cause of this sterility, therefore, could be environmental.

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1. Roy, S. K., *Sci. and Cult.* 1967, 33, 377.
2. Richardson, M., *Cytologia*, 1934, 5, 337.
3. Darlington, C. D., *J. Genet.*, 1929, 21, 207.

PHOTOPERIODIC RESPONSES OF SOME SPECIES OF *MARSILEA*

THE aquatic fern genus *Marsilea* represented by 10 species in India, is well known for its phenotypic plasticity. The results of an ecological study of some common Indian species have further shown the wide ecological amplitude and interspecific differences[1,2] and even the existence of ecotypic variations[3]. This communication reports the results of a study of the photoperiodic responses of three species, namely, *M. minuta*, *M. aegyptiaca* and *M. maheshwarii*. Five-internode long rhizome pieces from clones, maintained in the garden, were transplanted in unglazed earthen pots filled with garden soil and farmyard manure. The soil analysis showed about 2·2% organic matter content. The established plants in the pots were subjected to photoperiods between 8 and 24 hours in a 24 hr cycle. The natural daylength of about 11 hours was supplemented by a 300 W incandescent bulb fitted with an aluminum reflector to provide a light intensity of about 500 Lx. At the end of the experiment, the plants were harvested, washed and various measurements were taken. Dry weights were obtained after drying the plants at 80° C for 24 hours. The data are presented in Fig. 1.

It is noted that *M. aegyptiaca* did not survive at 24 hr photoperiod. The rooting behaviour of the plants as noted by root depth or root weight did not show any correlation with the photoperiod. The internode length was maximum at 8 hr photoperiod in all the four populations and showed steep fall with increase in the daylength to a certain level after which a rise was again observed. Thus, shortest internodes were produced at 12 hr daylength in *M. minuta* (B.H.U.) and at 14 hr daylength in *M. aegyptiaca* and *M. maheshwarii*. The differences were also statistically significant ($P = \cdot001$). Similarly, the petiole length was maximum at 8 hr photoperiod and the smallest petioles were obtained at 24 hr photoperiod. The photoperiod had similar effect on the size of the leaflets. Largest leaflets were produced at 8 hr photoperiod except that in *M. minuta* (B.H.U.) largest leaflets were obtained at 12 and 14 hr photoperiod. With the exception of *M. minuta* (B.H.U.), the other three populations produced greater amounts of dry matter per plant at 10 hr photoperiod and increase in the daylength had adverse effect on dry matter accumulation. *M. minuta* (B.H.U.) gave maximum dry matter per plant at 8 hr photoperiod.

