Document Title: Description, AN, Calculation of LAI Interception of short canopies		Part # and Rev. 13427-00	
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Rev.	Description	Revision By	Date

Production Filename: 13427 (In Product Library)

Path to Working Files: DecaDoc\Application Notes\Master

Dimensions: 8.5 inch wide, 11 inch tall

Material: Paper, 92 Bright White or better, 75g/m² or heavier

Colors: Color Print on White

Printer: HP Color LaserJet 8550-PS

Finish: None

Adhesive: None

Special Notes: Illustrations are Ref Only ** Not to Scale ** (Shown page 1 of 2)

DECAGON DEVICES Application Note

Calculation of LAI and Interception of Short Canopies from First Growth Cover Measurements

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First Growth was designed to measure the green cover of short, sparse plant canopies. The camera measures the fraction of its field of view that is green. If the camera views a vegetated surface from a position normal to the surface, then the fraction it measures is the green cover, c. With certain assumptions, this value can also be used to estimate the leaf area index, L, and the fractional light interception for a plant canopy. For short, sparse canopies, this approach is one of the few indirect methods available.

The fraction of incident light transmitted through a canopy can be calculated from

$$\tau = \exp(-KL_e) \quad (1)$$

where K is the extinction coefficient for the canopy and L_e is the effective leaf area index. The extinction coefficient depends on the angle distribution of leaves in the canopy and on the angle with which the light intercepts the canopy. We refer here to the effective leaf area index. This is the leaf area index of randomly distributed leaves that would have the same transmission value as observed. If the leaves in the canopy are actually randomly distributed in space, then the actual leaf area index and the effective leaf area index are the same. If the leaves are clumped, then the actual leaf area is larger than L_e. This effect will be quantified later.

The probability of light getting through the canopy is the same, whether the light is coming from the sun to the soil or the soil to the camera lens, so, we can use a First Growth picture of a canopy to get transmission:

$$\tau_n = 1 - c \quad (2)$$

where c is the fractional green cover registered by First Growth. The subscript n on t is to indicate that this is the transmission at normal incidence. From this value of t_n and eq. 1, we can compute effective leaf area index if we know a value for K:

$$L_e = -\ln(\tau_n)/K_n \quad (3)$$

It is also possible to compute the canopy transmission for incident light at other angles, and the daily interception of light from this measurement. The details of these calculations can be found in the AccuPAR user manual (available online at www.decagon.com/instruments/agdownload.html).

Finding K_n

The canopy extinction coefficient is determined by the angle distribution of leaves in the canopy and the incidence angle of the radiation. The equation describing this is

$$K = \frac{\sqrt{x^2 + \tan^2\theta}}{x + 1.744(x + 1.182)^{-0.733}} \quad (4)$$

where x is the leaf angle distribution parameter and ? is the angle of incidence of the radiation (vertical is zero). If the leaves were all vertical, x would have a value of 0. If they were all horizontal, x would be infinite. A typical angle distribution, with leaves having a range of inclination angles, gives a value of x around 1.

The value of x is the ratio of the vertically projected canopy element area to horizontally projected canopy element area. One could find this by taking a representative individual plant or branch and determine the shadow area with light coming directly down from above and