YIELD PHYSIOLOGY OF COWPEA (VIGNA UNGUICULATA, L. WALP), A REVIEW OF WORK AT IITA

by

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To become familiar with the growth and yield production of cowpea, growth analysis experiments were conducted in 1972 in which two varieties of contrasting growth habit were grown at three spacings. Biweekly harvests were divided into various plant fractions, including leaves, to determine dry matter partitioning and leaf area. Light interception was measured using quantum sensors. For comparison, two varieties of soybeans were grown at identical row spacings in an adjacent field. Results, presented in more detail in the 1972 and 1973 Annual Reports, showed that cowpea and soybean have comparable rates of dry matter accumulation in the vegetative and reproductive period, with crop growth rates of 14gm/m^2 day. Crop growth rate was asymptotically related to leaf area index, reaching a maximum in both crops at leaf area index 3 which coincided with the point of maximum light interception. Due to a much longer pod filling period of individual pods, and more efficient partitioning into reproductive sink, soybean yields in the second set of experiments were twice as high as those of cowpea. In the first experiments, lack of moisture shortened the growth duration of the soybean and decreased the expected yield.

Experiments to identify varieties of cowpea with podfill times longer than the usual 19 days showed that podfill time varied from 17 to 22 days in one experiment, and between 17 and 24 days in another, and that longer podfill times were associated with large seed size. Some scope exists, therefore, for lengthening the podfill period of cowpea cultivars.

The short podfill period in cowpea means that yield is produced by a succession of pods ripening over an interval. In leafy indeterminate cultivars, the final yield produced depends on the length of the growing season, and how long the leaves remain green. More compact cultivars of limited leaf area tend to senesce and lose their leaves after the first pods ripen, a characteristic that can be produced in indeterminate cultivars if they are induced to set and ripen a larger-than-normal number of pods at one time (1973 Annual Report). These effects of sink upon source are currently under investigation.

Improved partitioning of dry matter in the reproductive period is possible through morphological changes such as decreasing length of peduncles, decreasing vegetative growth after flowering and increasing pod and peduncle numbers. The presence of a cowpea germplasm collection of over 7,000 lines at IITA provides a good source for these characters. Crosses to incorporate all the characteristics listed into the future cultivars are under way.

Work to date on source-sink relations indicate that the cowpea produces more flowers and pods than it can fill, and shows no decrease in yield if pods are removed in the early stages of their growth. Removal of leaf area resulted in yield decreases, implying that the crop has a source rather than a sink limitation (1974 Annual Report).

To identify cultivars of soybean and cowpea insensitive to daylengths found in the humid tropics, 168 cultivars of soybean and 197 cultivars of cowpea were screened in an outdoor facility in which light duration was extended 13½ hours at an intensity of 3.5-5 ftc. using incandescent bulbs. Photoperiod sensitivity is much more prevalent in soybean, with 17% versus 73% for cowpea showing a delay in flowering under the longer daylengths.

Table 1. Morphological changes in cowpea, cv. Iran Grey, in response to extended day-length (13½ hours) of various intensities produced by a light gradient in the field

Light intensity of extended day	Total branch no/plant	Total node no.	Repr.. nodes on main stem	Peduncles total node no.
ftc.			%	
16	26	312	0	0.2
12	26	299	0	0.3
9	33	324	0	0.4
7.5	25	268	3.6	3.7
6	17	227	8.6	6.5
5.5	20	302	0	6.7
5	16	227	1.0	7.7
4	19	281	3.5	11.6
3.5	15	197	7.3	16.9
3	10	136	7.1	20.1
2.5	9	154	12.1	30.6
2	12	124	14.5	31.7

Besides routine varietal screening for sensitivity to 13½ hours photoperiod, investigations on the effect of light intensity of the extended day on vegetative and reproductive growth of cowpea and soybean has yielded interesting results (1973 Annual Report). As a light intensity of the extended day was increased, date of first flower of photosensitive cultivars was progressively delayed. While in soybean the proportion of vegetative to reproductive structures was little affected by the treatment, cowpeas responded by producing more branches and fewer peduncles and pods when more strongly induced by long photoperiod (Table 1). The light gradient provides a useful technique for producing a continuous variation in degree of photoperiod induction that would otherwise require the use of a large number of controlled environment cabinets.