GROWTH OF *ELEUSINE INDICA* (L.) GAERTN. UNDER REDUCED LIGHT INTENSITIES

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(Communicated by R. Misra, F.N.I.)

(*Received 20 November 1967*)

Growth of *Eleusine indica* (L.) Gaertn. under reduced light intensities was studied to explain its habit and distribution under open and shaded habitats. It is observed that growth of this plant as reflected by number of tillers, lateral spread, dry matter yield and number of inflorescence rays is influenced favourably by increase in the intensity of sunlight. The plants are taller because of elongation of shoots under shade. Species appears to be heliophytic in nature. Reduction in the intensity of sunlight has in general a suppressive effect on this plant.

INTRODUCTION

Preliminary observations on the habit and growth performance of *E. indica* revealed that plants, occurring in areas which are partly or fully shaded, are erect and taller as compared to those occurring in open. Similarly on north facing slopes of field bunds which remain shaded for considerable period of time daily, the plants assume erect habit. A preliminary experiment conducted in 1966 revealed that plants cultivated in pots placed under the shade of *Cajanus indicus* are considerably taller as compared to those cultivated in pots kept in open (Fig. 1). Field surveys in different parts of India have revealed that this species does not generally grow in the midst of crop plants and is localized towards field borders. From this it appears that light intensity has some important role in its distribution and growth. Studies on the effect of shade on growth of a number of plants have greatly contributed towards the understanding of ecophysiology of the species (Clements and Long 1934, Burkholder 1936, Shirley 1936, Apaoan 1939, Benedict 1941, Kuroiwa *et al.* 1964). Therefore, the present experiment was conducted in order to assess the influence of reduced light intensities on the growth behaviour of *E. indica*.

MATERIALS AND METHODS

Seedlings were raised in earthenware flats during September 1966 from seeds collected from a population of prostrate plants growing in Varanasi area. When 15 days old, they were transplanted in earthenware pots of 15 cm size

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filled with garden soil and farmyard manure in the proportion of 3 : 1. Three seedlings per pot were maintained and grown until the end of the experiment.

For the light intensity treatment three sheds of 1 m height were constructed in the weed garden of Banaras Hindu University with the help of bamboo poles. One shed was covered with one layer, the other with two

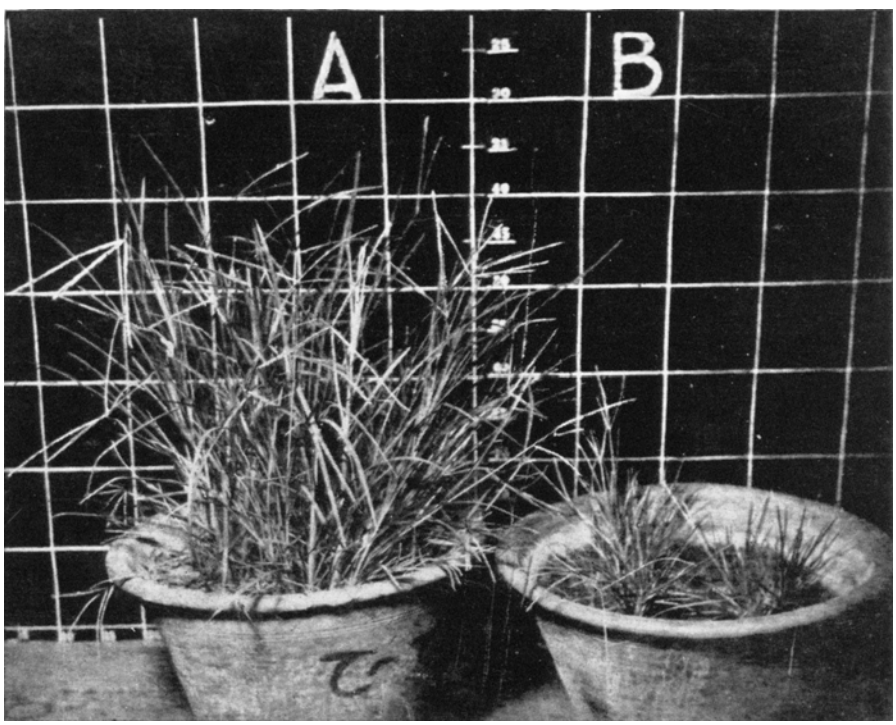

FIG. 1. *Eleusine indica* (L.) Gaertn. grown in pots kept in shade and sunlight :
A—Pot kept in the shade of *Cajanus indicus*
B—Pot kept in sunlight

layers and the third with three layers of muslin cloth (Fig. 2). Light intensity was measured under each of the above-mentioned sheds and the adjacent open area with the help of a photometer. It was found that under the shed with one layer of muslin cloth light intensity was 70 per cent, under two layers of muslin cloth 50 per cent and under three layers 40 per cent of the full sunlight (in the open).

