

BRIEF COMMUNICATION

Seasonal variation in CO₂ exchange, transpiration and stomatal conductance in *Sesbania*

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Abstract

Net photosynthetic rate (P_N), stomatal conductance (g_s), carboxylation efficiency and economy coefficient of tree species *Sesbania sesban* and *S. grandiflora* were maximum in rainy season, declined in autumn, and reached minimum in summer months. Also water use efficiency and economy coefficient were lowest in summer. P_N , g_s and the economy coefficient were higher in *S. sesban* than in *S. grandiflora*.

Key words: carboxylation efficiency; dark respiration; economy coefficient; net photosynthetic rate; *Sesbania grandiflora*; *Sesbania sesban*; water use efficiency.

Analysis of seasonal pattern of CO₂ exchange may be useful in constructing models of tree growth. Therefore the present study was undertaken to determine the seasonal changes in P_N , transpiration rate (E), water use efficiency (WUE) and carbon balance in fodder, fuel and N₂ fixing tree species of *Sesbania* used in agroforestry systems.

Seeds of *Sesbania sesban* (L.) Merr. and *S. grandiflora* (L.) Pers. collected from natural habitat were sown in polythene bags containing a 1:2 mixture of farmyard manure and garden soil at the Indian Grassland and Fodder Research Institute, Jhansi (semi-arid region). Uniform seedlings at the 3-4 leaves stage were transplanted in porcelain pots and grown under natural conditions. Measurements of photosynthetically active radiation (PAR), air temperature (T_a), relative humidity (RH), P_N , intercellular CO₂ concentration (C_i) and E were made in the leaves using the LI-6250 Portable Photosynthesis System (LI-COR, Logan, USA). In each replication fully expanded healthy second and third leaves were used. The measurements were done between 11.00 and 12.00 h under sunlight and ambient CO₂ concentration. Dark respiration rate (R_D) of the same leaf was recorded after covering the assimilation chamber by black cloth.

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The monthly T_a and PAR were maximum in June and minimum in December whereas RH was highest in the rainy season and lowest in summer (Fig. 1, top). In both the tree species P_N (Fig. 1, middle) as well as stomatal conductance (g_s) were highest in the rainy season and lowest in summer months. The sharp reduction in P_N in the summer months was caused by high temperature and low RH. g_s in *S. sesban* was during the whole vegetation season higher than in *S. grandiflora* by about 50%. g_s positively correlated with RH, T_a , PAR and P_N .

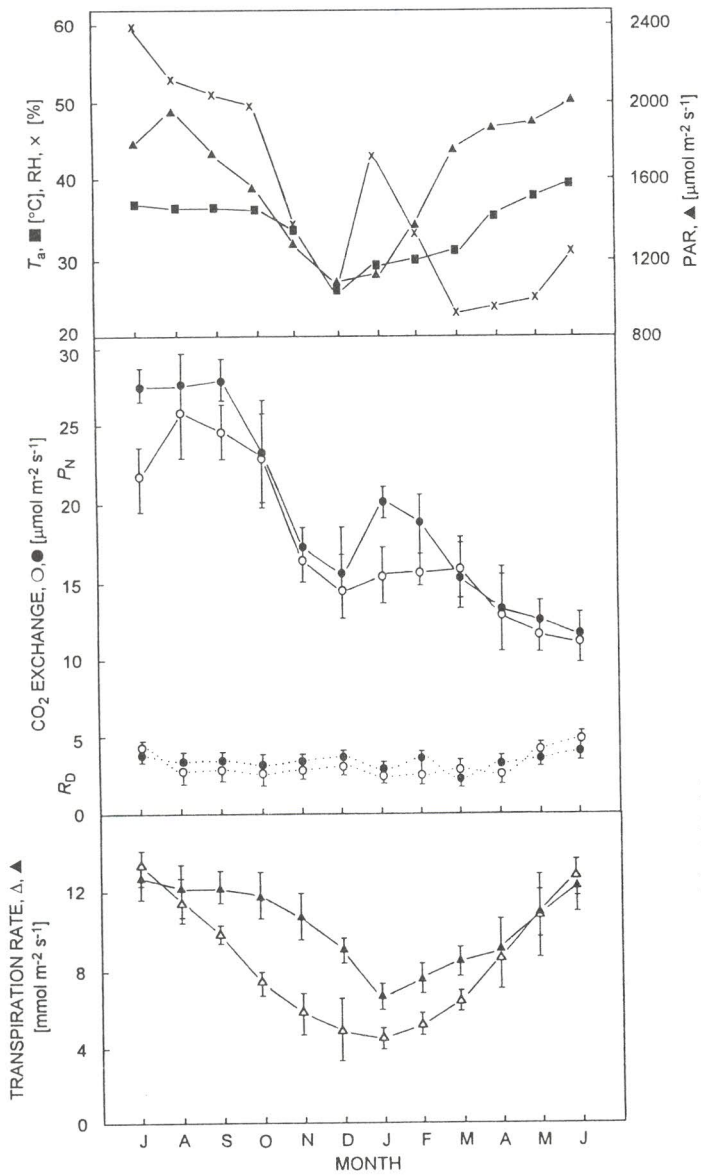


Fig. 1. Monthly variation in air temperature (T_a), relative humidity (RH), photosynthetically active radiation (PAR) (top), net photosynthetic rate (P_N), dark respiration rate (R_D) (middle) and transpiration rate (E) (bottom) in *S. sesban* (full symbols) and *S. grandiflora* (open symbols). P_N is given as CO_2 uptake, R_D as CO_2 evolution.

R_D in both species did not change much during the vegetation season (Fig. 1, middle). The economy coefficient $[(P_N + R_D)/R_D]$ - Winkler 1958] was slightly but insignificantly higher in *S. sesban* confirming its higher productivity potential. The lowest economy coefficient was found in summer months. No definite trend was observed in C_i . The ratio P_N/C_i (which represents the carboxylation efficiency - Farquhar and Sharkey 1982) was highest in rainy season and lowest in summer.

E increased with increase in T_a and PAR in summer and decreased in winter (Fig. 1, bottom). Similar results were reported, e.g., by Haseba *et al.* (1967) in *Citrus* and by Bhatt (1990) in *Prunus*, *Celtis* and *Grewia*. The P_N/E ratio was significantly correlated with the economy coefficient and hence it might be important for selecting plant species for fast growth and biomass production (cf. also Liang and Maruyama 1994).

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