and private organizations, and assist in the 4-H gardening program. The urban interns participate in radio and television interviews and regular radio programs.

A large portion of the intern's time is spent answering office and telephone calls pertaining to horticulture. The types of questions vary among the counties, although the average percentage figures show that more than half of the questions in 1978 were in areas related to home food production (Fig. 1).

The urban interns contact clientele and disseminate horticultural information through work with Expanded Food and Nutrition Extension Program and with displays in shopping malls, garden centers, and other public locations. Gardening techniques are taught through community garden programs and demonstration gardens maintained by each intern.

With the cooperation and assistance of city officials and businessmen, most urban and rural interns have helped to organize and establish farmers' markets. These markets provide small and part-time farmers with an outlet for their excess produce and a means of supplementing family income.

The interns utilize their time according to the needs of their assigned counties. Nearly 50% of their time is spent in the extension office preparing materials and in telephone and office consultations, allowing the county extension director time for other program activities (Fig. 2).

The interns conduct a special project as part of the course requirements. The projects are chosen to give the student experience in development of extension materials. Many projects involve preparation of slide sets pertinent to the needs of the state and county extension staff.

Evaluation

The students are evaluated at the conclusion of their 6-month internship. They receive their grade in horticulture on the basis of the final report, evaluation by project coordinator, and, in a large part, on the evaluation submitted by the county extension director concerning the effectiveness of the intern as a county extension worker.

The overall response to the program from the county extension staff and the students has been excellent. In the 3 years of the program, 20 students and 9 counties have participated in the program. More applications for interns are received from counties than can be filled. Further, the horticulture intern program has lightened the heavy summer workload of the county extension staff, allowing them to spend more time on other programs.

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Adventive Embryony in Apple[1]

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Abstract. **Adventive embryos of 'Golden Delicious' apple (*Malus domestica* Borkh.), with differentiated cotyledons and axes, were initiated from micropylar halves of nucellus cultured in darkness on Murashige and Skoog's salts, vitamins, glycine, and sucrose. Embryos were observed 50 days after culture. Reculture of embryos onto the same medium resulted in proliferation of embryo-like structures from their cotyledons.**

Apomixis is a frequent occurrence in *Malus* species (2, 6, 10, 11) but nucellar embryony has not been reported. Embryos have been obtained *in vitro* from nucellar tissue isolated from ovules of both mono- and polyembryonic *Citrus* types (3). The stimulation of monoembryonic *Citrus* to form nucellar embryos *in vitro* suggests that the nucellus of other species might respond similarly when cultured. Formation of adventive embryos from maternal tissue has great potential for clonal propagation of disease-free plants, especially of perennial species difficult to vegetatively propagate (1, 9). In this research we evaluate the embryogenic potential of cultured apple nucellus.

The basal medium, adjusted to pH 5.7 ± 0.1, contained Murashige and Skoog salts (8) and the following additional constituents, in mg/liter: sucrose, 30,000; *myo*-inositol, 100; thiamine·HCl, 0.1; nicotinic acid, 0.5; pyridoxine·HCl, 0.5; glycine, 2.0; and Bacto agar, 8000. Experimental media also contained the following concentrations of naphthaleneacetic acid (NAA) and benzylamino purine (BA) in mg/liter: medium I = NAA, 0 and BA, 0; medium II = NAA, 0.1 and BA, 3.0; and medium III = NAA, 3.0 and BA, 0.3.

'Golden Delicious' apple fruits, 5 cm in diameter, (50 days after anthesis) were collected from the Purdue Horticulture Farm in 1978 and surface disinfested for 2 min in a solution containing 70% ethanol and 0.1% Tween 20. Ovules were removed from the fruit and disinfested in 0.26% NaOCl and 0.1% Tween 20 for 5 min, rinsed 3 times with sterile distilled water, and bisected transversely to yield micropylar and chalazal halves. Cotyledons and embryonic axes were carefully removed from the ovule halves. Using microdissecting forceps, the nucellus was sufficiently separated from the integuments to allow insertion of a surgeon's scalpel between the 2 tissues. A longitudinal incision was made through the integuments and the nucellus isolated by removing the integuments with forceps. Twelve micropylar and 12 chalazal halves were cultured on each experimental medium, 1 nucellus half per tube. Half of the cultures were maintained in darkness; the others in 16-hr of daily illumination at 1.5 klx from Cool White fluorescent lamps. All cultures were maintained at constant 26°C.

The experiment was repeated during fall 1978 using 'Golden Delicious' fruits collected at 25, 32, 39, and 46 days after anthesis in Pelotas, Brazil. Fruits were in transit for 9 to 15 days prior to culture.

One micropylar nucellar half on medium I in darkness produced 3 adventive embryos (Fig. 1a) 50 days after culture of explants from fruit collected at the Purdue Horticulture Farm. These embryos had 2 to 4 cotyledons which were either separated or fused. Nucellar explants on all other treatments callused, except those on medium I in the light which showed no development. The 3 adventive embryos were recultured on medium I, and 2 were placed in the light and 1 in darkness. After 22 days (93 days after initial culture of nucellus), embryo-like structures developed from the cotyledons of the embryos placed in darkness. The 2 embryos in the light did not undergo morphogenesis; however, after

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The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked *advertisement* solely to indicate this fact.
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[5]Appreciation is extended to Edilson Paiva for the Brazilian fruit and Dr. R. Nicholson for providing photomicrographic equipment.

