THE IMMEDIATE EFFECT OF SEVERING ON THE PHOTOSYNTHETIC RATE OF NORWAY SPRUCE BRANCHES[1,2,3]

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Though many investigations of photosynthesis have been carried out on detached parts of plants, the immediate effect of the severance of tree branches on their rate of photosynthesis has not been demonstrated. Lundegårdh (5) states that the photosynthetic capacity of a leaf (no species given) is not altered by cutting it from the plant, though it might be indirectly affected through changes in cell turgor or stomatal aperture. Matthaei (6) showed that under certain conditions, detached leaves of the evergreen cherry laurel (*Prunus laurocerasus*) maintained a constant rate of carbon dioxide assimilation for 10 to 24 hours and in some cases even longer. Recently Freeland (3) used detached twigs of coniferous trees to determine the effect of age of needles on the photosynthetic rate. These investigations showed that a more or less steady rate of photosynthesis was maintained over a period beginning some time after detachment of the leaf or twig. No data were given, however, for rates of photosynthesis prior to or immediately following severance.

The experiment reported here was designed primarily to determine whether the photosynthetic rate of spruce branches changed during the period immediately following their detachment from the tree. In addition, a study was made of the effect of clipping the needles of the current year from twigs as compared to the effect of removing the entire current year's twigs. This latter question is of importance in studies of defoliation.

The experimental trees, which had been growing in large flower pots for more than a year, were 30.5 to 40.6 cm high and from five to seven years old. All were apparently in good health as indicated by regular shoot growth increments for the past three growing seasons. The current year's shoots were well developed but their needles were not fully matured.

Photosynthetic rates were obtained by enclosing a branch in an illuminated chamber and measuring the rate of reduction of carbon dioxide concentration with an infra-red gas analyzer. The apparatus has been described by Decker (2).

A tree was placed on its side beneath the photosynthesis chamber and a branch, consisting of two or three years' growth, was inserted into the chamber which was then sealed with modeling clay. For a 30-minute period prior to the first photosynthesis run, the branch was subjected to routine operating conditions (5300 fc, 28° ± 0.5° C) except that room air was pumped through the chamber. This induction period was inserted because earlier work with spruce showed that the photosynthetic rate increased during the first 15 minutes, or more, of illumination. The system was then closed and the air within it recycled continuously between the chamber and the analyzer. A minute quantity of carbon dioxide was injected into the circulating air stream and the rate of photosynthesis was determined by timing the fall of carbon dioxide concentration over the range 0.712 mg to 0.476 mg per liter of air. The mean operating concentration, 0.594 mg CO_2/l air, is that generally accepted for normal air (1, 4). Three photosynthesis runs were made. The branch was then severed below the chamber and recut under water without disturbing the clay seals. Three runs were made on the severed branch. Next, the chamber was removed, the current year's needles were clipped off, the chamber was replaced and resealed and three runs were made on the partially defoliated branch. Lastly the defoliated twigs were cut off and three runs were timed for the pruned branch. The total elapsed time for each branch was about 2.5 hours from the start of the induction period to the end of the last timed photosynthesis run.

The experimental design was that of paired individuals (7) with each pair consisting of measurements of the same branch before and after the treatment. This procedure excluded inter-tree variability from the analyses and thus only the differences due to treatments were tested.

The results (table 1, fig 1) show that there was no change in the photosynthetic rates of spruce

TABLE I

APPARENT PHOTOSYNTHESIS OF 20 NORWAY SPRUCE BRANCHES

	MEAN RATES AS MG CO_2 PER BRANCH PER HR				
TREATMENT	1ST RUN	2ND RUN	3RD RUN	MEAN RUN	MEAN DIFF.
Branch attached	4.320	4.335	4.339	4.3360	0.0065 ± 0.0456
Branch severed	4.329	4.315	4.343	4.3295	
Needles off	2.318	2.345	2.364	2.3435	0.0230 ± 0.0249
Twigs off	2.317	2.321	2.324	2.3205	

	Statistical analysis				
	d.f.	Mean diff.	s_d*	t	prob.
Attached vs. severed	19	0.0065	0.0218	0.298	0.60
Needles off vs. twigs off	19	0.0230	0.0119	1.925	0.07

* Standard error of mean difference.

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[3] Work was done in the Department of Botany, New York State College of Forestry, Syracuse, New York.

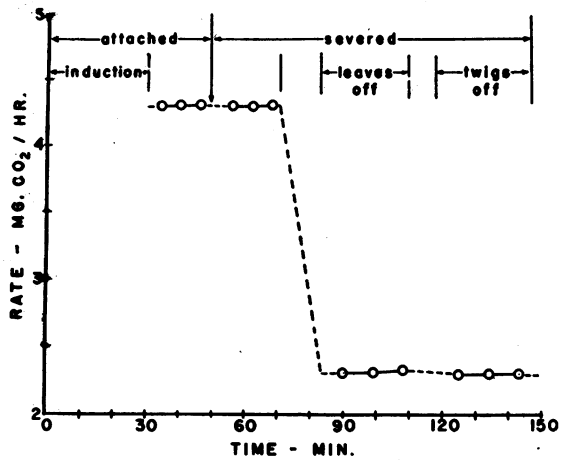

FIG. 1. Time course of photosynthesis in Norway spruce branches before and after detachment from tree, then with the current year's needles and twigs removed.

branches for 20 minutes following detachment from the tree, and, as indicated by the new constant rate after defoliation there probably was none during the 90 minutes following detachment. The results also show that the two methods of artificial defoliation differed negligibly in their effects on apparent photosynthesis.

The sensitivities of the experimental and analytical methods were such that a mean difference between treatments of about one percent would have been statistically significant.

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THE INFLUENCE OF 2,4-DICHLOROPHENOXYACETIC ACID ON THE PHOSPHORUS METABOLISM OF CRANBERRY BEAN PLANTS (PHASEOLUS VULGARIS) [1,2,3]

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The effects of 2,4-dichlorophenoxyacetic acid (2,4-D) on several aspects of the metabolic activity in bean plants have appeared in numerous publications, but little information is available on the influence of this compound on the metabolism of phosphorus. Recently, Loustalot et al (3) have shown that application of 2,4-D to white bean plants increased the inorganic phosphorus content. Since the latter substance plays an important role in the biochemical processes of plants, the effect of 2,4-D on the metabolism of this important element was studied.

Samples of leaf, stem, and root tissue of the cranberry bean plant were obtained by the procedure described by Neely et al (4). Seeds of a certified strain of cranberry bean plants were selected for uniformity of size and planted in 4-inch pots in the greenhouse in April of 1953. Each pot contained two plants that were treated with 2,4-D (1000 ppm) when the first trifoliate leaves were expanding, approximately 10 days after planting. The plants were harvested 6 days after treatment and three replications of 200 plants each of 2,4-D treated and non-treated plants were used for the analyses. The phosphorus content of the leaf, stem, and root tissue was divided into the following four fractions: total, acid soluble, alcohol soluble, and nucleic acid phosphorus. Phosphorus was estimated by the method outlined in the AOAC (1). For total phosphorus the samples were ashed in a muffle furnace. Solutions for alcohol soluble determinations were prepared by a modified procedure of Snell and Snell (8) using a HNO_3–$HClO_4$ oxidizing agent; acid soluble phosphorus by method of Pons and Guthrie (5); and nucleic acid phosphorus according to the procedure of Williams (10).

The results when expressed as mg of phosphorus per one hundred plants are summarized in table I. The phosphorus content of the leaves of plants

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