The values given for the percentages of full sunlight transmitted by various layers are those obtained when the layers of cloth were placed at right angles to the direction of sun rays. This ensures the measurement of light at its greatest transmission. The values were checked from time to time during the progress of experiment.

Ten pots each having three plants were kept under each of the above sheds and an equal number of pots was maintained in the adjacent open area under full sunlight. The pots were irrigated regularly. However, those kept under reduced light intensities required irrigation less often than those in full sunlight.

The following observations were recorded at the conclusion of the experiment (3-2-1967) from samples collected at random: number of tillers per plant, height of plants, lateral spread, number of leaves and nodes on the longest tiller, and number of inflorescence rays. The soil was then carefully washed from the plants and their dry weights determined by drying at 105° C for 24 hours.

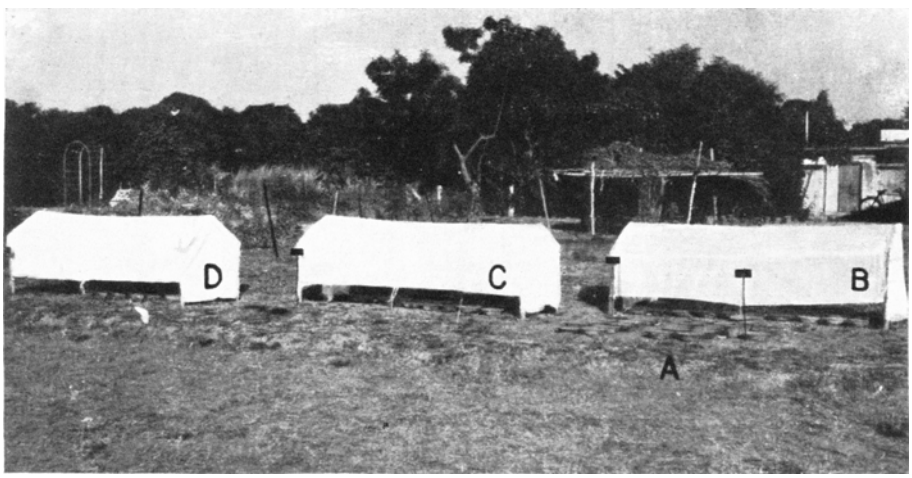

FIG. 2. Muslin cloth sheds (reducing the intensity of sunlight):
A—Pots kept in full sunlight
B—Shed transmitting 70 per cent sunlight
C—Shed transmitting 50 per cent sunlight
D—Shed transmitting 40 per cent sunlight

RESULTS

It is noted that the shaded plants assume erect habit and the unshaded ones are prostrate. Observations on the morphological characters are represented in Fig. 3. Fig. 4 gives some idea of the general condition of the plants grown under different light intensities.

It is evident from Fig. 3 that increase in the percentage of sunlight results in an increase in the number of tillers per plant. Height of the plants, however, is affected in a different way. Under reduced light intensity, the plants are decidedly taller, the minimum height being recorded for those grown in full sunlight. Plants attain maximum lateral spread when grown under

70 per cent sunlight and minimum when grown under 40 per cent sunlight. Lateral spread under 100 per cent light is more than that under 50 per cent. There is no appreciable difference in the number of leaves and nodes. Nevertheless plants grown under 40 per cent sunlight develop minimum number of leaves and nodes.

