THE USE OF NITROGEN LEVELS IN TREE LEAVES AS INDICATIVE OF ABILITY TO GROW IN COLLIERY SPOILS

MOHAMED ABDO DESOUGI[1]

ABSTRACT:

Colliery spoils are known for showing variability and for presenting difficulties to afforestation. The problems in colliery that limit tree growth include element deficiencies and toxicity. Extreme spoil reaction is also a problem.

Foliar analysis throughout the season is used as a tool. Nitrogen showed a change of concentration with season. Nitrogen concentration with season in *Betula pendula* is a little different from that of *Alnus glutinosa*. The ability of *Alnus glutinosa* to maintain a relatively high nitrogen level indicates the suitability of the species for growth on relatively nitrogen deficient sites.

الملخص

تتنوع مخلفات مناجم الفحم الحجري وتتسبب في مشاكل بالنسبة للتشجير بالغابات. إن مشكلات مخلفات الفحم الحجري والتي تعوق نمو الأشجار تتمثل في نقص العناصر والسمية. كما أن تفاعل المخلفات العالية تعتبر مشكلة.

في هذه الدراسة استعمل تحليل أوراق الأشجار كوسيلة لمعرفة تركيز عنصر النيتروجين. وقد أظهر تركيز النيتروجين تغيرا في كل موسم. كما أن تركيز النتروجين في شجرة البتيولا (*Betula pendula*) اختلف عما هو عليه في شجرة الألنس (*Alnus glutinosa*). إن قدرة الألنس (*Alnus glutinosa*) في المحافظة على مستوى أعلى نسبيا من النتروجين تشير إلى ملائمة هذا الصنف على النمو في المواقع الفقيرة نسبيا في عنصر النتروجين.

[1] College of Forestry and Range Science, SUST

INTRODUCTION:

Nitrogen is a well-known important element for tree growth. Leaf analysis could be used as a tool to study concentration of elements at a certain time or throughout the season. This may be indicative of suitable tree species for land reclamation or sites study.

In this study two species *Betula pendula* and *Alnus glutinosa* were studied in six sites, four of which are colliery spoil sites and these are Maltby, Water Haig, Roundwood and Mitchell. The other two sites, Skipwith and Ashkam Bog, were used as control sites.

THE USE OF FOLIAR ANALYSIS:

It has been indicated that the use of leaf composition as an index of supply of available plant's nutrients requires a good knowledge of the seasonal trends in leaf contents of various nutrients (Tamm 1951). It has also been suggested that for the effective use of foliar analysis, seasonal trends for the elements in question must be known Labanauskas, *et al.*, (1959).

Guha and Mitchell (1965) used foliar analysis to study seasonal changes in inorganic elements of several deciduous trees. The mineral composition of a tree provides a guide to its growth requirements. Tree leaf chemical composition is also of interest since it gives some indication of the quality of the organic material falling on the forest floor (Ovington 1956).

Leyton (1957) pointed out that foliar analysis carried out with necessary sampling precautions would appear to give a reasonably consistent guide not only to the nature and extent of particular mineral deficiencies but also to the interpretation of field observations. For example it has been shown that there is a relationship between phosphorus supply, height increment and phosphorus concentration in the current needles of *Sitka spruce* plantation (Leyton l957).

Foliar analysis has the advantages of giving a reliable estimate of nutritional element, which have been absorbed and therefore available to plants. For these reasons, foliar analysis has been selected as a tool for the study of the nutritional status of tree species on colliery spoil.

METHOD:

CHEMICAL ANALYSIS:

The samples from the trees under study were collected at four weeks intervals. They were redried for a few hours and then about 0.5 g of each sample were weighed accurately. This was transferred to a 100-ml Kjedahl flash. One Kjedahl tablet containing 1 g of sodium sulphate and 0.1 g copper sulphate (5 H_2O), a few glass beads to prevent splashing and loss of material and 10 ml of concentrated sulphuric acid were added. The flasks were placed on a heating mantle in a fume cupboard and heated gently to prevent bumping and splashing (setting 2-4). On clearing the heat was increased to the point at which the solution vapour condensed about one third of the way up the neck of the flask (setting 7,8 or 9). Heating was continued until the solution became completely clear or pale yellow-coloured (approximately 3½ hours).

The digested material was allowed to cool slowly for about one hour. Adding deionised water to the flask then diluted it. The cooled diluted solution was filtered through Whatman No.1 filter paper and made up to 100 ml. The solution was stored in stoppered polythene bottles at 4°C in the dark until analysis.

TOTAL NITROGEN:

Distillation: 5 ml of the solution was placed into the inner chamber of a Markham still. 6 ml of 50% sodium hydroxide solution were placed in the reservoir and allowed to run into the inner chamber slowly. Steam prepared by boiling deionised water was passed and 30 ml of distillate were collected in a 100 ml capacity conical flask containing 10 ml of boric acid indicator solution. Care was taken to ensure that the tip of the condensor was beneath the surface of the indicator solution.

The boric acid indicator used was prepared as follows: 5 g of boric acid crystals was dissolved in 200 ml of hot deionised water. When cool this solution was added to a 2 litre volumetric flask containing

45 ml of a methyl red solution (0.02% methyl red in 60% ethanol) and 15 ml of bromo-cresol green solution (0.1% of bromo-cresol green solution in 60% ethanol). Enough tap water to turn the solution green was added and the volume was made up to 2 litres with deionised water.

Titration: The distillate was titrated against 0.01 N hydrochloric acid. A permanent pale pink colour indicated that the end point had been reached.

Blank digests, distillations and titrations were performed and the titres obtained were basically that of Bremner (1965).

