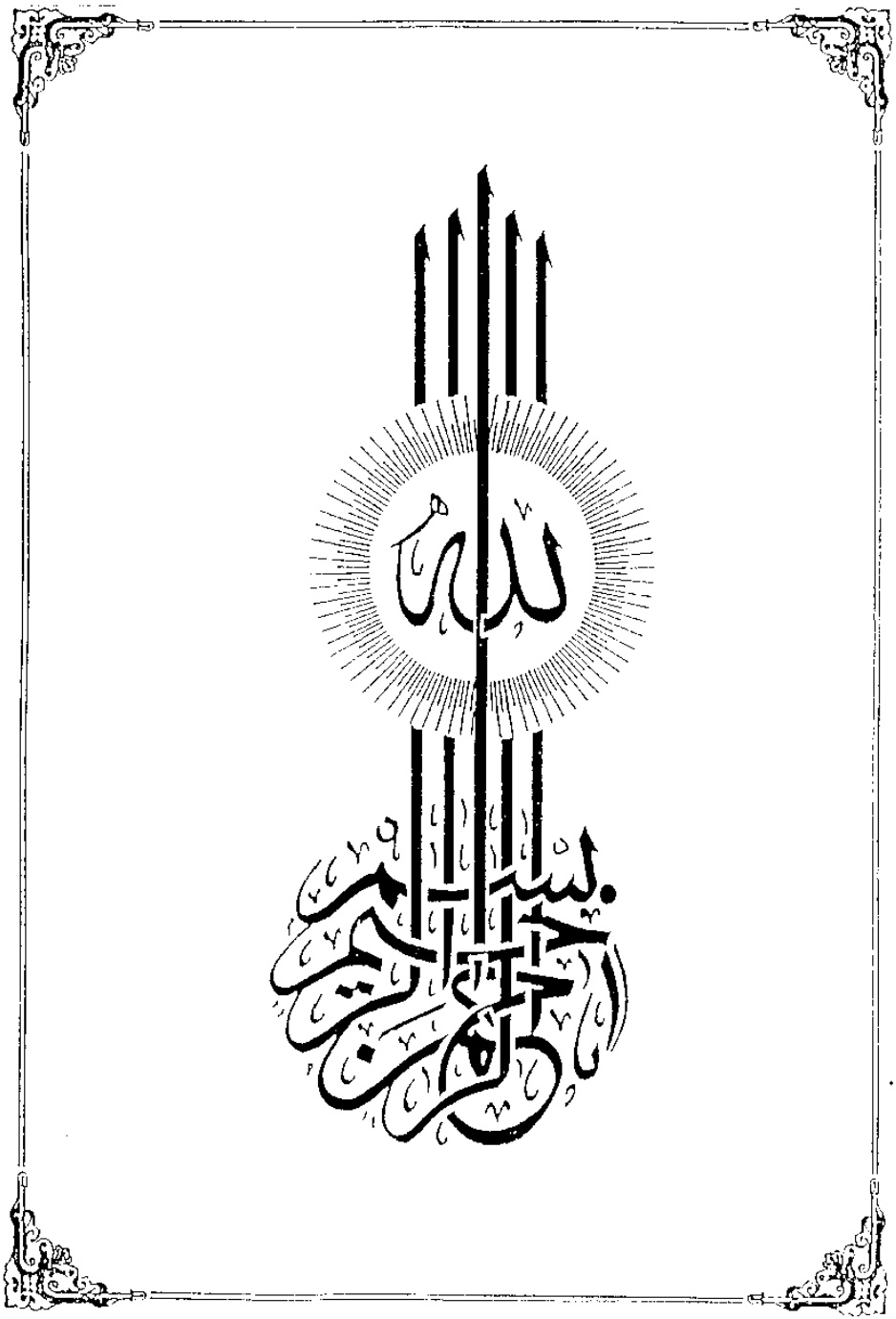

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PART I

- INTRODUCTION
- MATERIALS
- GENERAL METHODS

INTRODUCTION

The growth of a plant depends in part on the interaction of endogenous auxins, growth inhibitors, gibberellins, and kinins, together with certain other, as yet unknown, native substances having regulatory properties. These, and other substances having growth regulatory activity, have been a subject of interest to many plant physiologists, concerning their role and the changes in their levels during seed development and germination.

1. Changes of Growth Regulators during Seed Development

Growth regulating substances including auxins, growth inhibitors, gibberellins and kinins may be involved in seed development.

a) Auxins and Growth Inhibitors

Several investigators have suggested that endogenous auxins and growth inhibitors may have an important role in seed development.

