was also reported by Hiratsuka[3] in *Bombyx mori*. It is, therefore, essential to note that computation of E.C.I. and E.C.D. values for various nutrients by using equation of Waldbauer[5] is possible only for the essential nutrients of the test insect. However, C.A.D. values for different nutrients can be calculated directly from Waldbauer's[5] equation because it involves estimation of nutrients consumed and amount of nutrients in the faeces during the experimental period.

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PARTHENOCARPY IN *TRICHOSANTHES DIOICA* ROXB. AND *MOMORDICA DIOICA* ROXB.

THE female plants of *Trichosanthes dioica* and *Momordica dioica* are cultivated by vegetative propagation in betel vine yards in the outskirts of Rewa. The other cucurbits that are cultivated are: *Coccinia indica*, *Lagenaria leucantha* and *Momordica charantia*. A servey of fifty betel yards revealed the total absence of male plants of *T. dioica* and *M. dioica*. In absence of the male plants, the female plants, as a result of external stimulus, produce parthenocarpic fruits. Recently, Lal[3] has reported the parthenocarpic fruit development in *Coccinia indica* by the stimulus of intergeneric pollinations and some previous workers[1-2] reported such a type of fruit formation in other cucurbitaceous plants by the application of growth promoting hormones. Since the phenomenon of parthenocarpy in *T. dioica* and *M. dioica* has been overlooked so far, the present investigation has been made.

The floral buds and flowers of both *T. dioica and M. dioica* were treated in four ways as follows: flowers left open for natural pollination, flowers pollinated with pollen grains of *Lagenaria leucantha*, flowers pollinated with pollen grains of *Momordica charantia* and flowers pollinated with a mixture of pollen grains of *L. leucantha* and *M. charantia*.

TABLE I

Parthenocarpic fruit setting (%) *in* T. dioica *and* M. dioica

Pollination conditions	Parthenocarpic fruit setting (%)	
	T. dioica	*M. dioica*
Natural pollination	58	36
Pollination with *L. leucantha*	67	40
Pollination with *M. charantia*	71	45
Pollination with *L. leucantha* and *M. charantia*	85	66

The percentage of parthenocarpic fruit setting is presented in Table I, which indicates that a higher percentage of parthenocarpic fruit setting is achieved as a result of pollinating the flowers with the extraneous pollens as compared with the naturally pollinated flowers in both the species. The percentage of fruit setting in both the species is further stimulated more when a mixture of pollen grains of *L. leucantha* and *M. charantia* is applied as against the pure pollen application. A lower fruit setting in natural pollination may be attributed to non-synchronization of anthesis and duration of corolla opening in these plants.

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INFLUENCE OF *RHODOTORULA* AND *AEROBACTER* ON PROTONEMAL GROWTH AND BUD INITIATION IN TWO MOSSES

SOME aspects of mixed cultures of *Barbula gregaria* (Mitt.) Jaeg. and *Timmiella anomala* Limpr. with a yeast (*Rhodotorula rubra*) and a bacterium (*Aerobacter* sp.) have been studied,

Plants of *Barbula gregaria* and *Timmiella anomala* were collected from Delhi and Manali (H.P.) respectively. Axenic cultures of both these were established on a semi-solid (0·8% agar) nutrient medium comprising half strength Knop's major salts, Nitsch's trace element solution (1 ppm), ferric citrate (10 ppm), and 1% sucrose. The medium was sterilized by autoclaving at 15 lbs sq inch for 15 minutes. The pH of the medium was adjusted to 5·8 before autoclaving. The cultures of *Barbula* were raised from gametophores and those of *Timmiella* from spores and maintained at ordinary cultural conditions (light 3,000–3,500 lux; temperature 25 ± 2° C).

Protonemal development and bud formation in these mosses have been studied in the presence of *Rhodotorula rubra* (Strain No. ITCC 23(2) as well as both *Rhodotorula* and *Aerobacter*. However, the extent of infection in the medium was approximately adjusted. The effect of the infectants was three fold: (*i*) infected cultures showed more luxuriant protonemal growth, (*ii*) there was a preponement in bud initiation, and (iii) the number of buds was increased. The amount of infection in a culture and its effect on bud induction in *Barbula* were linearly correlated, and the effect was localized. Buds appeared after 19 and 26 days of inoculation, on infected and non-infected cultures respectively. In the control cultures of *Timmiella* buds appeared 22 days after inoculation. Presence of infectants decreased the time by 6–8 days (Fig. 1 A, B).

