ABSTRACT

The shoot of the germinating yam tuber piece or 'headless' tuber was found to arise de novo from a tuber germination meristem which was in turn formed from the primary thickening meristem of the tuber. The latter meristem was also the site of origin of tuber-roots, fine,white, surface roots, whose development preceded shoot development. An organ of proliferation, the primary nodal complex (PNC), developed early in shoot ontogeny at the first-formed node of the developing shoot. The PNC later gave rise to roots (PNC-roots), shoots and later the tuber of the new plant.

The PNC was also found to exist at the nodal region of the Dioscorea stem,where its tremendous capacity for regeneration was demonstrated in the production of multiple shoots under conditions of moisture stress, and in root and bulbil production. It was concluded that the PNC was the organ of renewed growth in Dioscorea species.

Differences in the origin, development, morphology, anatomy and germination of bulbils of D. alata and D. bulbifera were observed, the former species possessing late-initiating tuber-like bulbils and the latter, early-initiating stem-like bulbils. Germination showed marked proximal end dominance in D. alata bulbils as was observed in tubers of Dioscorea species, but no such quality was observed in D. bulbifera bulbils in which germination occurred from any region of the bulbil placed in contact with a moist surface.

Gibberellic acid was found to dramatically extend the dormancy of bulbils, tubers and tuber pieces of tropical Dioscorea species, with the exception of bulbils of D. bulbifera on which gibberellic

acid had no apparent effect on length of dormancy. In addition to extending dormancy of dormant storage organs, gibberellic acid also reinduced dormancy in sprouted tubers. Maleic hydrazide and 2,4-dichlorophenoxyacetic acid also occasioned extension of dormancy in tuber pieces of D. alata, but to a much lesser extent, while in tubers of D. esculenta,2,4-D treatment resulted in considerable extension of dormancy. Additionally 2,4-D stimulated the production of large roots on tuber pieces and tubers of both D. alata and D. esculenta. Ethrel greatly promoted tuber-root production.

Anatomically, the effect of gibberellic acid appeared similar to that of normal dormancy in that activity of the primary thickening meristem was suppressed and initiation of both tuber-root and shoot production delayed.

The metabolic effect of 2,4-D and GA_3 as observed with the use of aged tuber tissue, revealed that peroxidase activity generally increased with age but was decreased with increasing concentrations of both growth regulators. These growth regulators had no marked effect on the level of activity of either the phenolase or α-amylase enzymes in aged tuber tissue. Additionally, there was no significant effect of GA_3 treatment on the activity levels of these enzymes in stored tubers. Therefore, it was concluded that the effect of GA_3 in extending dormancy in yam tubers was probably not mediated through the peroxidase, phenolase or α-amylase enzyme systems.

It was suggested that GA_3 might function both by stimulating the batatasin-synthesising system, responsible for yam tuber dormancy, in immature tubers and by reactivation of the system in dormant and

sprouting tubers. It was also suggested that differences existed between the dormancy mechanism of D. bulbifera and other yam species examined, because of the ineffectiveness of gibberellic acid on the length of dormancy of this species.

The pre-harvest foliar application of growth regulators proved ineffective in extending the tuber dormancy of D. alata and D. rotundata and morphologically and anatomically, tubers from these treatments were similar to control tubers. However, in D. esculenta, gibberellic acid and 2,4-D caused extension of tuber dormancy. In 2,4-D-treated tubers, externally visible callus areas and production of large roots from these areas, made the tubers unattractive. Thus it was established that there existed great possibility for commercial use of gibberellic acid in the extension of yam tuber dormancy through both pre-harvest and post-harvest application.

The thesis is presented in the form of three sections with a total of seven papers, one of which has been published and another submitted for publication.