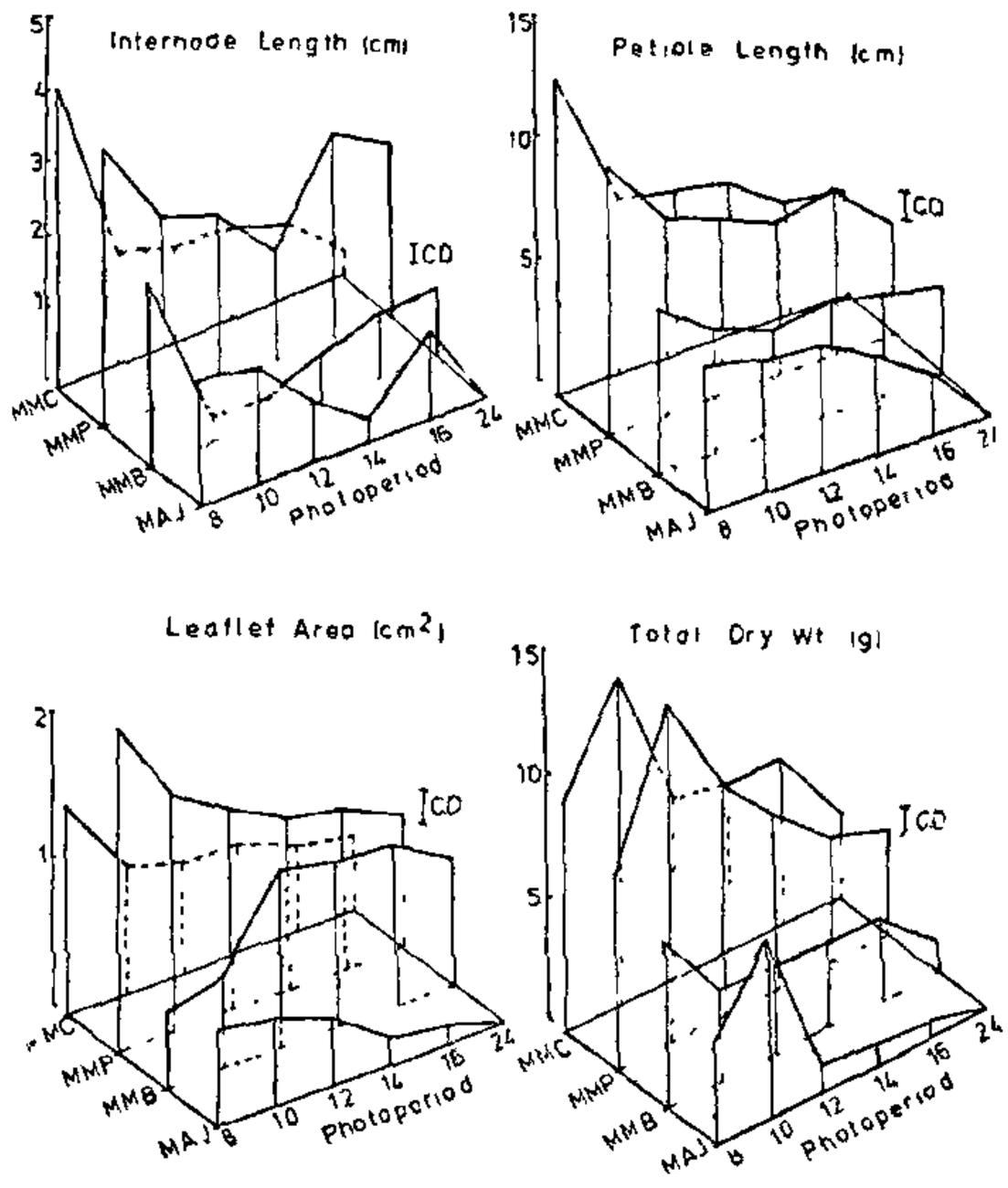

FIG. 1. Effect of different photoperiods on growth of *Marsilea species*. [MAJ—*M. aegyptiaca*; MMB—*M. minuta* (B.H.U.); MMC—*M. minuta* (Chandauli, Varanasi); and MMP—*M. maheshwarii*.]

Observations on the reproductive response of the four populations under investigation showed that except *M. minuta* (Chandauli, Varanasi), the other three produced sporocarps at all the photoperiods to which the plants were subjected. Thus, *Marsilea* species behave as day neutral plants. The failure of the Chandauli population of *M. minuta* to produce sporocarps is well explained by the fact that it requires a high soil organic matter status for reproductive growth[3].

These studies reveal that *Marsilea* species behave quite differently from other water ferns and other plants. *Regnillidium diphyllum* and *Salvinia natans* have been observed to show better vegetative growth (and also larger leaves) at longer photoperiods[4–6]. Greater stem length with longer internodes and higher dry matter production have been found at increasing photoperiods in several other flowering plants[7–9]. But strangely enough,

the responses of *Marsilea* species are just to the contrary. Concerning reproductive growth also, *Salvinia natans* and *Regnellidium diphyllum* are found to be more dependent on temperature than the daylength[10].

