Annals of Arid Zone 31(3) 281-284 1992

PAR Conversion Efficiency of Pigeonpea (*Cajanus cajan* (L.) Mill sp.) With Different Intercrops and Levels of Fertilizers

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Abstract Studies on PAR conversion efficiency under different levels of fertilizer application, showed that the grain yield of pigeonpea and pigeonpea equivalent in cropping system was found to be significant, while fertilizer treatments remained non- significant. The PAR efficiency in intercropped pigeonpea was low during early growth and harvest stages of intercrop, but the same was accelerated with canopy development during reproductive stage. The conversion efficiency of sole pigeonpea, during reproductive stage remained more or less constant resulting in highest straw and lowest grain yield. An overall conversion efficiency of component crops in pigeonpea + groundnut, pigeonpea + cowpea, pigeonpea + greengram and pigeonpea + blackgram cropping systems were superior over others for yield stability and monetary returns.

Key words Intercropping, Conversion efficiency, Interception, Photosynthetic active radiation

Higher yields in pearl millet/groundnut intercropping system were achieved by an increased efficiency in converting light energy into final yield by combined canopy (Reddy & Willey 1979). Intercropping is, however beneficial when it involves component crops having different growth cycles, which allow greater scope for making better temporal use of radiation. Natarajan and Willey (1979) reported that light used by sorghum/ pigeonpea canopy was efficient except for a period of low interception during the period immediately after sorghum harvest, whereas overall efficiency of interception by maize/pigeonpea was found to be very good (Sivakumar & Virmani 1980). Therefore an attempt has been made to evaluate the PAR conversion efficiency of monocrops and intercrops under different levels of fertilizer.

Materials and Methods

The experiment was laid out in split plot design with quadruplicates. Treatment details are given in Tabe 1. The row spacing ratio of main and intercrop was 1:2 at a distance of 90x30 cm and 30x10 cm respectively. Solar radiation, PAR and reflected radiation were measured from the different treatments by integrated quantum radiometer (model Li-188B) at 0830, 1130, 1400 and 1630h and converted into Megajoule per sqare meter per day (MJm^{-2} day^{-1}). The relationship between solar radiation (SR) and PAR was PAR = 0.42 SR. Monteith (1965) reported that this fraction remained between 0.40 and 0.45. Accumulated

Table 1 *Experimental treatments details*

Main plots (Croping systems)
(T_1) Pigeonpea (*Cajanus cajan* L. Mill sp.) cv. T-15-15 sole
(T_2) Pigeonpea + greengram (*Vigna radiata* L.) cv. K. 851
T(3) Pigeonpea + cowpea (*Vigna catijang* Walp) cv. G-2
T(4) Pigeonpea + blackgram (*Vigna mungo* L. Cv. JL-24
(T_5) Pigeonpea + groundnut (*Arachis hypogea* L.) cv.JL-24
(T_6) Pigeonpea + soybean (*Glycine max* Merr.) cv. JS-2
(T_7) Pigeonpea + pearlmillet (*Pennisetum typhoideum* L.) GHB-30cv.
Sub plots (Levels of fertilisers)
(a) Recommended fertilizer dose (RFD)* to pigeonpea only
(b) RFD to pigeonpea and intercrops
(c) RFD to pigeonpea and 1/2 RFD to intercrops
(d) 1/2 RFD to both the crops

RFD* for pigeonpea was 25 + 50 + 0; green gram, cowpea, and balck gram was 24 + 40 + 0; groundnut 12.5 + 25 + 0; soyabean 30 + 60 + 0; and Pearl millet was 80 + 40 0 kg N + P + K ha^{-1}

