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Absorption of P-32 and 1-131 by Coleus blumei (Labiatae)

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Absorption of P-32 and I-131 by *Coleus blumei* (Labiatae)[1]

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Abstract. Quantity and rate of absorption were tabulated and analyzed. Radioautographs produced an accurate method of determining the concentration and location of the isotopes in the plants.

This experiment was undertaken to determine the translocation and concentrations of the radioactive isotopes P-32 and I-131 in *Coleus blumei.* Ten microcuries of each of the isotopes were obtained from the Atomic Research Laboratories, Oak Ridge, Tennessee. Eight potted *C. blumei,* similar in appearance and size, were selected as test plants.

Due to the half-life of these isotopes (14.3 days for P-32 and 8 days for I-131) experimentation was begun promptly upon the arrival of the isotopes. Tap water (200 ml) was placed in each of 8 bottles which were 8 cm. high with mouth openings of 4 cm. The ten microcuries of each isotope were divided into groups of 3 μc, 3 μc, 3 μc, and 1 μc, and added to the water.

Safety procedures were observed in handling the radioactive substances, and self-exposure was kept at a minimum. Forceps and gloves were used. Experimentation was conducted under the supervision of a radiologist. All equipment was safely disposed of. After the plants were washed free of all particles of soil, they were placed in the water-isotope solution. P-32 and I-131 translocation was checked with a Nuclear Geiger counter capable of registering 600,000 counts per minute. The coleus plants absorbing the P-32 were checked for beta emissions; the plants absorbing the I-131 were checked for gamma rays (Figure 1).

During the experiment the background count was noted to be higher than was expected. To investigate this, specially prepared fly paper obtained from the Health and Safety Laboratory of the Atomic Energy Commission, New York City, was used. This special paper was mounted on a wooden frame and left outdoors for four days. Then it was ashed and checked with the Geiger counter. The background count was 200/minute. This is a considerable increase over the average, but these results coincided with data ob-

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tained by others in the vicinity. This pointed to increased fallout in this area.

Within a short period after the isotope application, activity was detected in the stems and leaves. These were checked with the Geiger counter four hours after the plants had been placed in the water-isotope solution. Each plant was tested every 24 hours and the data tabulated as indicated in Table 1 and Table 2.

Table 1

Radioactivity in Coleus Plants Treated With P-32

P-32 Strength	Time of Uptake	Leaf Activity			
		4 hrs.	24 hrs.	48 hrs.	60 hrs.
1 μc	24 hrs.	250 c/m	300 c/m	x	x
3 μc	24 hrs.	250 c/m	900 c/m	x	x
3 μc	48 hrs.	200 c/m	400 c/m	600 c/m	x
3 μc	60 hrs.	260 c/m	900 c/m	1300 c/m	1750 c/m

Table 2

Radioactivity in Coleus Plants Treated With I-131

I-131 Strength	Time of Uptake	Leaf Activity			
		4 hrs.	24 hrs.	48 hrs.	60 hrs.
1 μc	24 hrs.	200 c/m	200 c/m	x	x
3 μc	24 hrs.	200 c/m	200 c/m	x	x
3 μc	48 hrs.	220 c/m	300 c/m	450 c/m	x
3 μc	60 hrs.	220 c/m	370 c/m	380 c/m	x

To prevent the radioactive-water solution from influencing the counts in the leaves and stems, lead shielding was fitted snugly around the stem and over the top and sides of the bottles. The probe was placed 5 cm. from the radioactive testing material. Figure 2 shows the effect of P-32 and I-131 on coleus.

Results

It can be seen that radioactive phosphorus was readily absorbed, whereas the radioactive iodine was taken up very slowly and in small quantities. Since plants need phosphorus for their metabolism, the coleus quickly absorbed the P-32; on the other hand, I-131 is not needed in plant metabolism and, as a result, the I-131 was not taken up in the same quantity as P-32.

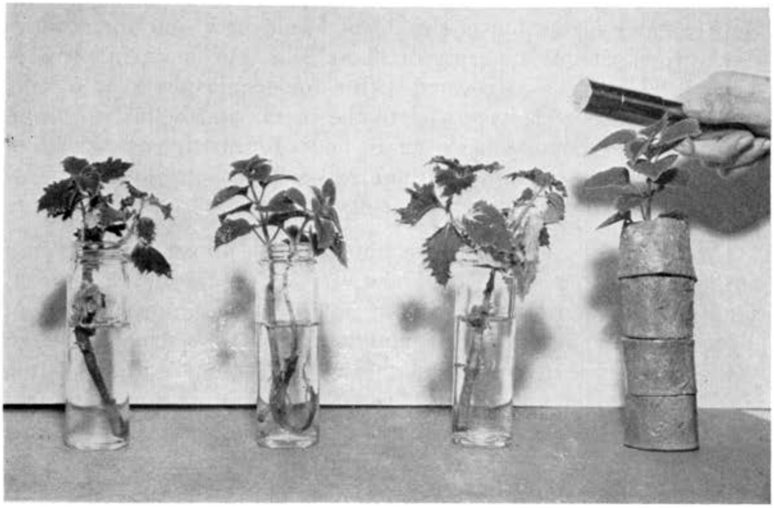

Figure 1. *Coleus blumei* in isotope-water solutions. Plant on the right has roots shielded with lead during the check on the foliage.

Radioautographs

The exact location and the greatest concentration of radioactivity in the plant was determined by radioautographs. The first problem in radiography is to determine the proper time of exposure of the plant to the photographic film. Overexposure or underexposure will produce inaccurate readings. Experimentation produced a successful table for time exposure.

