BIOLOGIA PLANTARUM 34 (1-2): 131-134, 1992

Plastochron index for detecting juvenility and deciding the components of maturity period in cowpea

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Abstract

Growth of nine field grown cowpea genotypes was characterized using plastochron index. Attainment of the final plastochron index was considered as a point of completion of a vegetative phase. The population under study completed a vegetative phase within 50 d and exhibited flower initiation in 55 d. The gap between completion of the vegetative phase and flower initiation indicated the prevalence of juvenility in cowpea. The maturity period was found to be a sum of the periods for plastochron completion, lag I, pod development and lag II. Lag I and Lag II periods existed due to variation in the relative sensitivity of successively formed leaves to the normal inductive conditions. A high genotypic variation for the two lag periods indicated a scope for designing an efficient plant architecture of cowpea either for grain or for vegetable purpose.

Introduction

The grain legumes are known for their complex and unpredictable growth behaviour. A clear understanding of critical phases of development is, therefore, a basic requirement for scheduling a yield improvement programme of these crops. In current investigation, an attempt has been made to characterize growth phases of cowpea by using the concept of a plastochron index with a special emphasis on detection of juvenility and identification of the components of variation in a maturity period among the genotypes.

Material and methods

An experiment was conducted on nine genotypes of cowpea [*Vigna unguiculata* (L.) Walp]: C-152, Patana-1, Wali, No.61-B, ACCC-216, ACCC-198, ACCC-210, ACCC-224 and VCM-8 at the Research Farm, Department of Botany, College of Agriculture, Dapoli during rabi 1989-90.

Received 10 October 1990, *accepted* 22 September 1991.

It was laid out in Randomised Block Design with three replications. Three randomly selected plants of each genotype from each replication were marked for recording observations on developmental changes. The observations on initiation of flowering, first pod maturity and overall maturity were critically recorded. The plants were also regularly monitored for the time of emergence of every leaf on the main shoot. The length of each of the trifoliate leaves was recorded from the day of its emergence till the attainment of final length. Observations on the lengths of two terminal leaves along with the information on the number of leaves appearing at any particular phase of growth were employed to obtain the estimates of Erickson and Michelini's (1957) plastochron index. It is estimated by the following formula:

$$\text{Plastochron Index (P.I.)} = n + \frac{\log_e L_n - \log_e R}{\log_e L_n - \log_e L_{n+1}}$$

Here, n is the youngest leaf whose length exceeds the reference value R of 10 mm, L_n and L_{n+1} are the lengths in mm of leaves n and n+1. The statistical processing of the data was done by usual methods.

Results and discussion

The population under study attained a final plastochron index of 11.63 within a period of 50 d (Table 1). Since the estimation of the plastochron index is based on

Table 1. Plastochron index (P.I.) in relation to flowering in nine genotypes of cowpea.

Genotype	Final P.I.	Time for final P.I. [d]	Time to flower initiation [d]	Final P.I. to flowering [d]
C 152	11.20	49	60	11
Patana-1	10.90	47	55	8
Wali	14.30	59	68	9
No. 61 B	12.10	53	55	2
ACCC 216	11.70	49	51	2
ACCC 198	11.75	45	48	3
ACCC 210	11.70	52	56	4
ACCC 224	10.75	46	51	5
VCM 8	10.05	47	47	-
Mean	11.63	49.67	54.56	4.89
S.E.	0.40	1.46	2.16	1.23
C.V.	10.34	8.83	1.23	75.61

the number of fully expanded leaves and relative measurements of developing and developed leaves, the attainment of the final plastochron index could be considered

as a point of completion of vegetative phase. The population under study hence completed vegetative phase by its 50th day. The overall mean for duration to initiate flowering was 54 - 56 d. This indicated that a period of 4 to 5 d is required for flower initiation after completion of vegetative growth. In critical examination of individual genotypes, it was revealed that a period of zero to 11 d required for flowering after completion of plastochron development. It was maximum in C 152 and minimum in VCM 8 with intermediate values in other genotypes.