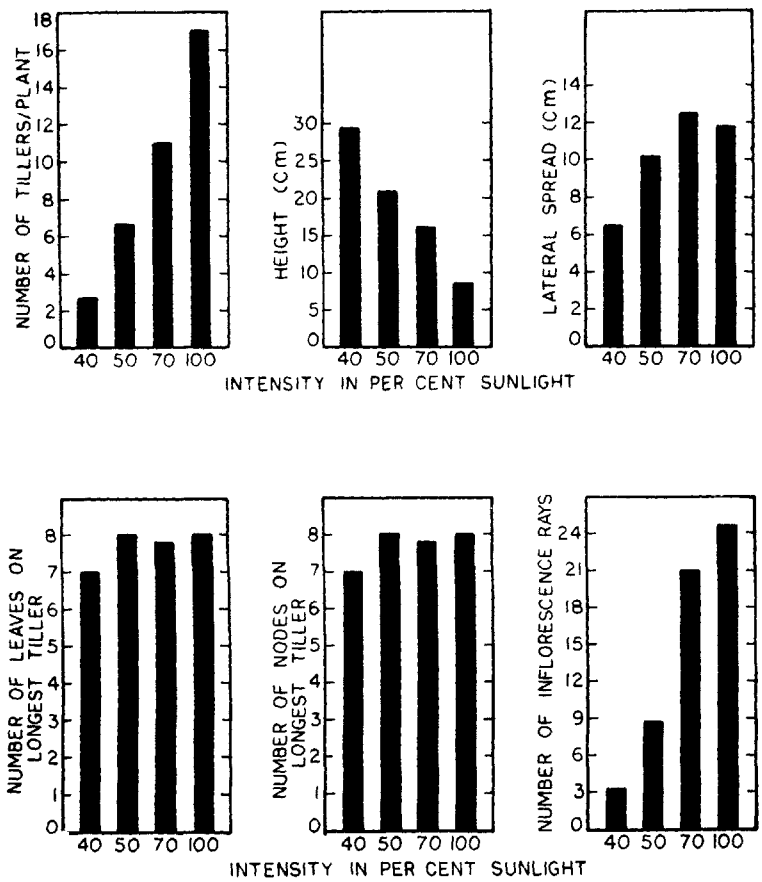

FIG. 3. Performance of *E. indica* under different light intensities.

Maximum number of inflorescence rays are recorded for plants grown under full sunlight and minimum for those under 40 per cent sunlight. The number of inflorescence rays increases with an increase in the intensity of sunlight falling on the surface of the plants.

Dry matter yield of shoot and root systems and shoot/root ratios of plants grown under different light intensities are recorded in Table I.

It is evident from Table I that dry matter yield of both shoots and roots decreases as the intensity of sunlight is reduced. Plants grown under 40 per cent sunlight record very low values. Dry matter yield of

these plants is only about 12 per cent in the case of shoots and 6·6 per cent in the case of roots as compared to those cultivated under full sunlight. Shoot/root ratio is highest in plants grown under 40 per cent sunlight.

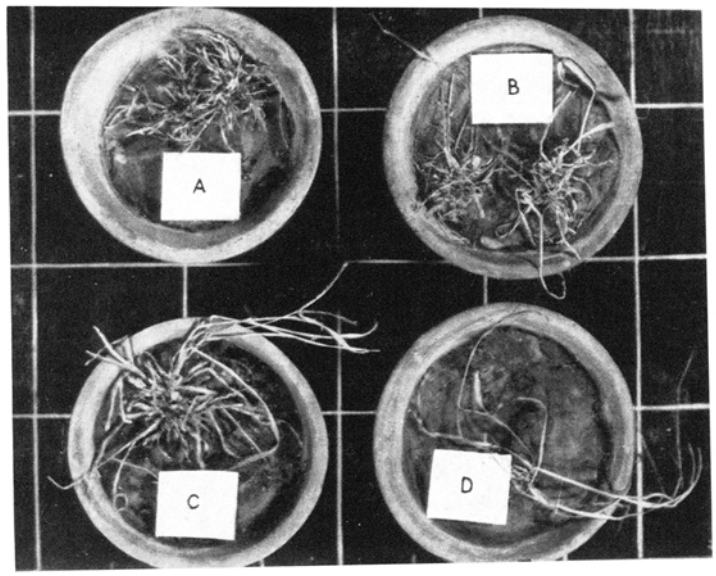

FIG. 4. *E. indica* grown under different light intensities:
A—100 per cent sunlight
B—70 per cent sunlight
C—50 per cent sunlight
D—40 per cent sunlight

TABLE I

Influence of different intensities of sunlight on dry matter yield and shoot/root ratio of E. indica

Intensity of sunlight	Dry weight of shoot (g)	Dry weight of root (g)	Shoot/root ratio
100%	10·80	8·00	1·35
70%	7·00	5·75	1·21
50%	4·24	3·00	1·41
40%	1·40	0·53	2·64

Analysis of variance (Table II) indicates significant differences among the treatments in all the characters studied except in the case of number of leaves and nodes on the longest tiller and lateral spread.

