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Leaf area index estimation using grid counting method

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ABSTRACT

The easy, economic, and precise estimate of leaf surface area has been a concern to plant scientists for a long time. Leaf area estimate is valuable in studies of plant nutrition, plant competition, plant-soil-water relations, plant protection measures, respiration, light reflectance, and heat transfer in plants. To count the number of square cm., a simple approach is to construct unit squares within the interested area using the graph paper that has 1-centimeter square grid lines can be used the millimeter graph paper method described in this paper was used to estimate individual leaf area of four plant species. The leaf area measurement of *Duranta erecta, Phyla nodiflora, Stachytarpheta jamaicensis* and *Lippia alba* are 16.6 ± 2.796, 10.0 ± 1.632, 12.6 ± 1.349 and 59.2 ± 18.599 respectively. The leaf area is maximum in *Lippia alba* and minimum in *Phyla nodiflora.*

Key Words - Leaf area, Leaf area measurement, graph paper.

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INTRODUCTION

Leaf Area Index (LAI), defined as a single leaf area per unit ground area (Chen & Black, 1992). Leaf area index (LAI), one half the total green leaf area per unit horizontal ground surface, is an important structural property of vegetation. Because leaf surfaces are the primary border of energy and mass exchange, important processes such as canopy interception, evapo transpiration, and gross photosynthesis are directly proportional to LAI (Fang & Liang, 2008). Leaf area index (LAI) is an indicator of the size of assimilatory surface of a crop (Ahmad & Rasool, 2014). Leaf area measurement is an important structural property of vegetation used in many lands surface vegetation, climate and crop production models (Francisco *et al.* 2019). Canopy structure and biochemical parameters directly influence the radiative transfer process of sunlight in vegetation, determining the amount of radiation measured by passive sensors in the visible and infrared portion of the electromagnetic spectrum (Addai & Alimiyawo, 2015). Accurate quantification of LAI is therefore important for crop growth and development (Dey *et al.* 2019).

MATEIAL AND METHODS

The fresh healthy plant leaves of *Duranta erecta* L., *Phyla nodiflora* (L.) Greene, *Stachytarpheta jamaicensis* (L.) Vahl and *Lippia alba* (Mill.) N.E.Br. ex Britton & P. Wilson were collected from different areas of Ranchi. To find the leaf surface area is to sum the number of square cm. needed to cover a leaf surface. To count the number of square cm., a simple approach is to construct unit squares within the interested area using the graph paper that has 1-centimeter square grid lines can be used. The estimation of leaf surface area is obtained using following steps (Bakr, 2005) .

(1) Place the leaf to be measured on graph sheet that has 1 cm^2 square grid lines.

Outline the perimeter of the leaf on the graph paper.

(2) Estimate the number of square blocks is enclosed inside the leaf outline.

(3) Finally, the leaf surface area is calculated using (Stewart & Dwyer, 1999);

Leaf Area = NGS × OGA

Where, NGS is the number of grid squares inside the leaf outline and OGA is the area of single square grid.

RESULTS

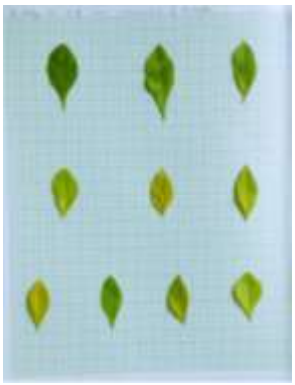
Among all four plants the highest leaf area measured in *Lippia alba* is 59.2 ± 18.599 and lowest were recorded in *Phyla nodiflora* that is 10.0 ± 1.632. The leaf area of *Duranta erecta* and *Stachytarpheta jamaicensis* recorded 16.6 ± 2.796 and 12.6 ± 1.349 respectively. The leaf area measurement of *Duranta erecta*, *Phyla nodiflora*, *Stachytarpheta jamaicensis* and *Lippia alba* are 16.6 ± 2.796, 10.0 ± 1.632, 12.6 ± 1.349 and 59.2 ± 18.599 respectively. The leaf area is maximum in *Lippia alba* and minimum in *Phyla nodiflora*.

Table 1 : Leaf Area Measurement

Leaf Area Measurement (cm^2)	*Duranta erecta*	*Phyla nodiflora*	*Stachytarpheta jamaicensis*	*Lippia alba*
R1	20 cm^2	10 cm^2	16 cm^2	80 cm^2
R2	16 cm^2	12 cm^2	12 cm^2	78 cm^2
R3	20 cm^2	10 cm^2	14 cm^2	86 cm^2
R4	16 cm^2	10 cm^2	12 cm^2	46 cm^2
R5	16 cm^2	12 cm^2	12 cm^2	66 cm^2
R6	24 cm^2	10 cm^2	12 cm^2	60 cm^2
R7	16 cm^2	12 cm^2	12 cm^2	54 cm^2
R8	16 cm^2	8 cm^2	12 cm^2	50 cm^2
R9	16 cm^2	8 cm^2	12 cm^2	46 cm^2
R10	16 cm^2	8 cm^2	12 cm^2	26 cm^2

Table 2 : Mean of Leaf Area Measurement

Leaf Area Measurement (cm^2)	*Duranta erecta*	*Phyla nodiflora*	*Stachytarpheta jamaicensis*	*Lippia alba*
Mean	16.6	10.0	12.6	59.2
S.D.	16.6 ± 2.796	10.0 ± 1.632	12.6 ± 1.349	59.2 ± 18.599
S.E.	16.6 ± 0.884	10.0 ± 0.516	12.6 ± 0.426	59.2 ± 5.881




DISCUSSION

LAI is necessary for assimilate production but the photosynthetic products formed by the leaves will be channelled towards the development of seeds and grains at the expense of further leaf production. According to Ahlrichs and Baue (1983) authors, LAI predicts the photosynthetic capacity of a crop and serves as a reference tool for crop growth and development. An increase in leaf area index increases light interception and the source/ sink strength. Thus, the higher the LAI, the higher the photosynthetic activity and the higher the growth and the crop yield. Tsialtas and Maslaris (2008) stated that LAI influences plants to capture photon to increase photosynthetic rate and this enhances assimilate partitioning resulting in high growth and grain yield.

CONCLUSION

Leaf area measurement is important in plant studies of understanding and modelling ecosystem function. Grid count method is a conventional method for leaf area measurement.

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