

large amounts of selenium in their fruit as a result of spraying with selenium dissolved in potassium ammonium sulfide solution for the control of red spider.

A complete account of this and other work on

selenium carried out in the California Agricultural Experiment Station is in process of compilation.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

GROWTH SUBSTANCE DETERMINATIONS

THE Went *Avena*-coleoptile test and the *Cephalaria* test of Söding are the most sensitive ones that have been devised for quantitative hormone studies. These tests, however, are available only to a few laboratories which have facilities for the accurate regulation of temperature, humidity, etc.

The authors have developed a method of hormone determination which requires only the facilities available in every botanical laboratory. The manipulation is simple, no special apparatus is required, and the method is applicable over a wide range of growth substance concentrations. It may be used for detection of hormones at the low concentrations to which the *Avena* coleoptile responds, but so far as the method has been tested, does not appear to be available for the detection of minute differences within the low range of concentrations, as do the *Avena* and *Cephalaria* tests.

The new method depends on the fact that when etiolated seedlings of *Lupinus albus*, decapitated below the cotyledons, are exposed to light, growth ceases almost completely. However, when a growth substance is applied to the cut surface of the hypocotyl, elongation of the hypocotyl takes place in the presence of light, and this elongation is proportional to the concentration of the growth substance applied.

Some twelve or fourteen *Lupinus albus* seeds of approximately uniform size are planted in six-inch pots in sand. They are germinated in a dark room for six to seven days, or until the hypocotyls are seven to eight centimeters high. In the morning the pots are brought into the light, and the seedlings are selected for uniformity. The cotyledons are cut off with a razor blade, at the apex of the V-shaped notch which they make with the hypocotyl. A mark is made one centimeter below the cut, with India ink, and the growth substance is applied in an agar block, or in lanolin paste to the cut surface of the hypocotyl. The pots are placed under bell jars in order to insure high humidity and are exposed to full daylight. On the morning of the fourth day, the increase in length of the original centimeter segment is measured. Ten to fifteen test plants are used for each determination. With low concentrations of growth substances, control plants treated with lanolin or agar only are run in the same pot with the test plants. Indole-3-n-acetic acid in appropriate dilutions is used as a standard.

A straight-line relationship is obtained when high

concentrations of heteroauxin ($100 \gamma - 0.01 \gamma$) are plotted logarithmically against increase in growth. However, in the lower range of heteroauxin concentration detected by the *Avena* test¹ ($0.01 \gamma - 0.001 \gamma$) the curve rounds off.

The wide range of concentrations to which the hypocotyls respond should make this test especially applicable to the study of the growth-promoting activities of various substances that are not inactivated by light. Moreover, a test object whose physiological make-up is somewhat different from that of *Avena*² should prove of value in attempting to understand the mechanism of growth reactions.

The authors have had the benefit of Professor F. G. Gustafson's interest and advice in the studies, which will be described later in greater detail.

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A BODY PLETHYSMOGRAPH FOR MEASURING RESPIRATORY VOLUMES WITH HIGH RESPIRATORY RATES

WHEN animals which are deficient in sweat glands, *i.e.*, dog, cat, rabbit, etc., are exposed to heat they develop a peculiar type of respiration called "heat polypnea" or "panting." The ventilation and respiratory rate increase, while the tidal volume decreases. With dogs respiratory rates may reach over 300 per minute. In measuring respiratory volumes of panting animals it is customary to use a tracheal canula or mask connected through valves to a recording system such as a respirometer or gas meter. Objections to this method include the following: (1) either anesthetics must be used or the respiratory pattern becomes subject to artificial alterations due to pressure stimuli, pain, etc.; (2) the dead space of the apparatus does not match that of the normal animal; (3) canulae impede air movement; (4) the purpose of panting is to blow air over the moist surface of mouth, tongue and pharynx for purposes of evaporation and this cooling mechanism is lost to the canulated animal; (5) moving mechanical systems have the disadvantages of having appreciable inertia and of giving false records when the respiratory period approaches or becomes less than the natural period of the moving system. In order to

¹ George S. Avery, Jr., Paul R. Burkholder and Harriet B. Creighton, *Am. Jour. Bot.*, 24: 226-232, 1937.

² Sam Granick and H. W. Dunham, *Papers, Mich. Acad.*, 22: 69-78, 1936.