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The Use of P in Preparing Radioautographs

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The Use of $_{15}P^{32}$ in Preparing Radioautographs

Specially prepared tomato plants were injected with $_{15}P^{32}$. The penetration of the radioactive material into the stem and leaves of the plant was shown by Geiger counter tests. To make the radiograph, the plant was wrapped in Saran-Wrap, placed in a cassette with a sheet of Royal-X-Pan film and left for five days. On the size of film used (16x10 inches), very clear definition was obtained.

A radioautograph is a photograph produced by exposing a sensitive film to the radiations emanating from a source which has been impregnated with radioactive material. In the present experiments the source was a tomato plant which had been impregnated with a solution of $_{15}P^{32}$. To prepare the plant for the experiment, it was fed for six days with a nutrient solution from which monopotassium phosphate (KH_2PO_4) had been withheld and for which potassium phosphate (K_2SO_4) had been substituted. (Turtox; Boyd, 1955.) Thus the necessary potassium ions were provided but the plant was "starved" for phosphorous, making it fairly certain that it would be quite ready to quickly absorb $_{15}P^{32}$ when provided. This proved to be the case.

Radioactive phosphorous $_{15}P^{32}$ is particularly suitable for an experiment of this kind. It is plentiful, inexpensive and not too dangerous to handle. $_{15}P^{32}$ is a beta ray emitter having a half-life of 14.3 days. There is some danger from x-rays produced when the beta particles are stopped by matter, but if the standard precautions for handling radioactive materials are followed there is little hazard. The solution used was in vials containing 25 microcuries in 4cc. of water. Constant checking of hands, clothing and equipment by a Geiger counter is advisable in the procedure following.

The plant selected for the test was impregnated with 50 microcuries of ${}_{15}P^{32}$, using a luer glass syringe with a 17 gauge, 3 inch needle. The needle was thrust into the thick part of the stem just below the surface of the dirt, and just above the roots. (See Fig. 1.)

Figure 1—Injecting the plant with 50 microcuries of ${}_{15}P^{32}$, using a Luer syringe.

After an hour, Geiger counter tests were made on a Tracerlab Laboratory Monitor provided with a .015 inch mica window counter tube. Since the limit of this counter was 20,000 counts per minute, the tube was fitted with a lead cap with a 2mm. hole drilled in it. The tube was held at 1 inch distance from the points where recordings were taken. One can see that not too much accuracy can be expected with this method. Figure 2 shows a record of the count obtained.

To make a radioautograph the plant was up-rooted carefully from the dirt, and washed off under running water. Most of the dirt was shaken off first, and the rest was carefully washed down the drain, where sufficient dilution eliminated any hazard. Great care must be taken to protect the hands at this point, and rubber gloves are recommended. Each plant was cut off just above the roots, since