The period between completion of vegetative phase and flower initiation thus noticed, may be regarded as a lag period. An occurrence of such a lag period could be due to the insensitivity of plants to normal inductive conditions. Hence, this warrants that there exists a period of juvenility in cowpea. According to Chatterjee and Bhattacharya (1986) juvenility has been not reported in any grain legumes so far examined. However, use of a plastochron index could make it possible to decide the exact point of completion of vegetative phase and hence to detect the juvenile phase in cowpea.

Table 2. Components of variation in maturity period of nine cowpea genotypes.

Genotypes	Time [d] required for final P.I.	pod development	expected maturity	lag I	first pod maturity	lag II	overall maturity
C 152	49	20	69	11	80	3	83
Patana 1	47	18	65	8	73	10	83
Wali	59	25	84	9	93	24	117
No.61-B	53	23	76	2	78	6	84
ACCC 216	49	19	68	2	70	4	74
ACCC 198	45	22	67	3	70	2	72
ACCC 210	52	17	69	4	73	5	78
ACCC 224	46	19	65	5	70	4	74
VCM 8	47	19	66	--	66	3	69
Mean	49.67	20.22	69.9	4.88	74.78	6.78	81.55
C.D.	4.38	2.58	6.25	3.69	8.07	6.86	14.32
S.E.	1.46	0.86	2.08	1.23	2.69	2.29	4.77
C.V.	8.81	12.57	8.94	75.61	10.79	101.18	17.56

According to Patil (unpublished), the total maturity period in cowpea has to be only the sum of periods for attainment of a final plastochron index, and the duration for pod development. In current investigation the average duration for completion of plastochron growth was 49.62 d whereas that for pod development was 20.22 d. Hence, on an average all the genotypes are expected to mature within 70 d. However, it is revealed (Table 2) that there is a wide range of variation in the actual maturity period, due to two lag periods occurring during growth. A period between plastochron completion and flower initiation could be regarded as lag I period, and a gap between the first pod maturity and overall maturity could be a lag II period. According to Khudairi and Hamner (1954) sensitivity of leaves to inductive cycles

depends upon the developmental stage of leaves. Considering early born leaves as a source of stimulus for the first flowering, the length of lag I period may be a function of synchrony between completion of plastochron growth and transmission of stimulus from such leaves for evocation. The lag II period is obviously due to the staggerred flowering. If the late born leaves are considered as a source of stimulus for subsequent flowering the length of lag II period could be a function of time required for ripeness of such leaves to produce flowering stimulus in relation to that of the first flowering and ultimately of the first pod maturity. During lag I, the resources like soil water, nutrients, metabolites *etc.* were consumed by the plant merely for maintenance purpose and not for the processes linked with the determination of yield. Therefore, it could be regarded as an unrequired period.

Length of lag I was noticed to be of a genotypic character. It was totally absent in VCM 8 and was considerably long in Patana-1 and C 152. A considerably high variation (CV=75.61) among the genotype suggested a scope for increasing the production efficiency of cowpea by the elimination of a lag I period through genetic manipulation. In this connection, the culture VCM 8 derives due attention as a donor parent.

A shorter length of lag II would be desirable to facilitate synchronised maturity of a crop grown for grain purpose. A considerably wide range of variation (CV=101.18) for lag II among genotypes suggested a scope for manipulating the length of lag II as per desire and for designing an efficient plant architecture either for grain or vegetable purpose.

References

Chatterjee, B.N., Bhattacharyya, K.K.: Physiology of grain legumes. - In: Principles and Practices of Grain Legume Production. Pp. 51-143. Oxford and IBH Publishing Co., New Delhi 1986.

Erickson, R.O., Michelini, F.J.: The plastochron index. - Amer. J. Bot. **44**: 297-305, 1957.

Khudairi, A.K., Hamner, K.C.: The relative sensitivity of *Xanthium* leaves of different ages to photoperiodic induction. - Plant Physiol. **29**: 251, 1954.