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THE LEAF AREA OF FOREST TREES ITS IMPORTANCE AND HOW TO MEASURE IT

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Abstract:
The importance of calculating the leaf area lies in identifying the extent to which the plant benefits from the light energy to which it is exposed, which is useful in the process of photosynthesis, and its final result is the storage of the dry matter of the plant, since all the green parts of the plant carry out the process of photosynthesis, including the stem and other vegetative parts. The green area in those parts is difficult to measure, so it is neglected and measured instead of the area of the leaves only because it represents the large part of the green space in the tree. There are several methods for calculating the leaf area of a plant, the most important of which is the weighted method, where a group of leaves is weighed and then the area occupied by those leaves is found. After that, the total leaf area is estimated by. proportion ratio.

Keywords: Leaf area, Pinus brutia, Wood formation, Branch leafs, Natural forest

INTRODUCTION:

Pinus brutia trees is native to the Mediterranean region and grows in . This type of pine is a basic source of wood, which is used in many furniture and wood industries as well as the manufacture of cellulosic paste.

The leaf area of a tree is a key factor in many vital processes. The quantity and efficiency of leaf area in forests is related to the production of the forest or arboretum, and it is also used as a measure to determine planting distances and determine the best area occupied by the tree within the forest (Long and Smith, 1990) and the vitality of the forest (Blanche et al. 1985).

IMPORTANCE OF LEAVES :

The leaf of a plant is of great importance, as it is responsible for making food through several chemical processes that occur inside it, in which it needs light in a process called photosynthesis, and it is also responsible for the processes of respiration and transpiration, and the size of the crown and the density of leaves are among the variables affecting growth in a way In general, tree crown is the point of interaction between the tree and the atmosphere, and it is necessary for many important processes such as reducing solar radiation, and that most important of these processes is the photosynthesis process which is converted (CO_2) to another form that enters the energy chain in the structure of carbohydrates and this energy is used to increase growth represented by tree length and diameter, and expansion of the crown and root group (Zihui and Christoph, 2020).

STUDIES ON TREE LEAF AREA :

(James et al., 1988) explain the relationships for *Pinus taeda* L., between tree leaf area (LA), stem volume growth (m^3/ha/year), growth efficiency of leaf area (m^3 stem/ha/year) and leaf area index. LAI in three districts of India-Kashmir. The results showed a strong linear relationship between the leaf area and the size of the woody stem as well as a linear relationship with the growth in size. He also noted a decrease in the GE growth efficiency for older trees and suggested using LAI as an indicator of the growing stock because LAI combines between tree size and tree density and the effect of location degree. In addition, it is suggested that the deviation of the current arborescent LAI from the maximum LAI based on stationary site factors (eg stalactites and temperature).

The researchers (Coya and Morgalis, 1994) showed the effect of leaf area efficiency (LAE) on natural mortality and the extent of insect infestation in (*Abies balsamea*) trees. It showed significant vulnerability to bud insect infestation compared with growth in diameter (d.b.h.) and basal area, so the researchers suggested that (LAE) could be used as a physiological sensitivity and as a basic guide for forest health.

(Reid et al., 2004) measured leaf area, crown area, growth in volume and basal area over a five-year period to evaluate growth efficiency (GE) and crown efficiency (CE) of dominant, semi-dominant, and suppressed trees that

grow and develop normally in pine trees. The leaf area index (LAI) measured the ratio between the leaf area and the actual available area, and obtained a result, the growth in size was closely related to both leaf area and crown projection area. He stressed that depending on the location and height, the growth efficiency changes in relation to the size and area of the crown site. The fastest growing trees were the large trees, because LAI, as a result of distributing the total area of leaves among many trees, indicated that pent-trees And the small crown canopy is more efficient than the dominant and semi-dominant ones as well as for the content of tree leaves of nitrogen and phosphorous, the suppressed trees were the superior, and from this they had a high efficiency, or this leads to an increase in the efficiency of the crown.

(Berrill and O'hara, 2007) used the expected leaf area estimates to estimate the growth in size and basal area of trees (*Sequoia sempervirens*) for the Jackson Demonstration State forests in California. He used regression equations to estimate the size of the five-year leaf area and the coefficient of determination ranged between (0.48 and 0.55).) that the highest (LAE) of the dense forest with complete density and with a fully developing stock of redwood trees, followed by the dominant and semi-dominant trees.

