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INFLUENCE OF SHADE ON THE GROWTH PERFORMANCE OF *SOLANUM NIGRUM L.*[1,2]

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ABSTRACT

Both the varieties (Black and Red berried) of *S. nigrum* behave as heliophytes during winter (October to February) and Sciophytes during summer months (February to May). Maximum seed output per plant is obtained under open conditions during different seasons. Floral initiation takes place first in full sunlight. Light, therefore, seems to be a factor of primary importance as far as flowering and fruiting are concerned in and around Varanasi.

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Introduction

There is a large amount of evidence to show that the individual features of vegetative growth as well as the proportional relationship between various organs, vary in relation to changes in the environmental conditions. The works of Ashby (1950), Ashby and Wangerman (1950), Gregory (1928), Blackman (1947), and Whalley and Leech (1950) record instances of changes in leaf shape, plastochrone rate, vegetative growth rate, leaf stem ratio and leaf root ratio, induced by changes in light conditions. There are also differences in the responses of varieties within a species toward the changes in the external environmental conditions (Clausen, Keck, and Hiesey, 1940; Went 1944). Ecologically light intensity and duration of light are of prime importance to the plants influencing their growth and distributional pattern.

Solanum nigrum L. occurs in and around Varanasi from September to May. During winter months these plants have been observed by the author both in sun and shade, whereas during summer these plants have been seen only in shady (i.e. under trees) and moist habitats. In order to investigate, therefore, the influence of the light intensity on the growth performance of this plant, certain experiments were performed during the winter and summer months. Both the varieties, viz. black berried and red berried, were considered so that the differential response, if any, may be brought out.

Material and Methods

Seedlings were raised in earthenware flats and when 30 days old they were transplanted to earthen pots of 25 cm diameter. These pots were divided into three lots of 4 pots each and were subjected to the following treatments :

(i) Full sunlight...Pots were kept in open area (Under natural conditions)

(ii) Partial shade...Pots were kept under Mango Trees where light intensity as measured with the help of photometer fluctuated between 600 to 1200 lux during the day time.

(iii) Deep shade...Pots were kept under a wooden frame covered with a thick cloth leaving the north and east sides open upto 15 cm from the ground level. The light intensity under this shade varied between 50 to 200 lux.

The experiment was performed twice in the year, once from October 1964 to February 1965 and again from February to May 1965.

Results and Discussion

It was found that variations in light intensity resulted in large differences, in both, in the pattern of growth. (Table I)

Results presented in Table I show that the pattern of growth behaviour of both, Black & Red berried plants, are more or less similar qualitatively although the quantiative differences are there. Both varieties behave as heliophytes (Sun loving plants) during winter months and as sciophytes (shade loving plants) during hot summer months as shown by overall vegetative growth (height of the shoot, number of leaves, leaf area and dry weight of plant) which is significantly higher in plants growing in open during winter and in plants growing in partial shade during summer (Tables II–V). Such observations explain to some extent the natural occurrence of the plants in shade and moist places only in summer and in open during winter. Since the intensity of light in nature is directly related to

temperature (Daubenmire, 1959), high temperature seems to restrict plant growth as has been recorded in case of plants growing in sun during summer months, while the lower temperatures under shade (by 10–20°c) seems to favour good vegetative growth. Another factor which seems to be important here is soil moisture. In full sun during summer months the relatively drier conditions may also account for the restriction of this plant in shady and moist localities. Presently however, no quantitative data are available to support this. This plant, therefore, cannot be considered as either heliophyte or sciophyte completely because behave it like both types under different temperature and moisture conditions. These results are in accordance with those of Hanson (1917), Isanogle (1944) and Anderson (1955) who also recorded the differential seasonal development of plant in sun and shade.