Several investigators (Avery et al., 1942; Hatcher and Gregory, 1941; Hatcher, 1943 & 1945; Hemberg, 1958;

Hinsvark et al., 1954) showed that the auxin content of a number of cereal grains is greatest before maturity and gradually falls as this process proceeds. A decrease in the auxin content of apple seeds towards maturity has also been recorded by Luckwill (1948 & 1953). Nitsch & Nitsch (1955) stated that, the auxin content of kidney bean seeds increases gradually during the course of development, attaining a maximum about the 10th day after the opening of the flower. Wareing & Foda (1957) studying the hormone and inhibitor changes during development of Xanthium seeds, detected two promoting substances more or less identical with indole acetic acid and indole-acetonitrile. The first promoting substance increases gradually during development, then decreases as the seeds become fully mature. The second one, remains at a more or less constant level during the first stages of seed development and then slightly increases in the fully mature seeds. The same authors extracted from Xanthium seeds two growth inhibitors in the aqueous fraction, which appear only during the later stages of seed development. Wright (1956) studying the changes of the growth substances of Ribes nigrum fruit, found 3 auxins and one inhibitor. One of these promoters increases gradually

after fertilization and then decreases towards maturity. The other two promoters show 2 peaks during the fruit development. The inhibitor, on the other hand, shows a gradual increase towards maturity. Sircar and Chakravorty (1957) demonstrated the presence of some auxins in the husks of rice which decrease at maturity. Key and Donald (1959) extracted a natural germination inhibitor, in relatively large amounts, from immature soybean seeds. Varga and Erzsebet (1959) recorded a rapid increase in the B-inhibitor content during the development of bean pods.

The experimental evidences of Amen (1968) indicate that the levels of growth promoting hormones decrease markedly during seed maturation. Krugman (1965) studied the changes in the auxins of sugar pine seeds during maturation. He found that before fertilization, the plant hormone present in the ovule was indoleacetonitrile (IAN). After fertilization, the IAN decreased while the indoleacetetic acid (IAA) increased as the seeds approached maturity. He reported also, that in the developing embryo, IAA synthesis did not decrease as the seeds approached maturity, but continued until the seeds were shed.

Michniewicz and Popowicz (1968) stated that fully mature seeds of Pinus selvestris and Larix decidua were characterized by great amounts of inhibitors and by the lowest level of auxins. Nikolaeva et al., (1968) found an inhibitor in fully mature seeds in both seed coat and embryo of apple and maple seeds. Lodhi et al., (1969) studied the changes in auxin level during different stages of development of parthenocarpic and non-parthenocarpic Ficus carica syconia. They determined the total free auxins in extracts from weekly fruit samples. There were 3 peaks of auxins indentical in the 2 crops. The first auxin peak occurred at the end of period I (first rapid growth period), the 2nd shortly before the end of period II (period of slow growth), and the rise and fall in concentration of the 3rd peak accompanied the rise and fall of fruit growth rate in period III.

Foda and Radwan (1961) extracted two growth promoting substances from Gossypium seeds. They were found to be at their maximum level during the early stages of seed development, and towards seed maturity they showed a significant decrease. No growth inhibiting substances were found in the extracts of Gossypium seeds during the different stages of their development. Foda & Radwan

(1962) extracted from Prunus seeds two growth-inhibiting substances which showed a gradual increase in their activities towards seed maturity.

b) Gibberellins and Gibberellin-like Substances

Endogenous gibberellins or gibberellin-like substances may be involved in seed development.

The presence of gibberellin-like substances in the young seeds or fruits of Phaseolus vulgaris, Pisum sativum, Lupinus sp., Aesculus californica, Echinocystis macrocarpa, Zea mays, Prunus domestica, and Prunus amygdalus was reported by West & Phinney (1956).

Mitchell et al., (1951) stated that gibberellin-like substances were probably one of the components of the phyto hormones of Phaseolus seeds. Corcoran & Phinney (1962) obtained evidence for the presence of such substances in the extracts of the young seeds or fruits of 35 sp. of flowering plants representing 20 genera including Prunus, Cucumis, Cytisus. Murakami (1957 & 1959) obtained evidence for gibberellin-like substances from chromatographed extracts from 15 sp. of Leguminosae representing the genera : Albizzia, Arachis & Dolichos.

Radley (1958) and Corcoran & Phinney (1962) stated that growing seeds are known to be a relatively rich source of gibberellin-like substances. Corcoran & Phinney (1962) have shown an interesting correlation between growth of the seed and amounts of extractable gibberellin-like substances from the seeds of Echinocystis macrocarpa, Lupinus succulentus, and Phaseolus vulgaris. On a per seed basis, lowest amounts were obtained from the very young seed and seed that had nearly reached maturity. Increase in gibberellin-like substances occurred during the most rapid growth of the seed with maximal levels appearing at the time the seed approached maturity. The growth of the pericarp was not positively correlated with changes in gibberellin-like substances in the seed, since fruit growth was virtually completed before appreciable increases in gibberellin-like substances were detected. Such results would suggest that the developing embryo may be a site of gibberellin production and that these substances are necessary for the development of the seed and possibly the fruit wall.

Chauhan (1963) studying gibberellin-like substances of buds and seeds of peach at various stages of development,