Table 1: Mean leaf nitrogen (percent dry weight) in
a: *Betula pendula*   b: *Alnus glutinosa*

a: *Betula pendula*

	Collection ©								
No		1	2	3	4	5	6	7	Mean
	Sites (S)								
1	Maltby	4.18	2.36	2.12	1.96	2.02	1.82	1.22	2.24
2	Water Haigh	4.34	2.50	2.30	2.00	2.04	1.88	1.46	2.36
3	Roundwood	4.72	260	2.66	2.24	2.20	2.26	1.62	2.61
4	Mitchell	4.08	2.96	2.54	2.50	2.46	2.40	1.30	2.61
5*	Skipwith	3.56	2.36	2.14	2.12	2.04	2.06	1.26	2.22
	Mean	4.18	2.56	2.35	2.16	2.16	2.08	1.37	

L.S.D. (P = 0.05)

Sites = 0.14
Collection = 0.17
SXC = 0.37

B) *Alnus glutinosa*

	Collection								
No		*1	2	3	4	5	6	7	Mean
	Sites								
1	Maltby	-	2.66	2.78	2.82	2.70	2.72	2.72	2.73
2	Water Haigh	-	2.96	2.80	2.62	2.82	2.86	2.66	2.79
3	Roundwood		3.22	2.80	2.86	2.82	2.86	2.78	2.89
4	Mitchell	-	3.08	2.82	2.74	2.82	2.80	2.60	2.81
5	Askham Bog	-	2.94	2.78	2.80	2.54	2.62	2.44	2.69
	Mean	-	2.97	2.80	2.77	2.74	2.77	2.64	

L.S.D. (P = 0.05)

Sites = 0.12
Collection = 0.13
SXC = n.s

*There were no leaves at the beginning of the season at collection.

RESULTS AND DISCUSSION

Nitrogen concentrations are generally higher in *Almus glutinosa* than in *Betula pendula* (Table 1). This is not surprising as Cooker & Major (1955) found that species of *Almus* are amongst the earliest colonizers of glacial moraines in Alaska initially low in nitorgen. During the early stages of succession, dominated by *Almus crispa*, nitrogen levels were shown to build up in the substrate being colonized suggesting that species of *Almus* are able to obtain relatively substantial amounts of nitorgen through fixation when growing on nitorgen deficient soil.

Nitorgen concentrations with season in *Betula pendula* were a little different from that of *Almus glutinosa*. Decrease of nitorgen concentration with season is seen in *Betula pendula* which has a fall in nitorgen concentration masked to some extent by 'fixed nitrogen' in the leaves.

The ability of *Almus glutinosa* to maintain a relatively high nitrogen level by nitrogen fixation, with only small variations during the season, and the success of closely related species during early colonization indicates the suitability of such species for growth on relatively nitorgen deficient sites such as colliery spoil. *Betula pendula*, species with a good performance on colliery spoil sites, has a relatively low nitrogen level in the leaves. This species is probably adapted to colliery spoil conditions by virtue of its lower nitorgen demands.

Nitorgen concentration was at the highest level (collection) at the beginning of the spring and it reached its lowest level at the end of autumn (collection 7). So nitrogen is needed more at the beginning of the season.

REFERENCES:

1. **Bremmer, J.M (1965).** Total Nitrogen Methods of Soil Analysis part 2 (Ed. G.A. Black, D.D. Evans, J.L. White, L.E. Enminger & F.E. Clark). Agronomy 9, 1449-78 Amer. Soc. Agron. Madison, U.S.A.
2. **Crooker, R L. & Major, J. (1955).** Soil development in relation to vegetation and surface age at Glacier Bay, Alaska. J. Ecol. 43 427-48.
3. **Goodall, D. and W. & Gregory, F.G. (1947).** Chemical composition of plants as an index to their nutritional status. Tech. Comm. No 17 Imp. Bur. Hort. And plantations crops, Kent.
4. **Guha, M. M. & Mitchell, R. L. (1965).** Trace and major element composition of the leaves of some deciduous trees. Pl. Soil 23 323-38.
5. **Guha, M.M.** & Mitchell, R.L. (1966). Trace and major element composition of the leaves of some deciduous trees P1 Soil 24 90-112.
6. **Labanauskas C.K.,** *et al,* **(1959).** Seasonal changes in concentration of zinc, copper, boron, manganese, and iron in the leaves of Washington navel Proc. Amer. Soc. Hort. Sci. 74, 300-07.
7. **Leyon, L. (1957).** The relationship between growth and the mineral nutrients of conifers. The Physiology of Forest Trees (Ed.K. Thinmonn), 323-45.
8. **Ovington, J.D. (1956).** The composition of tree leaves. Forestry 29, 22-28.
9. **Tamm, C.O. (1951).** Seasonal variation in the composition of birth leaves Physiol. Plant 4, 461-69.

المراجع العربية:

(1) : الدوجي، علي (1999) استصلاح واستزراع الأراضي وتغذية النبات. مكتبة مدبولي القاهرة.

(2)السيد، عبدالوهاب بدر الدين (1998). الأشجار والبيئة . منشأة المعارف بالاسكندرية.

(3)بليغ عبدالمنعم (1987). استصلاح وتحسين الأراضي. دار المطبوعات الجديدة الأسكندرية.

(4)بيرتراند ، أتسون وكرنكة ، هيلموت (1984) . صيانة التربة. مطابع جامعة الموصل. مديرية مطبعة الجامعة.

(5)سلماني، نجوى (1998). البيئة وتوزيع النباتات الجغرافي. مديرية الكتب والمطبوعات الجامعية القاهرة.