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Concentration of nitrogen in some plant galls

By

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When healthy and tumorous tissues of an *infected plant* were tested for total nitrogen content, the latter tissue was always found to act as a nitrogen trap. This statement is based largely on the pioneer work done on the chemistry of bacterial tumours of both sugar-beet roots and stems of various plants, e. g. tomato (KLEIN & KEYSSNER 1932). While relative increase of nitrogen may characterize plant tumours, it cannot serve as a chemical character of plant galls. In plant galls, the total nitrogen content was determined to vary greatly according to the species of gall-inducing animal involved, and to be often substantially lower or higher than, rarely equal to that of corresponding leaf tissue (MOLLIARD 1913). An improved knowledge of these relative differences being fundamental to an elementary understanding of the physiology of galls, we carried out two series of similar tests on cecidia of the following four insect species: *Andricus curvator* HTG., *Neuroterus quercusbaccarum* (L.) (both *Hymenoptera* : *Cynipidae)*, *Mikiola fagi* (HTG.) (*Diptera : Cecidomyiidae*), and *Schizoneura lanuginosa* HTG. (*Homoptera* : *Pemphigidae*).

Fresh galls used in our investigation were dissected, their inhabitants and all impurity removed. The control host material consisted of leaf tissues sub-sampled from the more or less injured organs of *Quercus robur* (bearing galls of both *Andricus* and *Neuroterus*), *Fagus sylvatica* (bearing galls of *Mikiola*), and *Ulmus carpinifolia* var. *suberosa* (bearing galls of *Schizoneura*). Each leaf sample was subdivided to obtain two separate categories of material: a) laminae deprived of midribs; b) petioles, including blade midribs. In addition, healthy catalpa leaf sub-samples of both material categories were tested for comparison. Samples for the May series (except those of *Catalpa erubescens*) were collected at the foot of the Small Carpathians near Bratislava, whereas sample collections for the July series were made in the manor-house park at Ivanka pri Dunaji.

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The total nitrogen was determined by the unmodified Kjeldahl procedure; nitrogen of the nitro compounds, disregarded almost completely by MOLLIARD 1913, was not estimated. The tests (Tables 1 and 2) showed that, in two cases (*Mikiola fagi, Schizoneura lanuginosa*), the total N contents of galls were considerably lower than those of the corresponding leaves. The reverse was true in the case of *Andricus curvator*. In the case of *Neuroterus quercusbaccarum*, the N content of galls was only slightly higher than that of the corresponding leaves.

Table 1

Test series I (May, 1966)

Tissue analysed	Fresh weight g	Dry weight g	N content % fresh wt	N content % dry wt
Galls of *Mikiola fagi*	1.63	0.39	0.17	0.72
Beech leaf laminae (less midribs)	1.70	0.99	1.44	2.46
Beech leaf petioles (plus midribs)	2.40	1.08	0.60	1.34
Galls of *Andricus curvator* ♀ ♂	1.10	0.31	1.20	4.35
Galls of *Neuroterus quercusbaccarum* ♀ ♂	1.15	0.12	0.18	1.64
Oak leaf laminae (less midribs)	1.91	0.96	lost	lost
Oak leaf petioles (plus midribs)	1.80	0.84	0.69	1.47
Catalpa leaf laminae (less midribs)	5.00	1.41	lost	lost
Catalpa leaf petioles (plus midribs)	5.00	0.86	0.32	1.88

Table 2

Test series II (July, 1966)

Tissue analysed	Fresh weight g	Dry weight g	N content % fresh wt	N content % dry wt
Galls of *Schizoneura lanuginosa*	2.00	0.33	0.21	1.28
Elm leaf laminae (less midribs)	2.00	0.67	1.07	3.19
Elm leaf petioles (plus midribs)	2.00	0.68	0.49	1.42
Oak leaf laminae (less midribs)	2.00	0.69	0.51	1.47
Oak leaf petioles (plus midribs)	2.00	0.62	0.49	1.55
Catalpa leaf laminae (less midribs)	2.00	0.64	0.80	2.50
Catalpa leaf petioles (plus midribs)	2.00	0.55	0.30	1.08

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Of the galls mentioned in Tables 1 and 2, MOLLIARD 1913 analysed already those of *Neuroterus quercusbaccarum* and *Schizoneura lanuginosa*. The relative differences of values obtained by him and us respectively are in a more or less close agreement, as illustrated in Table 3.

Table 3

Confrontation of the results of different workers

Tissue analysed	N content % dry wt MOLLIARD 1913	Present investigation
Galls of *Neuroterus quercusbaccarum* ♀ ♂	2.94	1.64
Oak leaves	2.73	1.47
Galls of *Schizoneura lanuginosa*	I 2.64	1.28
	II 2.23	
Elm leaves	I 2.83	3.19
	II 3.06	

An interpretation of the variety of relative differences existing in the concentrations of N in different plant galls has not been presented till now. The factor of the physiological age of tissue, however important it may be (SMITH 1962, MERRILL & COWLING 1966), cannot, in fact, explain that diversity. As a rule, the most active plant organs require more nitrogen than physiologically less important ones (MENGEL 1961). Thus laminae were found to have a higher nitrogen level than petioles in leaves of all species examined, except oak (Tables 1 and 2). There is now reason to believe that the criterion of N concentration may be used as a sensitive indicator of both the physiological activity and phytopathological importance of a plant gall.

Comparably to plant galls, some Phanerogamic parasites (NICOLOFF 1923), whether heterotrophic (*Cuscuta, Orobanche*) or autotrophic (*Viscum*), may be divided into two or three groups with reference to the relative accumulation of nitrogen in their body.

For priority reasons, a short German Summary of the present paper appears elsewhere (PACLT & HÄSSLER 1967).

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Summary

The total nitrogen concentration of fresh cecidia induced by *Andricus curvator* HTG. (*Cynipidae*) was found to be substantially higher, and that of fresh galls of *Mikiola fagi* (HTG.) (*Cecidomyiidae*), and *Schizoneura lanuginosa* HTG. (*Pemphigidae*), to be considerably lower than the corresponding leaf-N levels. On the contrary, no marked difference in total N content could be detected between fresh cecidia of

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Neuroterus quercusbaccarum (L.) (*Cynipidae*) and the corresponding elm leaves.

It is assumed that the criterion of N concentration may be used as a sensitive indicator of the phytopathological importance of a plant gall.

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