Table III includes values of critical differences for various characters. It is evident from this Table that height of plants grown under 70 per cent and

50 per cent light intensities and number of inflorescence rays between 100 per cent and 70 per cent, and 50 per cent and 40 per cent do not show significant difference. Plants grown under different intensities of sunlight differ significantly in all the other characters except lateral spread and number of nodes and leaves on the longest tiller.

TABLE II

Analysis of variance for different characters of E. indica *grown under different intensities of sunlight*

Characters	Sources of variation	D.F.	S.S.	M.S.S.	Variance ratio 'F'
No. of tillers/plant	Between treatments	3	52·1	17·36	3·91*
	Within treatment	9	40·0	4·44	
Height of shoot	Between treatments	3	779·15	59·70	20·54‡
	Within treatment	9	113·8	12·64	
No. of leaves	Between treatments	3	1·8	0·6	0·68
	Within treatment	9	8·0	0·888	
No. of nodes	Between treatments	3	1·8	0·6	0·68
	Within treatment	9	8·0	0·888	
Lateral spread	Between treatments	3	59·96	19·98	1·79
	Within treatment	9	100·34	11·15	
No. of inflo. rays	Between treatments	3	82·78	275·93	11·48†
	Within treatment	9	21·62	24·02	
Dry wt. shoot	Between treatments	3	148·14	49·88	26·40‡
	Within treatment	9	16·87	1·87	
Dry wt. root	Between treatments	3	70·55	23·516	47·40‡
	Within treatment	9	4·45	0·494	

* $P < 0{\cdot}05$; † $P < 0{\cdot}01$; ‡ $P < 0{\cdot}001$

DISCUSSION

Maximum growth of plants as indicated by larger number of tillers and greater dry matter yield under full sunlight suggests that this species is a heliophyte. This observation is in conformity with results reported earlier indicating better performance of the plants on south facing slope (Singh 1967).

Lateral spread, although maximum when sunlight is reduced to 70 per cent also appears to be favourably affected by increase in light intensity.

Under reduced sunlight the plants become erect and taller. Since there is no appreciable effect on number of nodes and leaves this behaviour is undoubtedly on account of greater elongation under shade. Growth behaviour of this plant on north facing slope substantiates this finding (Singh 1967).

Increase in height and decrease in dry weight of the plants grown in shade as compared to those grown in full sunlight have also been reported by many workers as reviewed by Shirley (1936) and Burkholder (1936). Benedict

TABLE III

Critical differences at 0·05 probability for different characters of E. indica *grown under different intensities of sunlight*

Light intensity compared	No. of tillers	Height	No. of leaves	No. of nodes	Lateral spread	No. of flores-cence rays	Dry wt. of shoot	Dry wt. of root
(*a*) *v* (*b*)	4·35*	7·25*	1·94	1·94	6·89	9·99	2·82*	1·45*
(*a*) *v* (*c*)	3·46*	5·87*	1·55	1·55	5·51	8·08*	2·26*	1·15*
(*b*) *v* (*d*)	4·35*	7·25*	1·94	1·94	6·89	9·99*	2·82*	1·45*
(*b*) *v* (*c*)	3·96*	6·73	1·77	1·77	6·26	9·26*	2·53*	1·29*
(*a*) *v* (*d*)	3·39*	6·38*	1·74	1·74	5·88	9·04*	2·51*	1·27*
(*c*) *v* (*d*)	3·46*	5·87*	1·55	1·55	5·51	8·08	2·26*	1·15*

(*a*) = 100%; (*b*) = 70%; (*c*) = 50%; (*d*) = 40%

* Differences in the average values significant at 0·05 P.

(1941) also observed similar behaviour in certain grasses at Cheyenne, Wyoming.

Decrease in the number of inflorescence rays under reduced light intensity reflects that the reproductive potential of this plant declines in shade.

It is indicated by higher shoot/root ratios under reduced sunlight (except 70 per cent) that at least partly the elongation in aboveground parts is made at the expense of root system.

The suppressive influence of artificial shading suggests that reduced sunlight in crop fields is at least one of the factors responsible for the absence of this species from dense-crop fields. This finding may be utilized for suppressing this weed by modifying the cropping system.

ACKNOWLEDGEMENTS

The author is indebted to Prof. R. Misra, F.N.I., F.W.A., Principal Investigator, and to Dr. K. C. Misra, Research Officer, P.L. 480/Ecology Project, Banaras Hindu University, Varanasi, for constant encouragement and guidance. This research has been financed in part by a grant made by the United States Department of Agriculture, Agricultural Research Service, under P.L. 480.

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