Light interception efficiency in contrasting sorghums

Sumario. La intercepción de luz en Bangalore, India, fue mayor en sorgos enanos que en altos, en densidades altas de población que en bajas, en sembrios triangulares y cuadrados que en los rectangulares. El sembrio triangular fue menos interceptor de luz en altas densidades de población en el sorgo enano. Una fórmula se propone para evaluar el índice de eficiencia de intercepción de luz del dosel del plantel, expresada en rendimiento biológico o en grano en relación con el por ciento de luz interceptada

Light interception and utilization assumes great importance in view of the fact that it is one of the natural inputs which could be harnessed properly for maximising agricultural production without involving much cost. It has been rightly suggested that there is a possibility of increasing growth rate of crops by using reflectors and other auxillary heat collectors (6). Nevertheless, many studies have proved that light interception efficiency of crops could be increased by evolving proper canopy arrangements through using right genotypes, populations and varying the planting patterns, etc (1, 2, 4, 7). However, still there is need to explore such possibilities in sorghum. An attempt has been made in this communication to evaluate the light interception efficiency of the canopies of a dwarf and tall sorghum hybrids raised under different populations and stand geometries.

Sorghum hybrids 'CSH-3' (105 cm) and 'Kovilpatti Tall' (220 cm) were grown under two populations, 1.33 and 2.67 x10^5 plants per hectare with rectangular, square and triangular planting patterns at Agricultural college farm, Dharwar, India. Twelve treatment combinations were replicated four times in a randomised block design. Regular cultural operations were carried out to raise the crop. Light observations were taken in the canopy of a 60-day old crop, when all the leaves on the plants had fully emerged. The integrated light values were obtained following Friend (3) with suitable modifications. Ozalid paper booklets were exposed to the sun through black paper covers provided with 4 holes, by placing them beneath the crop canopy. The booklets were developed after exposure in vapours of ammonium hydroxide. The ratio of light reaching the ground through the canopy to the light received above the canopy was worked out based on the number of sheets of the booklet bleached after exposing beneath and above the canopy. The ratio has been expressed as the percentage of light intercepted by the canopy.

A new expression was formulated for evaluating the light interception efficiency of the canopy in producing grain and biological yield. This new parameter, viz, Light Interception Efficiency Index (E) indicates the effect of differences in two planting or canopy arrangements, in terms of grain or biological yield in relation to percentage of light intercepted. This was worked out using the formula:

$$E = \frac{\frac{Yb - Ya}{Ya}}{L} \times 100$$

where Ya and Yb are yield values for normal and varied planting patterns, respectively and L is the per cent light intercepted by the canopy of the planting pattern for which E is being worked out.

In general, the canopy of hybrid 'CSH-3' intercepted more light (41 per cent) than that of 'Kovilpatti Tall' (31 per cent). This may be because of the shorter internodes in 'CSH-3' which facilitated closer arrangement of leaves than in 'Kovilpatti Tall'. The population at 2.67 x 10^5 per ha resulted in interceptation of more light (41 per cent) than 1.33 x 10^5 per ha (31 per cent). Bowers *et al.* (1) have also suggested variation in radiant energy reaching the ground through sorghum canopy of different populations. Among the stand geometries, square and triangular (42 and 36 per cent, respectively) were more efficient in light interception as compared to rectangular pattern (33 per cent). In 'CSH-3', with 1.33 x 10^5 plants per ha, square and triangular plantings enabled better light interception by the canopy while with 2.67 x 10^5 plants per ha rectangular and square plantings were more efficient (Table 1). In 'Kovilpatti Tall', square planting was more advantageous than rectangular and triangular plantings under lower population, whereas under higher population both square and triangular plantings intercepted more light from reaching the ground.

The efficiencies of the crop canopy of square and triangular plantings in producing both grain as well as biological yields as related to their respective light intercepting ability was compared to those of rectangular planting by light interception efficiency index. Higher efficiency was indicated in 'CSH-3' at lower population wherein triangular planting was more favourable than square (Table 2). However, at higher population square planting attained greater efficiency than triangular pattern. Probably the canopies of the crop with square and triangular plantings provided better disposition of the foliage in order to trap more light and utilize it for

Table 1.—Percentage light intercepted by the canopy of sorghum hybrids under different populations and stand geometries.

Stand geometries	CSH-3		Kovilpatti Tall	
	P1 33	P2 67	P1 33	P2 67
Rectangular	31.25	50.00	25.00	25.00
Square	37.50	50.00	31.25	43.75
Triangular	37.50	43.75	25.00	31.25

P1 33 and P2 67 are plant populations in lakhs per ha

Table 2.—Light interception efficiency indices of square and triangular stand geometries as compared to rectangular pattern.

Stand geometries	CSH-3		Kovilpatti Tall	
	P1 33	P2 67	P1 33	P2 67
Square	0 113[1] (0 192)*	0 104 (0 042)	—0 923 (—0 030)	—0 475 (—0 130)
Triangular	0 305 (0 263)	0 024 (0 057)	—1 396 (—0 312)	—0 529 (—0 242)

1/ Light interception efficiency indices for grain yield.

* Figures in parenthesis indicate light interception efficiency indices for biological yield.

producing photosynthates. The light interception efficiency with regard to biological yield was also favoured by triangular and square plantings at lower population and by square planting at higher population. With 'Kovilpatti Tall', the light interception efficiency indices under square and triangular plantings attained negative values indicating the superiority of the rectangular planting. This may be due to the stature of this tall hybrid the performance of which is probably governed by the inter-plant competition and other factors apart from the light interception and distribution in the canopy.

Although the study provides some basic information on the relative light interception efficiency of sorghum canopies of different structure, it is suggested that this expression (E) becomes more useful when the light interception observations are made at different stages of the crop growth and also at different heights within the canopy. Also, the light interception values in the present study are to be viewed relatively, as the absolute figures would be much higher.

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Numerical characterization of the development of the bean plant (Phaseolus vulgaris L.)

Sumario. El desarrollo completo de la planta de frijol (**Phaseolus vulgaris** L.) se divide en ocho fases (I a VIII) que se pueden identificar a simple vista. El propósito de esta división es permitir una descripción objetiva para trabajos experimentales, independientemente del genotipo y del ambiente.

Introduction

In many experiments with beans, for instance in screening resistant genotypes through artificial inoculation, a bean scientist may have to closely follow the sequential stages of the ontogeny of bean plants, to intervene at the particular stage which he thinks most convenient for obtaining his objectives. In studying the effect of TIBA application on yield and protein content of *Phaseolus vulgaris* and *Vigna sinensis* cultivars, Rocabado and Pinchinat (1) have used the symbols E_1 and E_2 to designate respectively the first and third fully developed trifoliate leaf, E_3 for the first fully developed flower, and the symbol E_4 meaning 6-7 days after E_3. Unfortunately in many papers on dry bean mention is often made only of time of intervention, as in the following sentence picked up at random from bean literature "the treatments studied were one foliar application 10 days and two foliar applications 10 and 20 days after the emergence of the bean plants". Or else no mention at all is made, either of stage or of time, as in the following sentence: "groups of three plants, each one in