THE TRACE AND MAJOR ELEMENT COMPOSITION OF THE LEAVES OF SOME DECIDUOUS TREES
II. SEASONAL CHANGES
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INTRODUCTION

While soil examination is valuable for indicating the nutrient status of agricultural land, tissue analysis is often used as a means of studying the nutritional status of trees and plantation crops. Interpretation of the results of tissue analysis requires not only an appreciation of the complex biochemical and physiological functions of the inorganic constituents, but also a knowledge of seasonal changes in composition.

Arnon 1, Gauch 12, Hewitt 15, and Stiles 22, in reviewing published work, report some interchangeability of the functions of different elements in plants. Antagonism between different elements has been reported by Hoagland 16, Olsen 23 24, Lundegårdh 20 and others, while Cain 8 has shown that antagonism reported in leaves can often be ascribed to translocation and distribution factors rather than absorption or uptake by the plants. Biddulph 4 observed that symptoms of malnutrition are as often due to failures in the distribution system as in the initial absorption. Thus analysis of leaves or other organs cannot be considered to be an unequivocal indicator of nutritional status. Translocation of inorganic elements in plants is itself a complex subject. After Stout and Hoagland 33 provided direct evidence that upward movement of inorganic elements occurs through the xylem, important studies on translocation, mostly using radioactive isotopes, have been reported by Biddulph and Markle 5, Biddulph 4, Robertson 28 29, Langston 18 and Bollard 6. The mechanism is far from being completely understood.

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In an attempt to throw some light on the uptake and distribution of inorganic elements by plants, an investigation on the seasonal variation in composition of leaf and petiole samples collected from a number of mature deciduous trees was carried out during the season of 1959. Some samples of inflorescence were also examined. The effect of sampling height on such composition was also studied. The results of these investigations are reported in this paper, while the details of the materials and methods, together with the findings of some preliminary investigations, such as sampling error, contamination problems and reproducibility of analytical methods, prerequisite to the present study, were given in Part I (Guha and Mitchell 14). The object has been to advance the knowledge of factors related to the assessment of nutritional status by tissue analysis, not to consider the plant physiological aspects of the findings.

As indicated by Deleano and Bordeianu 10, Mitchell 21, Olsen 23, and Kramer and Kozlowski 17, many of the studies on alleged translocation of nutrients to and from the leaves based on concentration alone are of doubtful value because changes in dry weight of the leaves during the season cause fluctuations in concentration. Both concentration and absolute amounts have therefore been considered in this investigation. In all tables presented here, results are given for the weight of 1000 leaves or leaf blades, enabling absolute amounts to be calculated. Unless otherwise stated, all results refer to samples taken near the bottom of the crown.

SEASONAL CHANGES

Studies of seasonal variations were made on three sycamore and horse-chestnut and nine beech trees from the locations detailed in Part I. They were sampled regularly during the growing season, but as space is limited and different trees of the same species gave essentially similar results, generally only one tree of each species, on a granitic soil at Craigiebuckler, Aberdeen, is considered here. Full results have been recorded by Guha 13 elsewhere. Figures 1 to 21 present graphically the seasonal changes in concentration (v. also Table 4 of Part I) and absolute amount of 21 different elements in leaf blades of Sycamore No. 1 and Horse-chestnut No. 1 and leaves of Beech No. 1. Table 1 presents results for petiole, leaf blade, and inflorescence from a second sycamore tree (No. 2); result of samplings from Sycamore No. 3, Horse-chestnut No. 3 and