Thus, the results of the present investigations show that *Marsilea* species, though day neutral, show better vegetative growth at short photoperiods (8–10 hr). Further, some differences between various species can also be made out.

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BRIJ GOPAL.

1. Gopal, B., *Trop. Ecol.*, 1968, 9, 153.
2. Gopal, B., *Trop. Ecol.*, 1969, 10, 287.
3. —, *Curr. Sci.*, 1969, 38, 371.
4. Nakayama, S., *Bot. Mag.*, Tokyo, 1952, 65, 274.
5. Shibata, O., *Ibid.*, 1959, 72, 462.
6. Bloom, W. W. and Voth, P. D., *Bot. Gaz.*, 1956, 117, 173.
7. Downs, R. J., In Withrow, R. B. (Ed.). *Photo-Periodism and Related Phenomena in Plants and Animals*, Am. Assoc. Adv. Sci., Washington, 1959, p. 126.
8. Nitsch, J. P. and Nitsch, C., In Withrow, R. B. (Ed.), *Ibid.*, 1959, p. 225.
9. Nitsch, J. P., In Evans, L. T. (Ed.), *Environmental Control of Plant Growth.* Academic Press, N.Y., 1963, p. 175.
10. Labouriau, L. G., *Arq. Mus. Nac.*, Rio de Janeiro, 1958, 46, 119.

SHORT SCIENTIFIC NOTES

Apatite with Plecchroic Cores in an Early Precambrian Rock and its Geological Significance

Apatite showing pleochroic cores was observed by the author in a hornblende-plagioclase-quartz-microcline para-schist from a greenstone-granite belt of northeastern Minnesota, U.S.A.[1]. This occurrence is the first of its type, so far as known, from the Early Precambrian.

In thin section, the apatite grains are somewhat rounded prismatic crystals. Their cores are pleochroic in several shades of purple, dark blue, and bluish black. Some grains yield a typical uniaxial negative interference figure. The associated minerals are blue-green hornblende, brown biotite, calcic oligoclase (An_{25}), grid-twinned microcline, quartz, and sphene.

Apatite with coloured cores is reported to be abundant only in granitic rocks[2,3] which are especially possible sources of most detrital apatite[4]. This suggests that the para-schist containing pleochroic apatite was derived, in part, from the denudation of a granitic source. The oldest granitic rocks of the area comprise the Giants Range batholith[5] that is intrusive into, and hence younger than, the metasedimentary rock. The occurrence of apatite with pleochroic centres in the pre-batholithic rock, therefore, points to an earlier episode of granitic plutonism in the area.

Apatite showing pleochroic cores is a potentially useful provenance indicator in sedimentary petrological studies and may be useful in lithologic correlation.

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1. Viswanathan, S., In Sims, P. K. *et al.*, *Geologic Map of Minnesota*, Hibbing Sheet, Minn. Geol. Surv. Publ., 1970.
2. Baker, G., *Amer. Mineral.*, 1941, 26, 382.
3. Simpson, B., *Geol. Mag.*, 1933, 70, 375.
4. Milner, H. B., *Sedimentary Petrography*, 3rd Edn., Thomas Murby & Co., London, 1952, p. 244.
5. Viswanathan, S., *Bull. Ind. Geol. Assoc.*, 1972, 5, 77.

Spore Colour Mutants Induced by Gamma Irradiation in *Trichoderma glaucum* Abbott.

Morphological and nutritional mutants were induced by thermal neutrons in *Trichoderma glaucum*[1]. Growth characteristics of three spore colour mutants obtained by gamma irradiation in *T. glaucum* are reported here. Cultures of *T. glaucum* were grown and maintained on Czapex Dox agar supplemented with yeast extract (2 g/l). Maximum growth and sporulation were observed on fifth day of incubation at 30° C. Conidia collected in distilled water (concentration, 1×10^7 conidia/ml) were irradiated in a ^{60}Co cell for 1 hour (dose rate 45 kR/min.) and then plated on