Determining Drought Hardiness of Acacia Species Using Chlorophyll Stability Index (CSI) Method

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DETERMINING DROUGHT HARDINESS OF ACACIA SPECIES USING CHLOROPHYLL STABILITY INDEX (CSI) METHOD.

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ABSTRACT

Drought hardiness of 19 species of *Acacia* was determined using chlorophyll stability index method.. *Acacia scorpioides* var. *nilotica* (97.67%) was observed to be extremely drought hardy while *A. gourmaensis* (54.67%) showed that the least drought hardiness.

Key words: *Acacia*, Chlorophyll stability index (CSI), Drought hardiness

INTRODUCTION

Acacia Mill. is a member of leguminosae (Mimosoideae) having 750 - 800 tropical and sub-tropical species mostly trees (Willis and Airy-Shaw, 1973). They are native to Africa and usually considered as highly valuable component of agro-forestry systems, not only as soil turn-over, but also as a source of fuel wood and forage in semi-arid zones (El Houri Ahmed, 1979; Poschen, 1986).

Chlorophyll pigment in the green plants trap the light energy and fix carbon dioxide and water into carbohydrate during photosynthesis. Chlorophyll content is correlated with dry matter production of a plant hence its use as an index of production potential of the plant population (Misra, 1980).

Most methods of determining drought hardiness of plants are laborious and need constant watching (Sivasubramaniam, 1992). However, laboratory method described by Kaloyereas (1958), determines the drought hardiness based on the thermostability of chlorophyll pigment when kept in a hot water bath for an hour, the more stable the chlorophyll, the hardier the plant.

The acacias are extremely drought hardy and thrive well in the Northern part of Nigeria especially the semi-arid zones. In order to determine the relative drought hardiness of these acacias, their chlorophyll stability indices (CSI) was determined.

MATERIALS AND METHODS

Fresh leafy materials of 19 species of *Acacia* were collected from Adamawa State, in semi-arid area of Nigeria, (90° 14'N; 20° 12'E), during the hot dry season (Temperature between 36°C and 42°C) between March and April which is most ideal for determining the drought hardiness of tree species.

A revised method of determining CSI by Sivasubramaniam (1992) was used. The leaf samples were divided into two 2.5g lots. The samples were then put into empty test tubes standing in a heated bath. 20 ml of distilled water was added to each sample. One lot was kept in the hot water bath (heated sample) and maintained at 56°C for one hour. The other lot was kept at room temperature (30 ± 2°C) unheated. After one hour, the heated samples were removed from the hot water bath. The samples were drained and 20ml of 80% acetone added. Samples and solution were ground using a pestle and mortar. The well-ground leaf sample was centrifuged at 3,000 r.p.m. for 10 minutes and the supernatent fraction was poured into a clean test tube, containing another 20ml of 80% acetone. A similar procedure was used to extract the chlorophyll of the unheated sample. The diluted extract was divided into five parts, and the optical density was read using a colorimeter at 660nm and the chlorophyll stability index (%) was worked out using the formula:

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$$\text{Chlorophyll stability index} = \frac{\text{O.D. value of heated sample}}{\text{O. D. value of unheated sample}} \times 100$$

RESULTS AND DISCUSSION

Chlorophyll stability index (CSI) of 19 taxa of *Acacia* is summarized in Table 1. *A. scorpioides* var. *nilotica*, *A. senegal*, *A. scorpioides* var. *adstringens*, *A. dudgeoni*, *A. seyal* and *A. sieberiana* had very high chlorophyll stability index of 97.67%, 96.21%, 94.66%, 93.06%, 91.47% and 90.90% respectively. The least CSI was recorded in *A. gourmaensis* (54.67%). This pattern of result was observed by Sivasubramaniam (1992) for *A. auriculiformis* (96.26%) and *A. crassicarpa* (92.77%) and also suggested that the high chlorophyll indices in *acacias* is because they possess only phyllodes instead of leaves and hence, higher chlorophyll stability indices when compared to other plants. The experiment revealed that *A. scorpioides* var. *nilofica* is extremely drought hardy. This index will be helpful in future planning, planting and seed production of these species which could be tested for further growth and biomass production in comparison to other tree species in the arid and semi-arid zone of Nigeria.

Table 1 Chlorophyll stability index of *Acacia* species.

Taxa	Optical density values* Chlorophyll		
	Heated Sample	Unheated sample	Stability index (%)
Acacia albida Del.	0.115	0.135	85.19
A. ataxacantha D.C.	0.112	0.182	61.54
A. campylacantha Aubr.	0.134	0.188	71.28
A. dudgeoni Craibex Holl.	0.134	0.144	93.06
A. farnesiana willd	0.110	0.168	65.48
A. flava (Forsk.) Schwfth	0.123	0.189	65.08
A. gourmaensis A. Chev.	0.117	0.214	65.08
A. hebecladoides Harms	0.112	0.154	72.73
A. lacta R.Pr.	0.138	0.181	76.24
A. macrostachya Rejchenb	0.126	0.167	76.45
A. macrothrysa Harms	0.176	0.148	79.05
A. pennata willd	0.117	0.148	79.05
A raddiana Savi.	0.122	0.139	87.77
A. scorpiodes (L.) var *nilotica* (L.) A. Chev.	0.126	0.129	97.05
A. scorpiodes (L.) var. *adstringens* Bak.	0.124	0.131	94.66
A. senegal (L.) Willd	0.127	0.132	96.21
A. seyal Del.	0.118	0.129	91.47
A. sieberiana D.C.	0.110	0.121	90.90
A. stenocarpa Hochst. Var. *chariensis* A. Chev.	0.128	0.145	88.28

* Mean of 5 determinations.

REFERENCES

El-Houri Ahmed, A., 1979. Effect of land use on soil Characteristics in the Sudan. In: H.O. Mongi and P.A. Huxley (eds)., Soil Research in Agro-forestry, ICRAF, Nairobi, Kenya.

Kaloyereas, S.A., 1958. A new method of determining drought resistance. *Plant Physiol.* 33: 232:233.

Misra, K.C. 1980. Manual of Plant Ecology. Oxford & IBH Publ. Co. 314-315pp.

Poschen, P., 1986. An evaluation of the *Acacia albida* - based agro-forestry practices in the Hararaghe Highlands of East Ethiopia. *Agro-Forestry Ssyems.* 4: 129-143.

Sivasubramaniam, K., 1992. Chlorophyll stability index method for determining drought hardiness of Acacia species. *Nigrogen Fixing Tree Res. Reports.* 10: 11-12.

Willis, J.C. and Airy-Shaw, H.K., 1973. A dictionary of the flowering plant ferns. Cambridge University Press. 1245p.