In a dark room, illuminated by a red light, the "hot" plants were placed on 10 by 12 and 8 by 10 photographic (x-ray) film. Since the plants were radioactive, gloves were worn throughout the entire process. Every part of the plant had to be exposed to the

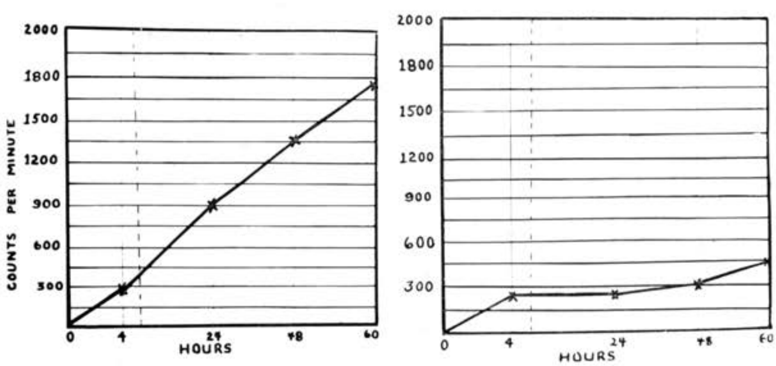

Figure 2. (Left) Absorption of P-32. Note the large amount absorbed. (Right) Absorption of I-131. Note the comparatively small amount absorbed.

film so that each section of the coleus would be visible for accurate observation. Scotch tape was used to hold the plants in place on the film. The film was covered with a folder and placed in a light-tight box which added pressure to the plants and helped to flatten them. Film exposure times were 10 hours for specimens exposed to 1 μc solutions; 24 hours for those exposed to 3 μc for 24 and 48 hour periods; and 32 hours for plants exposed to 3 μc for 60 hours.

The films were placed in wire frames which prevented them from curling or sticking together. They were left in the developer solution (silver halide crystals, sodium hydroxide, sodium sulfate, and potassium bromide) for three minutes. They were fixed in sodium thiosulfate (hypo), ammonium thiosulfate, sodium sulfate, ascetic acid, and salts of aluminum. Then the films were washed in tap water until all traces of the fixer were removed and all cloudiness had disappeared. Plants were immediately disposed of.

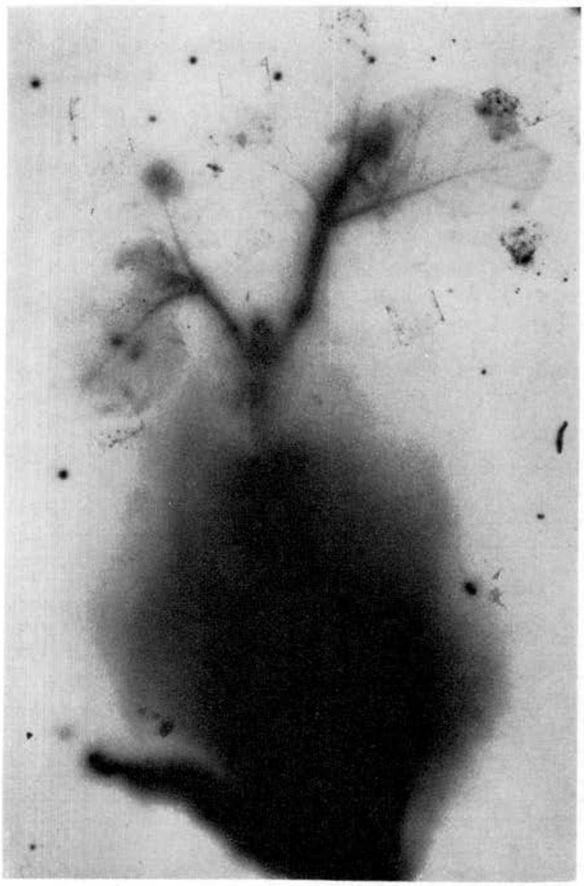

Figure 3. *Coleus blumei* exposed to P-32 for 60 hours. Note scattered radiation effects, the visible veins in leaves, and the high concentration at the apex.

Interpretation of Radioautographs

In plants which were exposed to the 1 μc and 3 μc solutions for 24 hours P-32 showed greatest concentration where the secondary stems began to branch off. The corresponding specimens which were exposed to the 1 μc and 3 μc solutions of I-131 showed greatest concentration where the secondary stems branched off also, but the concentration was considerably less in the I-131 than in the P-32 plants. The 3 μc specimens of both were more concentrated than the 1 μc specimens.

The plants with a 48-hour exposure to isotopes showed a large increase in the P-32 uptake. Radiation effects speckled the film surrounding the plant. The reason for this is that the potency of P-32 concentration was great enough to emit particles which showed up on the film. The radioactivity of the plant "jumped," as it were, to other portions of the film and showed up as black shadowed spots. The I-131 exposed for 48 hours did not differ much from the 24-hour exposure except for the shadowing effect, which was slightly more concentrated around the upper portion of the roots.

The 60-hour exposure to P-32 was far better than anticipated. The radiation effect surrounding areas near the plant literally saturated the film with spots of radiation, some as large as dimes. These spots were numerous and concentrated. P-32 had progressed to the apex of the plant where it remained concentrated. The veins of the younger leaves were saturated with radiation, as can be observed in Figure 3.

The plants exposed to I-131 showed the greatest concentration at the union of the secondary stems. The veins indicated that young leaves absorbed a greater amount of the isotope than did the older leaves. Only three or four spots of radiation were noted around the coleus exposed to I-131 for 60 hours.

Conclusion

Observations and data in this research lead to the following conclusions:

(1) P-32 is absorbed by coleus more readily than is I-131.
(2) P-32 is absorbed by coleus in greater quantities than is I-131.
(3) P-32 accumulated in the apex of coleus with great concentrations in the veins of the younger leaves.
(4) I-131 accumulated at the union of the secondary branches.

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