In order to determine whether the exudate obtained from *Rhodotorula rubra* alone can promote bud initiation, *Rhodotorula* cultures were raised for one month in Nitsch's Basal liquid medium. This conditioned medium was filtered, solidified with agar and autoclaved. It was again employed to raise the cultures of *Barbula*. The control medium was prepared by solidifying liquid medium obtained from one-month-old, non-infected cultures. In the conditioned medium buds appeared earlier and their number increased from 56 to 78 after 35 days of inoculation. Growth of *Barbula* on the autoclaved, conditioned medium was also much more luxuriant than on control medium (Fig. 1 C, D), indicating that *Rhodotorula rubra* alone can promote bud initiation, and further that the exudate obtained from this is heat stable.

Sironval[1] demonstrated that fungi substituted the effect of light on shoot development on moss protonema. Maltzahn and MacQuarrie[2] observed that growth of *Splachnum ampullaceum* protonema was strongly promoted by the mycelia of several fungi. Vaarama and Tarén[3] reported that the effect of *Penicillium martensii*, *Aspergillus*, *Mucor* and *Rhodotorula* on bud formation in seven species of mosses (*Dicranum scoparium*, *D. undulatum*, *Dicranoweisia crispula*, *Pogonatum urnigenum*, *Polytrichum strictum*, *Rhacomitrium fasci-*

