CARBOHYDRATE ACCUMULATION IN RELATION TO VEGETATIVE PROPAGATION OF THE LITCHI[1]

THE most satisfactory method of propagating many woody plants vegetatively is by grafting. In temperate regions, grafting is usually done in the late winter or early spring when the plant has passed through a dormant period, is well stocked with food reserves,[2] and the plant is ready to make its annual increment of growth. In Hawaii, however, there is no apparent dormant season in the litchi and little consequent accumulation of reserves. Starch, the principal carbohydrate storage form in the litchi, rarely accumulates to greater than .4 to .5 per cent. of the dry weight of non-flowering branches. The small amounts that do accumulate are quickly utilized in making a new flush of growth.

The usual method of propagating the litchi in China is by means of air-layering, which may be considered a form of cuttage. The treatment, *i.e.*, the removal of a ring of bark, is such that carbohydrates accumulate and roots are produced in a suitable container before removal from the tree. Mitchell[3] and Reid[4] have shown the importance of carbohydrates in the rooting of tomato cuttings, while little attention has been given to their importance in vegetative propagation by grafting. For many years, attempts have been made to graft the litchi, without regard to the carbohydrate storage, with very little success. By using scions high in starch we have increased the percentage of successful grafts from 10 per cent. as reported by Pope[5] to 75 and 80 per cent. Carbohydrates are caused to accumulate in the scion by removing a small ring of bark about one eighth inch wide from the branch, to be used three to four weeks later as scionwood. This branch should be about one half to three fourths inch in diameter. Table 1 shows the composition of the scionwood before and three weeks after girdling.

TABLE 1

EFFECT OF GIRDLING ON CARBOHYDRATE ACCUMULATION IN LITCHI (LITCHI CHINENSIS)

Per cent. dry weight	Girdled branch	Non-girdled branch
Starch	11.40	0.40
Total sugar	2.10	1.68
Protein nitrogen	1.14	1.16
Soluble nitrogen	0.10	0.12

This principle is also being applied successfully in propagating the macadamia (*Macadamia ternifolia*), which formerly was considered almost impossible to propagate by grafting. The main purpose of this note is to again call attention to the importance of food reserves in vegetative propagation. Table 1 shows that there was very little change in the nitrogen and sugars in the girdled branches as compared to the non-girdled, but that there was about a 28-fold increase in starch.

WINSTON W. JONES
J. H. BEAUMONT
AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF HAWAII

SCIENTIFIC APPARATUS AND LABORATORY METHODS

"AIR CONDITIONING" FOR MICROTOMES

HOT weather has always offered a serious handicap to the cutting of tissues embedded in paraffin. In many places this difficulty is experienced from June to November or even longer. It is therefore with a great deal of satisfaction that I can present here a method for cooling the microtome and tissue that takes but a few minutes to put into operation, is inexpensive to operate and is superior in cleanliness and effectiveness to the variety of devices already suggested.

Select a strong corrugated cardboard box with a cross-section approximately 12×12 inches and a length of about 18 inches. Lay it on one side with the top toward you. Leave the top flaps intact. Place the microtome in the box. Cut a rectangular window about $2\frac{1}{2} \times 4$ inches in the box just above the object block of the microtome. Obtain a pound coffee tin or one of similar dimensions and punch a few holes in the bottom and top. Insulate the tin by wrapping it in any good insulating material. Insulating felt is preferable, although a sufficient swathing of newspapers will do. Leave top and bottom of the tin exposed. Put one or two pounds of dry ice in the tin. Place the tin over the rectangular window on top of the cardboard box. A down draught of air is carried over the dry ice through the holes in the bottom of the can and from there the cold streams of air drift downward over the object mounted in paraffin, over the knife and over the microtome as a whole. When the lid flaps are closed the temperature inside of the box soon falls to six or eight degrees below room temperature.

With the paraffin block, knife and microtome at practically the same temperature, sections cut readily and adhere to form perfect ribbons. When the lid

[1] Published with the approval of the Director, Hawaii Agricultural Experiment Station.

[2] A. E. Murneek, *Proc. Amer. Soc. Hort. Sci.*, 30: 319–321, 1933.

[3] John W. Mitchell, *Plant Physiol.*, 11: 833–841, 1936.