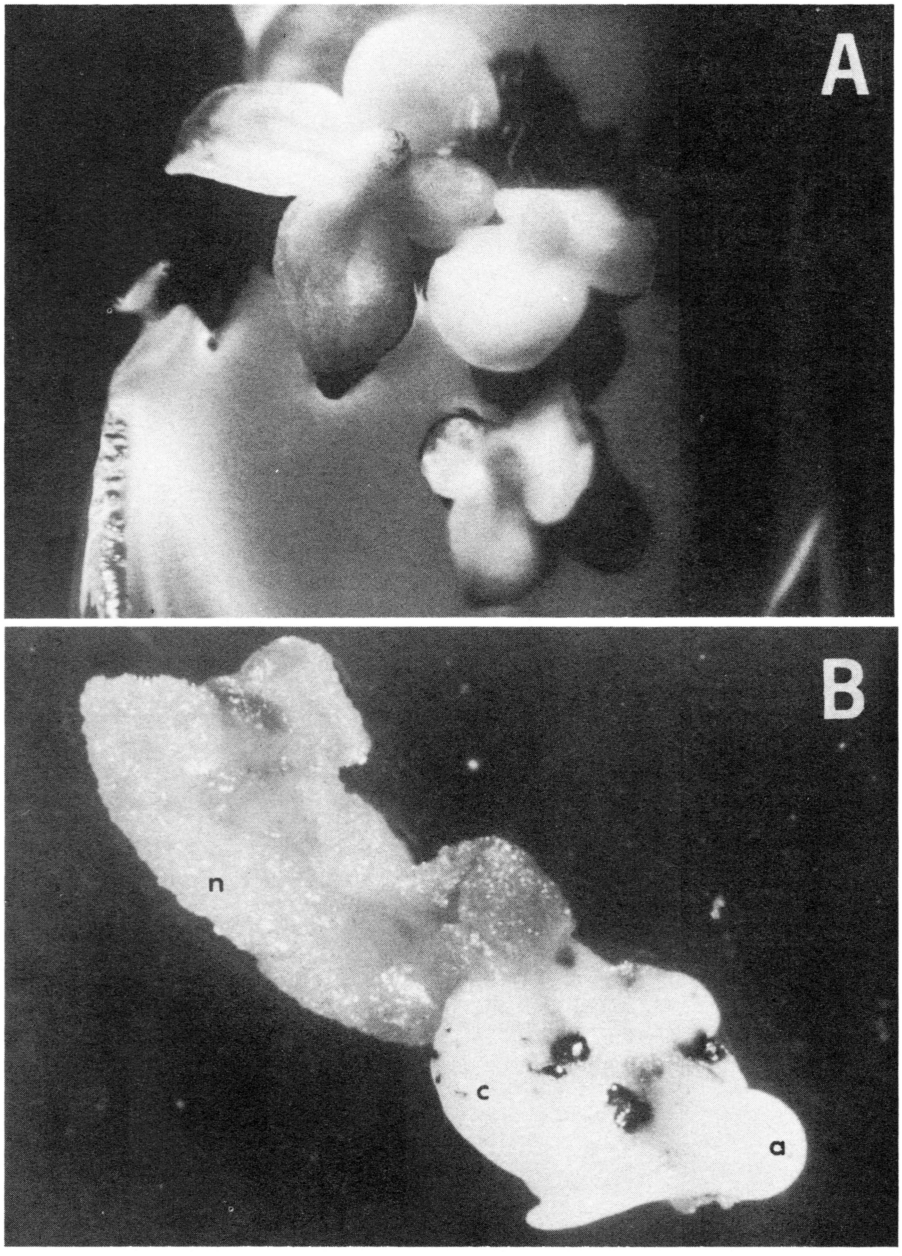

Fig. 1. Adventive embryos of 'Golden Delicious' apple arising from micropylar half of nucellus tissue cultured in darkness on Medium I. (A) Culture material obtained from Purdue University (B) Culture material obtained from Brazil, showing original nucellus (n), and the embryo with differentiated axis (a), and cotyledons (c).

a second transfer to medium I (28 days after the first reculture) and placement in darkness, embryo-like structures formed from their cotyledons 69 days later (168 days after initial culture).

In experiments utilizing Brazilian fruits collected at 32 and 46 days postanthesis, embryogenesis occurred only on medium I from micropylar halves in darkness after 50 days in culture (Fig. 1b). Cultures from each sampling period yielded 1 embryo. Additional embryo-like structures were also observed from the cotyledons and axis of the adventive embryo. Cultures from the 39-day fruit did not form embryos. The 25-day sample was not cultured due to poor condition of tissue upon arrival.

Callus from nucellar explants of *Citrus* has expressed the same embryogenic potential inherent in the nucellus (4, 5, 7). Our attempts to obtain asexual embryos from nucellar apple callus have been unsuccessful.

Our results indicate that apple nucellus can undergo embryogenesis *in vitro*. Techniques to proliferate adventive embryos from nucellar tissue would provide a method for rapid, disease-free, clonal propagation of selected genotypes (1, 9).

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