(Akihiro et al., 2009) developed a ground-based method for estimating the leaf area index (LAI) and the vertical leaf area density (LAD) distribution of two blocks of *Betula ermanii* tree. The research also showed that the error in the LAD distribution can lead to neglect of the horizontal canopy heterogeneity when applying indirect methods.

The authors (Mark and Mathew, 2005) report that the leaf area index (LAI) is a good and robust diagnostic of plant productivity despite the fact that many methods have been developed to measure LAI, either directly or indirectly, and leaf area index (LAI) remains difficult to determine accurately due to Great spatial and temporal variance.

(Prita et al., 2017) also found that the ecological functions of agro forestry systems are of benefit to people around the Sedanao watershed especially in protecting water quality. By knowing the LAI, the efficiency of the vegetation canopy can be assessed in these systems and several factors are likely It contributes to the variance of the LAI value and is strongly related to the leaf area and tree density, the most important of which is the type of plants that are planted among the trees.

In the study, (Pokorný and Stojnič, 2017) reported LAI data for 17 Norway spruce trees (*Picea abies*) with varying ages (from 15 to 102 years) and vital status (defoliation between 0 and 40%) and found that LAI decreased with age (about 12.6 to 8.5%), while leaf fall increased. Therefore, a strong relationship was found between defoliation and LAI, and LAI showed a high parameter value for the assessment of the arboretum (R^2 = 0.87) because of the linear relationship between LAI and defoliation. Since LAI can be estimated more accurately by the coronal canopy analysis, the coronal fall was calculated. During ocular observation, there is a tendency to use LAI on a large scale in forests as LAI values can be used to assess the health and growth status of Norway spruce trees.

(Jonas et al., 2017) mentioned that forest productivity and water consumption depend on leaf area, which may vary according to tree age, forest structure, and environment. Explaining how forest management affects leaf area and whether artificial production forests have a different leaf area than unmanaged natural forests, the researcher compared the leaf area index (LAI) of managed European beech forests (*Fagus sylvatica*) with that of natural forests in Slovakia and analyzed the change of LAI from Early to late stages of natural forests. was (LAI). The results of the mathematical model show that converting natural beech forests to managed production forests would reduce LAI by 1.6 units, if the density is constant. Thus, complex natural forest canopies increase LAI. However, this effect was offset by the higher density of productive managed forests, resulting in an average LAI similar to production and natural forests.

The researchers (Sumida et al., 2018) indicated that the difference in climatic conditions between years and the status of tree development has a significant impact on the leaf area of the LA tree. These sources have differences due to the diversity of definitions and estimation methods, which poses additional challenges for comparisons, and they relied on the maximum LAI for many of the studies they compared.

LEAF AREA MEASUREMENT FOR *PINUS BRUTIA* TREES:

It is done by dividing the crown of the tree in theory into three sections, lower, middle and upper, and a branch is taken from each part, representing that part in terms of the length of the branch and the quantity of leaves, removing its leaves and weighing it in the field, in order to avoid the evaporation of water from the leaves with a high-precision scale, then finding The surface area of each of the parts by weight by taking a sample of the papers and placing them on a graph paper, taking into account not to leave any empty part between the papers, by gluing the ends of the papers that are not included in the measurement of the sample area, then cutting a known area from those papers and then weighing The leaves are cut with a high-precision scale and also done in the field to avoid water loss by evaporation .Then, through proportion, we find the area of each part of the tree by the weight method, as in the following equation:

branch leafs weight / branch leaf area= sample weight/sample leaf area

Then we find the leaf area for each section by multiplying the leaf area of the branch by the number of branches in the section.

Leaf area of the section = leaf area of the branch x number of branches

The leaf areas of the three sections are summed to get the total leaf area of the tree.

CONCLUSIONS:

The leaf area is one of the important variables for tree and stand, as it is closely related to growth and wood formation, which is the result of photosynthesis. This topic has been addressed by many researchers, and they were able to find different mathematical equations that link the different elements of growth on the one hand, and the leaf area on the other. There are also several methods for calculating the leaf area of a tree, the most important of which is the method that depends on the weight and then finding the relationship between the weight and area of a sample of leaves and then finding the total leaf area by proportion.

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