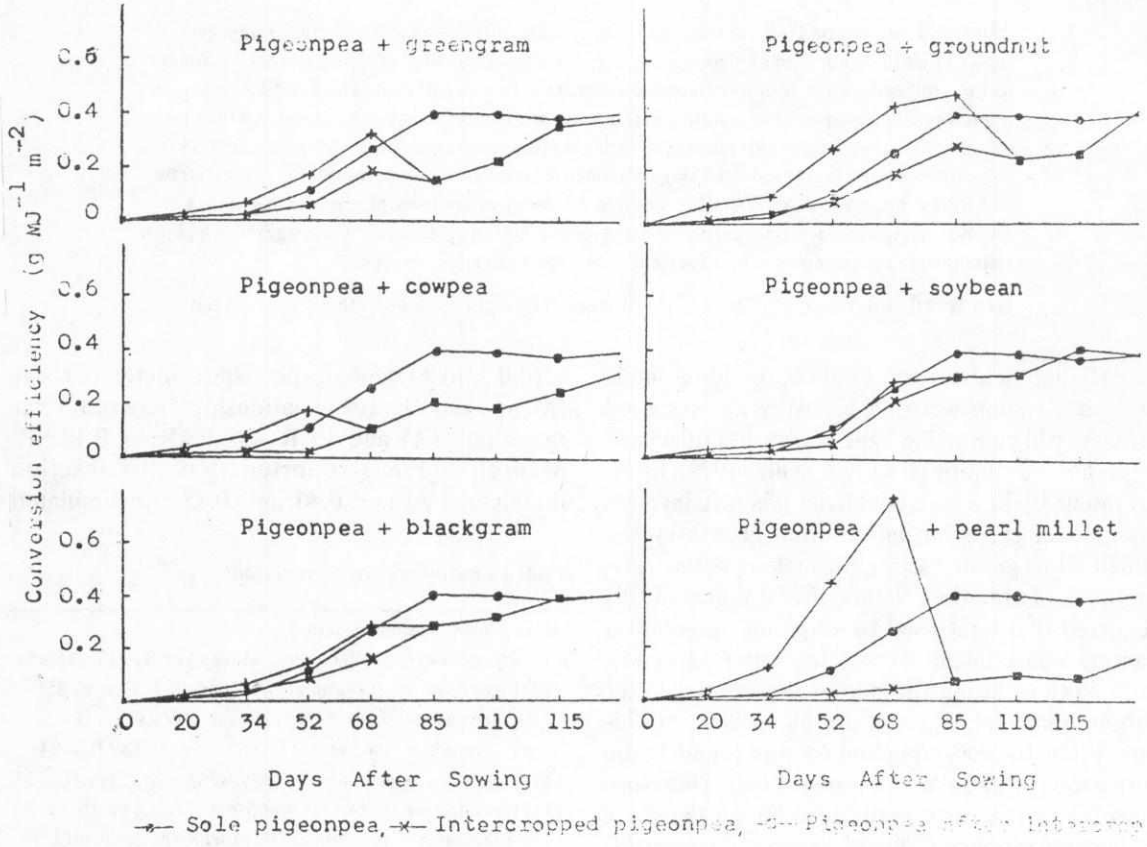

Fig 1 Conversion efficiency of pigeonpea with different intercrops

Table 2 *PAR conversion efficiency of different cropping system*

Treatments	Conversion efficiency (gMJ^{-1} m^{-2})				
	Main crop		Intercrop		Combined
	Grain	Straw	Grain	Straw	Total biomass
T_1	0.017	0.296	–	–	0.313
T_2	0.029	0.205	0.111	0.170	0.353
T_3	0.043	0.189	0.204	0.378	0.480
T_4	0.032	0.266	0.066	0.121	0.379
T_5	0.046	0.243	0.036	0.215	0.458
T_6	0.049	0.284	0.011	0.155	0.428
T_7	0.007	0.069	0.609	0.737	0.659

PAR and final dry biomass were used for computation of conversion efficiency. The crops were raised under rainfed condition, and only one life saving irrigation was given at 85 DAS.

Results and Discussion

Periodic conversion efficiency : Different cropping systems at different crop stages were found significant for PAR absorption, while it remained non-significant for fertilizer application. Higher conversion efficiency of cropping systems was achieved by combined canopy of both the component crops, compared to sole pigeonpea (Fig 1). In sole pigeonpea, the peak conversion efficiency occured at 85 DAS, while combined canopy had peaks at 52 DAS in pigeonpea + cowpea, at 85 DAS in pigeonpea + groundnut and at 67 DAS in all other systems.

After harvest of each intercrop, the conversion efficiency of intercropped pigeonpea accelarated with canopy development compared to sole pigeonpea. These results are in agreement with observations of Sivakumar and Virmani (1980). The conversion efficiency in sole pigeonpea remained constant after 85 DAS, while intercropped pigeonpea had not stopped its vegetative growth in latter part and accelerated canopy growth was utilized in grain formation. Thus, growth of intercropped pigeonpea during reproductive stage was beneficial and might be responsible for higher grain yield in all intercropping systems except pigeonpea + pearl millet, compared to sole pigeonpea.

In sole pigeonpea, there was no intercrop competition and hence available energy was used in forming higher dry matter in early stage of crop growth. During reproductive stage, vegetative growth was more or less constant and this might be the reason for getting low grain and high straw (Lawn 1980). This shows that PAR absorption by combined canopy is an essential component in the efficiency of PAR utilization.

Overall and combined conversion efficiency : Higher conversion efficiency achieved by the main crop except in pigeonpea + pearl millet (Table 2). This might be due to the leguminous nature of these intercrop. Shading of dense pearl millet canopy in pigeonpea on the other hand resulted in low interception. Vigorous growth of pearl millet owing to its being a C_4 type, resulted in competition with pigeonpea in the early growth stages, creating nutrient deficiency for pigeonpea, and higher conversion efficiency for pearl millet. Soybean recorded the lowest conversion efficiency (0.011) which may be due to its low LAI (1.0) and hence poor utilization of radiation. The combined efficiency of the crops, however, were found higher than sole pigeonpea. Highest conversion efficiency for grain yield of pigeonpea was achieved in pigeonpea + soybean (0.049) and lowest in pigeonpea + pearl millet (0.007) system but quite reverse trend was observed when intercrop grain yield was concerned. Thus, here both the cropping systems were not found superior with respect to their compatibility and the stability of yield. Remaining systems gave higher conversion efficiency for main and intercrops compared to sole pigeonpea which

might be due to the varying type of micro-environment created by component crops.

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(Received April 1990 Accepted July 1992)