FIELD GAS EXCHANGE MEASUREMENT IN COWPEA

by

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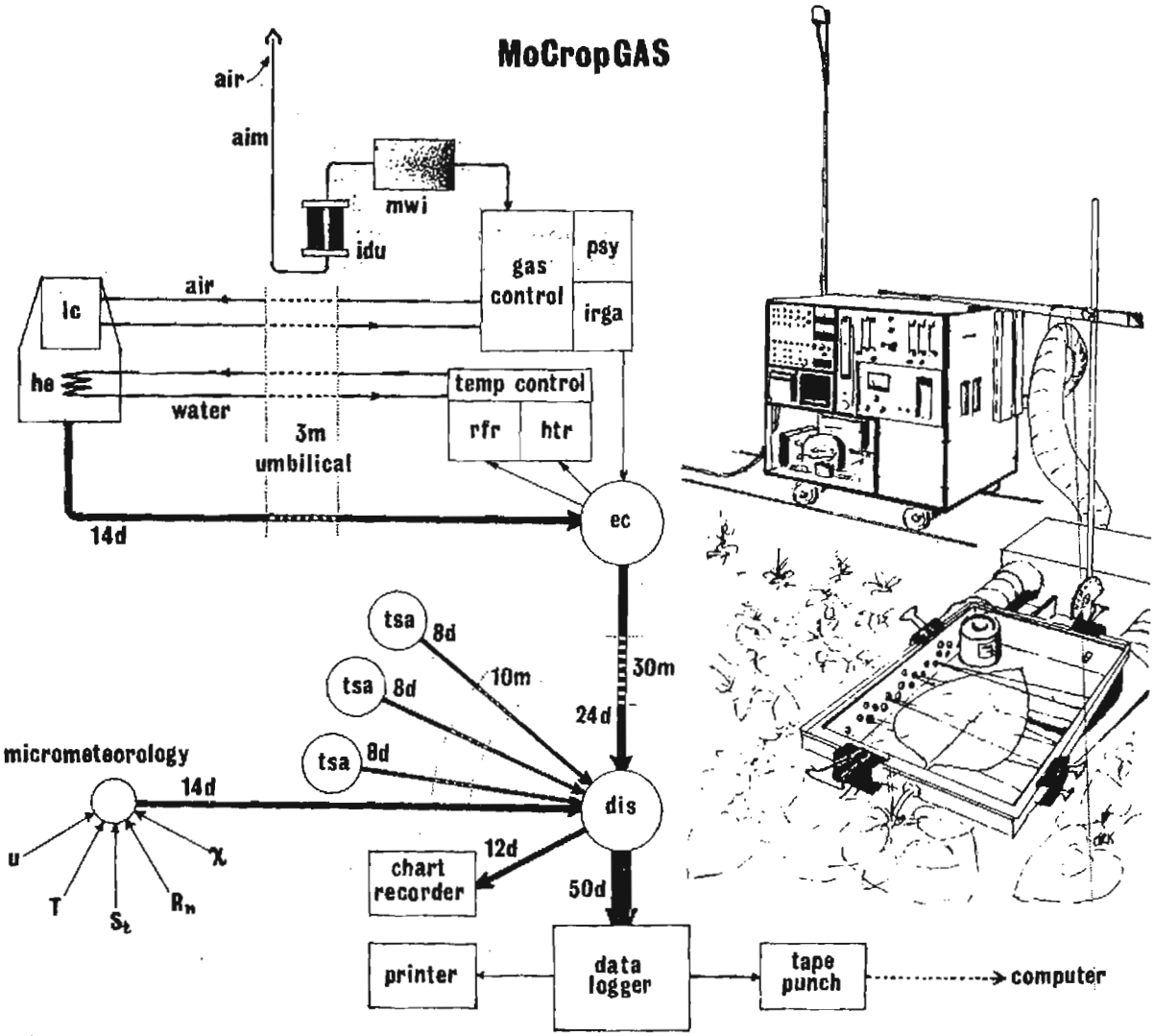
As part of a project aimed at estimating potential crop production in the humid tropics the work at IITA has attempted to measure the exchange of carbon dioxide and water vapour exchange of cowpea in the field using a leaf chamber technique. Detailed analysis of dry matter accumulation and partition was performed on the same crops as well as measurement of the special arrangement of photosynthetic surfaces and the incident light intercepted by them.

Although a uniform stand of plants is difficult to achieve in the field such measurements are to be preferred since the crop structure, natural irradiance and rooting pattern cannot be satisfactorily reproduced in controlled environments.

The work has two major aims. The first is to measure the response of individual organs, in terms of their exchange of carbon dioxide and water vapour in relation to variations in incident irradiance and temperature and the differences in these responses due to age, position on the plant and imposed treatments. The second aim is to use this gas exchange information in conjunction with the measurements of canopy structure and light penetration to calculate a carbon balance for the stand.

A mobile gas analysis system, MoCropGAS, has been built to make the gas exchange measurements with control of experimental parameters (Figure 1). MoCropGAS can be moved 30 m into the field and the assimilation chamber extends up to 3 m into the canopy. The advantage of an assimilation chamber technique is that continuous non-destructive measurements can be made. The disadvantage is the small number of measurements that can be made in a day and the enclosure of the leaf. It is desirable to measure and preferably control the environment with the chamber. In the MoCropGAS system, level of irradiance (by shading), leaf temperature (via air temperature), humidity and ventilation are controlled.

Preliminary gas exchange measurements on cowpea cv Tvu 4552 have shown typical light saturated photosynthetic rates of 3-5 g CO_2 m^{-2} h^{-1}. The highest rates occurred after full expansion. A rapid decline followed a plateau period which differed in extent for leaves at different nodes. Green pods generally had a net loss of CO_2 even in full sunlight. It is hoped that the relative contribution of each organ to final yield, and in particular the importance of assimilates stored in the vegetative period and retranslocated, can be assessed.



Key

aim	air intake mast	ec	electronic control/monitor
idu	inflow drier unit	dis	data interchange system
mwi	metering water injector	tsa	tube solarimeter array
psy	psychrometer	u	windspeed
irga	intra-red gas analyser	T	temperature (several)
lc	leaf chamber	S_t	total solar radiation
he	heat exchnager	R_n	net radiation
rfr	refrigerator	χ	relative humidity
htr	heater	8d, etc.	number of data channels

Fig. 1 **N.R.I.P.P. field installation**

Questions were raised concerning leaf photosynthesis during vegetative and reproductive stages and contribution to yield from different leaves. It was indicated that the seasonal changes in these parameters were being measured. The rate of dark respiration and its possible dependence on photosynthesis the previous day and how the process changed during the night period were thought necessary to monitor. This approach was considered very valuable particularly if extended to a wider range of crops.