The behaviour of flowering and fruiting was also found to be greatly influenced by light intensity and these functions were increased under full sunlight during winter as well as in summer months. Similar type of observations have also been made by various other workers (Shirely, 1935, 1945, Vinson, 1923). Went (1945a, b) has previously reported better initiation of floral primordia under full sun light and better growth performance under partial shade condition. Such observations on growth towards light intensity has been described for the various members of Solanaceae

TABLE I

EFFECT OF SHADING ON GROWTH PERFORMANCE AND SEED OUTPUT

Characters		Full Sun		Partial shade		Deep shade	
		S. n. B.	S. n. R.	S. n. B.	S. n. R.	S. n. B.	S. n. R.
Shoot height (cm.)	A	15·0	14·5	9·7	6·7	1·5	1·5
	B	6·5	5·6	16·4	12·9	2·5	2·2
Average Area of mature leaf (sq. cm.)	A	15·0	8·8	9·9	6·6	3·5	2·5
	B	24·7	9·9	48·0	12·8	—	—
Average number of leaves per plant	A	47	61	25	15	8	6
	B	15	20	18	15		3
Average number of fruits per plant	A	20	25	8	5	—	—
	B	8	10	5	4	—	—
Average seed output per plant	A	760	800	144	80	—	—
	B	224	250	50	32	—	—
Total dry weight of plant (g.)	A	1·7	1·99	0·26	0·24	0·14	—
	B	0·70	0·58	0·93	0·83	—	—
Percentage of Ash (Dry weight basis)	A	16·5	18·5	18·0	20·5	—	—
	B	12·2	13·6	15·3	16·9	—	—

S. n. B., *S. nigrum* Black berried; S. n. R., *S. nigrum* Red berried ; A denotes 15th October to 28th February 1965 ; B denotes 28th February to 14th May 1965

TABLE II

VARIANCE ANALYSIS FOR GROWTH PERFORMANCE DRY WEIGHT DATA OF *S. NIGRUM* GROWN UNDER DIFFERENT LIGHT CONDITIONS IN WINTER

Source of variation	D.F.	S.S.	M.S.S.	Variance Ration	F/at 5%
Variety	1	0·1	0·1	12·0*	4·042
Shading	2	35·6	17·8	2144·5*	3·191
Shading × variety	2	0·5	0·25	30·1*	3·191
Error	48	0·4	0·0083		
Total	53	36·6			

* Significant at 5% level.

TABLE III

SUMMARY TABLE OF DRY WEIGHT DATA FOR THE INFLUENCE OF SHADE ON *S. NIGRUM* IN WINTER

Treatment / Variety	Sun	Partial shade	Deep shade
Black (berried)	1·71	0 194	0·129
Red (berried)	1·98	0·195	0·0
Means	1·84	0·1945	0·064

C.D. for the body of the table—0·043 ;C.D. for variety—0·045: C.D. for treatment—0·06

TABLE IV

VARIANCE ANALYSIS FOR GROWTH PERFORMANCE DRY WEIGHT DATA OF *S. NIGRUM* GROWN UNDER DIFFERENT LIGHT CONDITIONS DURING SUMMER

Source of variation	D.F.	S.S	M.S.S.	Variance Ratio	F/at 5%
Variety	1	0·1	0·1	43·5*	4·17
Shading	1	0·560	0·56	243·5*	4·17
Variety × shading	1	0·14	0·14	60·8*	4·17
Error	32	0·073	0·0023		
Total	35	0·873			

* Significant at 5% level.

TABLE V

SUMMARY TABLE OF DRY WEIGHT DATA FOR THE INFLUENCE OF SHADE ON *S. NIGRUM* DURING SUMMER

Shading Treatment / Variety	Sun	Partial shade
Black (berried)	0·687	0·930
Red (berried)	0·576	0·844
Means	0·631	0·887

C.D. for body of table—0·045; C.D. for variety means—0 033; C.D. for treatment means—0·033

to which the genus, *Solanum*, belongs (Went, 1957). Light, therefore, seems to be a factor of considerable importance as far as flowering and fruiting are concerned.

Ash percentage of plants which was found to decrease with increase in light intensity shows the sciophytic feature of the plant. Mitchell (1953), also recorded increased ash content in plants grown under shaded conditions.

The treatment conditions used are by no means representative of all conditions met with when the plant grows in nature. The differences in pattern of development which have been induced are even more spectacular than had been suggested by the field observations. Therefore, the present observations and experimental results show the controlling influence of light and temperature conditions on the growth and phenology of this plant.

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