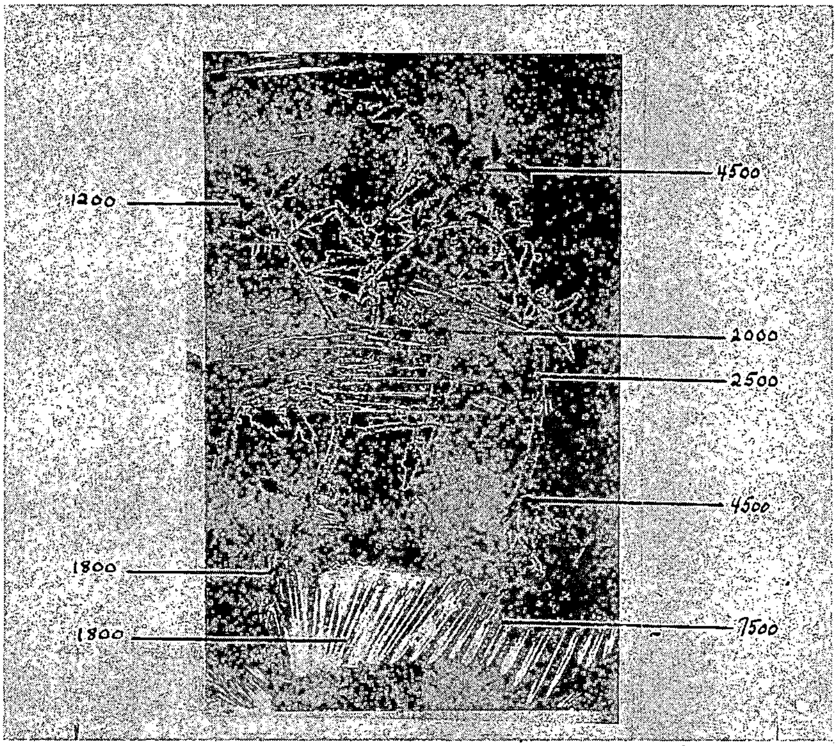

Figure 2—Readings in counts per minute taken on the Geiger counter one hour after plant's injection.

they were too long to fit on the cardboard used. It was mounted on the cardboard with Scotch tape and covered with Saran-Wrap. On the second piece of cardboard two sheets of 8 x 10 inch Royal-X-Pan film (Eastman Kodak Company) were taped, to make a film area of 10 x 16 inches, corresponding to the sheet containing the tomato plant. These were then put together face to face, with the saran covered plant in close contact with the emulsion of the film. These were taped together and inserted into a cassette shown in Figure 3. The cassette was then sealed with tape, spread out on a shelf, and weighed down to insure complete flattening and good contact between film and plant. This whole operation was done in complete darkness, since the film used here has an ASA exposure

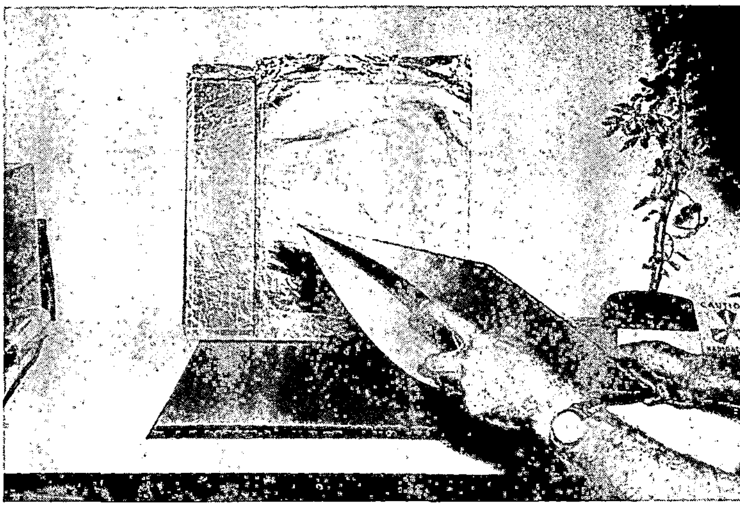

Figure 3—Cassette ready to receive saran-wrapped plant and film for 5 day exposure.

index rating of 1600. This film was chosen purposely because of its high speed, meaning shorter exposure times would be possible. The cassette was left undisturbed in the darkroom, which was sealed shut and posted with radiation hazard signs for five days and five nights.

The film was removed and processed in the usual way. The stem and leaves were very clearly outlined and the veins in the leaves are readily seen. It must be admitted that the large negative (10″ x 16″) shows the details of the radioautograph much better than the reduced print which is reproduced here in Figure 4.

To dispose of the flower pots and dirt from the experiment, all material was isolated for four half lives (about 60 days). After this time it was perfectly safe to handle in the ordinary manner.

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Figure 4—Reduction of 10x16 inch negative radioautograph. Definition is excellent on film. (Dark mass on lower right side of picture shows roots which after impregnation, were cut from main stem to reduce length of film required.)

carried out, and finally to Drs. Albert J. Linck and James D. DeVay, Assistant Professors of Plant Pathology, St. Paul Campus, University of Minnesota, who provided valuable information on the technique of making radio-autographs.

LITERATURE CITED

BOYD, GEORGE A. 1955. *Autoradiography in Biology and Medicine.* New York, Academic Press, Inc.

TURTOX SERVICE LEAFLET NO. 51. *Hydroponics; Growing plants in nutrient solution without soil.* (General Biological Supply House, 8200 Hoyne Avenue, Chicago.)