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PHOTOSYNTHESIS IN RELATION TO YIELD POTENTIAL IN BLACKGRAM

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Significant varietal differences were found to exist among blackgram cultivars for photosynthetic rate, total dry matter, seed yield and harvest index. Photosynthetic rate per se alone is not responsible for yield. However higher photosynthetic rate during pod development phase has a significant positive bearing on final yield. Higher phytomass and harvest index are also important for increased yield in blackgram.

Differences in photosynthetic rate among crop varieties are of major significance in crop improvement programme, since photosynthesis is considered to be the basis for economic yield in crop plants. Selection of photosynthetically efficient crop varieties is the object of many researchers as the character is found to be genetically controlled and quantitatively inherited (Ojima *et al.*, (969). However photosynthetic rates are not many times related to crop yield (Curtis *et al.*, 1969). There is no consistent association between photosynthesis and crop productivity. The reason for this lack of association is not clear. It is therefore necessary to study why photosynthesis is not always relating itself to yield before actually start screening germplasm stock for photosynthetic efficiency. When photosynthetic rate seldom shows a direct bearing on yield, total phytomass and harvest index assume greater signi ficance. The present study was thus undertaken to understand the possible association of photosynthesis with seed yield, total biomass and harvest index in blackgram, a cheap source of vegetable protein.

MATERIALS AND METHODS

Twenty blackgram cultivars were handseeded in an experimental field during winter 1984. Top most fully expanded trifoliate leaves (Kuo *et al.*, 1977) were selected for the measurement of net photosynthetic rate. Rate of leaf net photosynthesis was measured in detached condition using an Infra Red Gas Analyaer (ADC, Hoddesdon) at vegetative, flowering and pod development stages of crop growth. Ten plants per cultivar selected at random during harvest were considered for obtaining total dry matter production, seed yield and harvest index.

RESULTS AND DISCUSSION

Significant cultivar differences were noticed for leaf net photo -

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Table 1. Leaf net photosyntnetic rate, seed yield, total dry matter production and harvest index in blackgram cultivars

Cultivar	Leaf net photosynthetic rate ($mg.CO_2\ dm^{-2}\ hr^{-1}$)				Seed yield (g/plant)	Total dry matter (g/plant)	Harvest index (%)
	Vegetative	Flowering	Pod development	Mean			
TMV 1	36.5	51.1	39.5	40.4	9.6	18.8	51.3
CO 5	17.0	55.3	19.7	30.7	4.2	13.5	31.3
H 10	17.5	37.7	16.1	23.8	4.0	14.4	28.1
P 20	12.0	61.3	19.6	31.0	3.6	8.1	44.9
P 37	22.3	36.0	19.8	26.0	5.5	18.4	29.6
CO_2/23	12.2	22.2	28.0	20.8	8.4	14.1	59.5
CO_2/43	17.7	24.9	21.9	21.5	6.9	17.2	40.1
K 78	37.5	18.5	35.1	30.4	10.5	19.5	53.9
CO_2/100	14.7	26.4	33.5	24.9	9.9	23.2	42.7
P 133/1	29.6	23.5	23.8	25.6	8.0	18.0	44.4
P 133/29	33.2	37.0	14.6	28.3	6.0	18.5	32.6
P 178	17.4	51.4	6.1	25.0	3.0	13.8	21.8
VZM 189/61	18.1	22.6	12.2	17.6	10.1	31.2	32.5
P 223	30.6	33.9	9.2	24.6	10.0	35.8	28.0
P 237	15.2	33.7	14.1	21.0	5.8	25.2	23.1
AC 275	18.5	22.0	18.2	19.6	8.9	33.0	27.0
Lam BG 295	38.7	15.7	7.8	20.7	5.9	25.8	23.0
Bilsagreen	24.6	39.2	14.7	26.2	6.2	33.1	18.7
Mithiulundu	37.3	24.0	12.2	24.5	7.5	27.6	27.1
Sardarnagar	26.7	21.4	13.1	20.4	6.7	24.0	27.9
CD at 1% F	3.06**	5.19**	3.20**	4.56**	1.31**	5.71**	3.62**

Table : 2 Correlation between leaf net photosynthetic rate and seed yield, total dry matter and harvest index in blackgram cultivars

Net photosynthesis ($mg.CO_2\ dm^{-2}\ hr^{-1}$) at	Seed yield (g/plant)	Total dry matter (g/plant)	Harvest index %
Vegetative	0.328	0.308	-0.026
Flowering	-0.622**	-0.491*	-0.096
Pod development	0.483*	-0.323	0.722**
Mean over stages	-0.037	-0.412	0.394

* Significant at 5%P ** Significant at 1%P

synthetic rate, seed yield, total dry matter and harvest index (Table 1). Similar varietal differences for photosynthetic rate, yield and other characters were reported in many crop plants (Evans, 1975). Mean leaf net photosynthetic rate did not show direct relationship either with seed yield or total biomass or harvest index (Table 2). This phenomenon indicates that photosynthetic rate alone is not responsible for yield in blackgram. There are many cases where differences in productivity (Rhodes, 1972). The relation between photosynthesis and yield appears to be a function of specific growth phase of the crop. Studies at AVRDC, Taiwan revealed a significant positive correlation between RuBPCase activity during pod-filling period and final grain yield in mungbean. In the present experiment a similar positive association between photosynthetic rate at pod development stage and seed yield ($r=0.48^*$) was noticed. The reason why photosynthesis and its positive bearing on yield is linked to a specific developmental stage may be due to increased sink demand and its feed back effect on the process of photosynthesis during pod-filling period (Kuo *et al.*, 1980). It is possible that this feed back mechanism could result in the positive association of photosynthesis at this developmental stage with final yield in blackgram.

Leaf photosynthesis is one of the basic physiological attributes upon which plant biomass production depends. Interestingly in the present study no relationship was evident between photosynthetic rate and total day matter produced. Higher photosynthetic rates not resulting in greater phytomass may be due to photorespiration *via* the competitive uptake of CO_2 and O_2 by RuBP Carboxylase/Oxygenase. RuBPC and RuBPO activities are highly interrelated and

the RuBPC/O ratio is constant for all plant species. Studies indicated that in general, high photorespiration is associated with high photosynthesis (Pallas and Samish, 1974). Probably this increased respiratory loss of photosynthates may likely to weaken the positive relation between photosynthesis and total biological yield. Also environmental constraints such as mutual shading may limit crop photosynthesis since plant canopy arrangement may influence photosynthetic rate per unit leaf area.

Considerable yield increases are possible by improving harvest index in crop plants. Greater harvest indices result in increased sink demand for photosynthates during pod development. Bulk of seed dry matter are derived from current photosynthesis occurring during post-anthesis (Kuo *et al.*, 1978). This kind of sink control over source activity at pod-filling stage coupled with efficient translocation of assimilates may result in the positive linkage of leaf photosynthesis during pod development with that of harvest index as evidenced in the present study ($r = 0.72^{**}$)

It is understood that photosynthetic rate alone is not responsible for yield in blackgram. However, high photosynthetic rate at pod development stage could improve seed yield in blackgram if higher total phytomass through low photorespiration and harvest index are ensured at that developmental stage.

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