the present study supports the views of Schwanitz[11] and Stebbins[4] that an optimum cell size exists for each species and that this size may be attained through natural selection at the diploid level in some species and at higher ploidy levels in others. The favourable response to induced polyploidy will then depend upon whether or not the optimum cell size has already been attained in the initial population chosen for colchicine treatment.

If this correlation between GA and polyploidy effects is generally operative, an interesting application of the present observation will be that positive response to GA can be used as a sieve for selecting plants for the induction of polyploidy. This technique may be particularly useful in ornamental and fodder plants but not in crops where the economic part is the seed, since in such plants increased grain size is not the only component of increased yield and the seed sterility associated with autopolyploidy also reduces the utility of the polyploid.

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DRY MATTER PRODUCTION IN SUN AND SHADE LEAVES AND A SIMPLE METHOD FOR THE MEASUREMENT OF PRIMARY PRODUCTIVITY

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WITH increasing emphasis in recent years on the evaluation of primary productivity the role of sun and shade leaves in production has drawn considerable attention. Although some amount of work is available on the differential behaviour of sun and shade leaves (often referred to as upper and lower leaves) with regard to their dry weight per unit area,[1-3] a direct evaluation of their capacity for dry matter production is lacking in ecological literature. In order to investigate, therefore, the gross productivity of these two types of leaves when exposed to their normal as well as reciprocal light conditions, a few experiments were conducted with *Bougainvillea spectabilis* during April 1968. The same are discussed briefly here.

Gross production was measured through the increase in the dry weight of leaf discs of one square centimeter area obtained with the help of a cork borer. Twigs of current growth with equal number of nodes were selected from the permanently shaded (10% of full daylight) and upper exposed areas from shrubs growing in the botanical garden of the Banaras Hindu University at 8 a.m. The leaves obtained from shaded and exposed areas are termed shade and sun leaves respectively. In order to avoid the error due to changes in the area of the leaves[4] they were immersed in water till fully turgid before cutting out the discs. The discs were then placed over cotton pads kept constantly wet in uncovered Petri dishes. Cotton pads were necessary to check excessive heat which otherwise would kill the discs within a short period when kept in full sunlight. Twenty discs were placed in each Petri dish and three such Petri dishes were used for each of the following treatments: sun leaves in full daylight, sun leaves in shade, shade leaves in full daylight, shade leaves in shade, and sun and shade leaves in a dark chamber with 40% KOH placed in another Petri dish. Presence of KOH solution was necessary as we have gathered some evidence of substantial dark fixation of CO_2 in this plant which will be published elsewhere.

At the start of the experiment an equal number of discs, both from sun and shade leaves, were ovendried at 80° C. for recording the initial dry weight. Increase in the dry weight of the discs at the end of six hours treatment is taken as the apparent photosynthesis or net production and the decrease in the dry weight in dark as respiration. Sum total of these two values represents gross production. This method has the advantage over that used by Denny[5] inasmuch as the photosynthate is not translocated out of the photosynthetic area. For experimentation in reduced light intensity the shade of the same shrub was used as the spectral composition of the light is liable to be different in shade of different plants.[6]

TABLE I
Initial dry weight and gross and net productivity of sun and shade leaves

	Sun leaf	Shade leaf
Control (g./m.^{2}) ..	912±17·2	567±10·2
Six hours in full sunlight (g./m.^{2})	995±15·3	643± 1·2
Six hours in shade (g./m.^{2})	981±22·8	596±15·3
Six hours in dark (g./m.^{2})	892± 2·9	555±11·9
Respiration (g./m.^{2}/hr.) ..	3·3	2·0
Gross productivity (g./m.^{2}/hr.) in sun	17·1	14·66
Gross productivity (g./m.^{2}/hr.) in shade	14·80	6·80
Net productivity in sun (g./m.^{2}/hr.)	13·8	12·66
Net productivity in shade (g./m.^{2}/hr.)	11·5	4·80
Gross productivity in sun (g./m.^{2}/day)	205·2	175·92
Gross productivity in shade (g./m.^{2}/day)	177·6	81·60
Respiration (g./m.^{2}/day)..	79·2	48·0
Net productivity in sun (g./m.^{2}/day)	126·0	127·92
Net productivity in shade (g./m.^{2}/day)	98·4	33·6

Table I indicates that the dry weight of the shade leaves per unit area is significantly lower than that of the sun leaves ($p < 0 \cdot 001$). It is further evident that both the gross and net productivities are higher in sun leaves as compared to the shade leaves ($p < 0 \cdot 001$) and $p < 0 \cdot 001$ respectively) under their normal light regimes. However, when the sun leaves are exposed to shade for limited period there is no appreciable decrease in their productivity. On the other hand, the shade leaves when exposed to full daylight increase their photosynthetic rate more than twice the normal value. When the data are converted to per day basis (taking 12 hr. light and 12 hr. dark period) similar trend in productivity is obtained but the net productivity of the shade leaves exposed to full sunlight equals to that of sun leaves under their normal light condition and is more than that of the sun leaves exposed to shade. From these observations it is clear that the shade leaves have inherent capacity to photosynthesize at the same rate as the sun leaves and therefore they also contribute significantly towards plant productivity as and when they are exposed even for a brief period to direct sunlight on account of sun flecks and changes in the light climate due to the action of wind, etc.

In the light of above observations an estimation of the amount of chlorophyll present seems necessary. Total chlorophyll $(a + b)$ in sun and shade leaves was determined in 80% acetone extract.[7] The ratio chlorophyll a/chlorophyll b was determined through their respective concentrations.[8] It was thus found out that sun leaves contain 84·5 mg./m.^{2} chlorophyll while the shade leaves have about twice this amount (182·9 mg./m.^{2}). The ratio chlorophyll a/chlorophyll b amounts to 1·2 in sun leaves and to 5·3 in shade leaves. It is obvious therefore that in full sunlight even lesser amount of chlorophyll per unit area photosynthesizes much more and hence sun leaves are more efficient energy trapping system. The increased amount of chlorophyll in shade leaves may, however, be helpful in stimulating production as and when sufficient light is available for a brief period. The present finding is in conformity with those of Harder[9] Seybold and Egle,[10] and Egle[11] who have reported greater amount of total chlorophyll in shade plants. However, contrary to their observations the shade leaves of *B. spectabilis* contain lesser amount of chlorophyll b as compared to the sun leaves. It has been established that chlorophyll b improves the utilization of light between 450 and 480 mμ, which is abundant in the shade of foliage.[12] Thus, in the sun leaves of the present species, containing more chlorophyll b, the photosynthetic efficiency is not significantly reduced in shade. Therefore, on a cloudy day also the sun leaves may photosynthesize with the same efficiency as on sunny day. On the other hand the shade leaves, having more chlorophyll a, increase their photosynthesis considerably when exposed to full sunlight.

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