[4] Mary E. Reid, *Amer. Jour. Bot.*, 13: 548–574, 1926.

[5] W. T. Pope and William B. Storey, Hawaii Agr. Expt. Sta. Circ. No. 6, 1933.

flaps are opened the streams of cold air continue to fall on the knife and paraffin block so that no serious change of temperature takes place.

In a box of the size mentioned no difficulty is experienced in turning the wheel of a rotary microtome, although it is not easy to adjust the paraffin block to proper cutting position. This can be accomplished by sliding the microtome out of the box to make the adjustments. A better method is to remove the floor of the box so that the microtome can stand on the table. In the latter case the entire box can be pushed back to expose the microtome.

Should the tissue and paraffin become too cold push the dry ice container away from the window until the proper temperature conditions are reestablished. Two pounds of dry ice costing ten cents will adequately "air condition" a microtome for five or six hours.

ROBERT T. HANCE

UNIVERSITY OF PITTSBURGH

A METHOD FOR STUDYING ENVIRONMENTAL CHOICES OF LABORATORY ANIMALS

A PIECE of research on the white-footed mouse, *Peromyscus leucopus noveboracensis,* demanded a study of the activity of the animals during periods of light and darkness. It was also necessary to determine how much time an animal spent in the light when it was free to make a choice between the two environmental factors. The apparatus to be described records such information continuously for as long as ten days if desired. It is hoped that other workers may find the method useful as adapted to their particular problems.

A two-compartment cage of a size suitable for the animal under investigation was constructed of light wire. (See the accompanying illustration.) One compartment, D, is made light tight and is connected by a tunnel, T, to the other, O, which is left uncovered, open to the environmental condition of light. Nesting material, food and water may be assigned to the two portions of the cage as seen advisable.

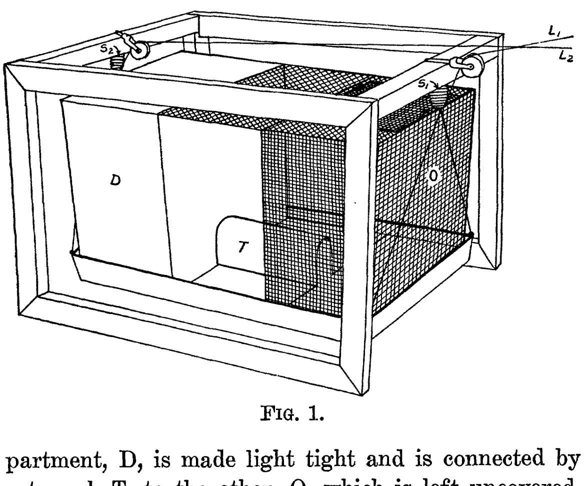

FIG. 1.

The cage is suspended to a suitable support by springs, S_1 and S_2. When the animal is active the cage moves up and down. When the weight of the animal is moved to one compartment the corresponding end of the cage is depressed, while the other is elevated. This shift may be exaggerated by moving the attachments of the two springs nearer to each other. Threads L_1 and L_2, connected with the ends of the cage and running through suitable pulleys, are attached to light heart levers on a ring stand. The levers make contact one above the other with the smoked paper of a slow moving kymograph. Movements of the animal are registered by both levers. If the upper lever is actuated by L_1 from the front end of the cage there is a spreading of the lines of the record when the animal is in front, O, whereas the lines approach each other when it is in the back compartment, D. An interval marker (alarm clock making electrical contact by either hand at twelve o'clock) leaves a time record every hour and a special mark at noon and midnight. A record of time and duration of the illumination of the unit is added by hand. Examination of the fixed paper reveals the time of activity and the position of the animal relative to light and darkness at any time during the experiment.

This method might be applied to various studies of animals heavy enough to move light heart levers in suitably constructed cages, except fish and others which must live in water continuously. That is, the choice an animal makes between two different environments which can be maintained in one cage can be determined and readily studied. For example, temperature choices of frogs, light choices of snails or moisture choices of certain insects might be recorded.

WAYNE L. WHITAKER

DEPARTMENT OF ZOOLOGY
UNIVERSITY OF MICHIGAN

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MAYNARD, LEONARD A. *Animal Nutrition.* Pp. xiv + 483. 36 figures. McGraw-Hill. $4.00.

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