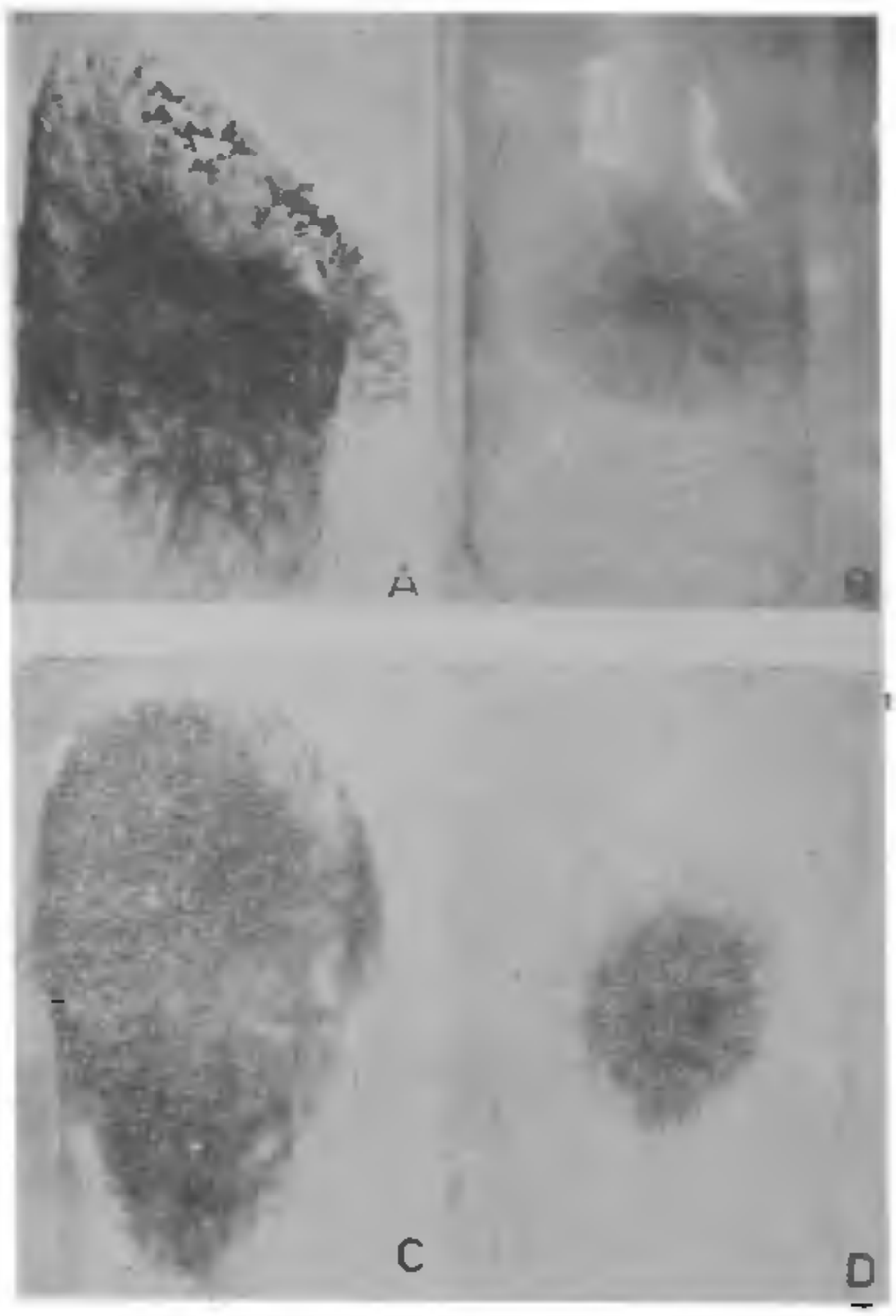

FIG. 1. Effect of fungal and bacterial contamination on the development of buds in *Timmiella anomala* (A, B) and *Barbula gregaria* (C, D), × 2. A—15-day-old culture showing infection (white patches, arrow marked) of *Rhodotorula rubra* and *Aerobacter* sp. B—Control for A. Note lesser protonemal growth and absence of buds. C—20-day-old culture on the conditioned medium of *Rhodotorula rubra*, showing luxuriant protonemal growth and gametophytic buds. D—Control for C.

culare, and *Tetraphis pellucida*) was similar to that of GA_3. Spiess *et al.*[4] showed that a virulent strain of *Agrobacterium tumefaciens* (B6) induces buds on the protonema of *Pylaisiella selwynii*, and prepones their appearance by 5–6 days. These buds developed into normal gametophores. The promotion of gametophore formation was directly related to the number of viable bacteria added. The changes induced by *A tumefaciens* were similar to those elicited by cytokinins. *A. tumefaciens* is also known to produce cytokinins (Mille [5]). Later, Spiess *et al.*[6] reported that *Rhizobium* spp., which are known to produce zeatin or ribosyl-zeatin, also induce normal gametophores in *Pylaisiella*. Spiess *et al.*[7] showed that *P. selwynii* does not respond to *Agrobacterium tumefaciens* or to *Rhizobium leguminosarum* unless the bacteria are in physical contact with the moss.

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EFFECT OF DIFFERENT CHEMICALS ON *IN VITRO* GERMINATION AND TUBE ELONGATION IN *NYCTANTHES ARBOR-TRISTIS* L.

OUR knowledge about the pollen physiology of night-blooming plants is inadequate and hence the present study was underteken on the oleaceous arboreal plant *Nyctanthes arbor-tristis* L. The effect of sucrose, some of the growth promoters and inhibitors on pollen germination and tube elongation has been studied. Several workers[1–4] have reported the effect of a number of growth regulators and of some inhibitors on pollen germination in different taxa. Though gibberellic acid and indole-3-acetic acid are generally regarded to increase the germination percentage of pollen grains[5–7]. their inhibitory effects have also been reported[8].

Pollen grains collected just after anthesis (5·25 P.M.), were sown in 0·02 ml of water containing 10 ppm of boric acid (control medium). They were grown by hanging drop technique at about 23° C for 9 hours and observed periodically.

The effect of sucrose has been studied by varying its concentration in the basal madium from 1% to 40%. The effects of two growth promoters, indoleacetic acid (IAA) and gibberellic acid (GA) have been studied between 1 ppm to 100 ppm in the medium while the effects of the three inhibitors, sodium fluoride (NaF), 2, 4-dinitrophenol (2, 4-DNP) and maleic hydrazide (MH) were investigated from 1 ppm to 20 ppm.

The effect of sucrose concentration has been presented in Fig. 1, which shows that at 5% concentration of sucrose, the per cent germination is maximum (75%).

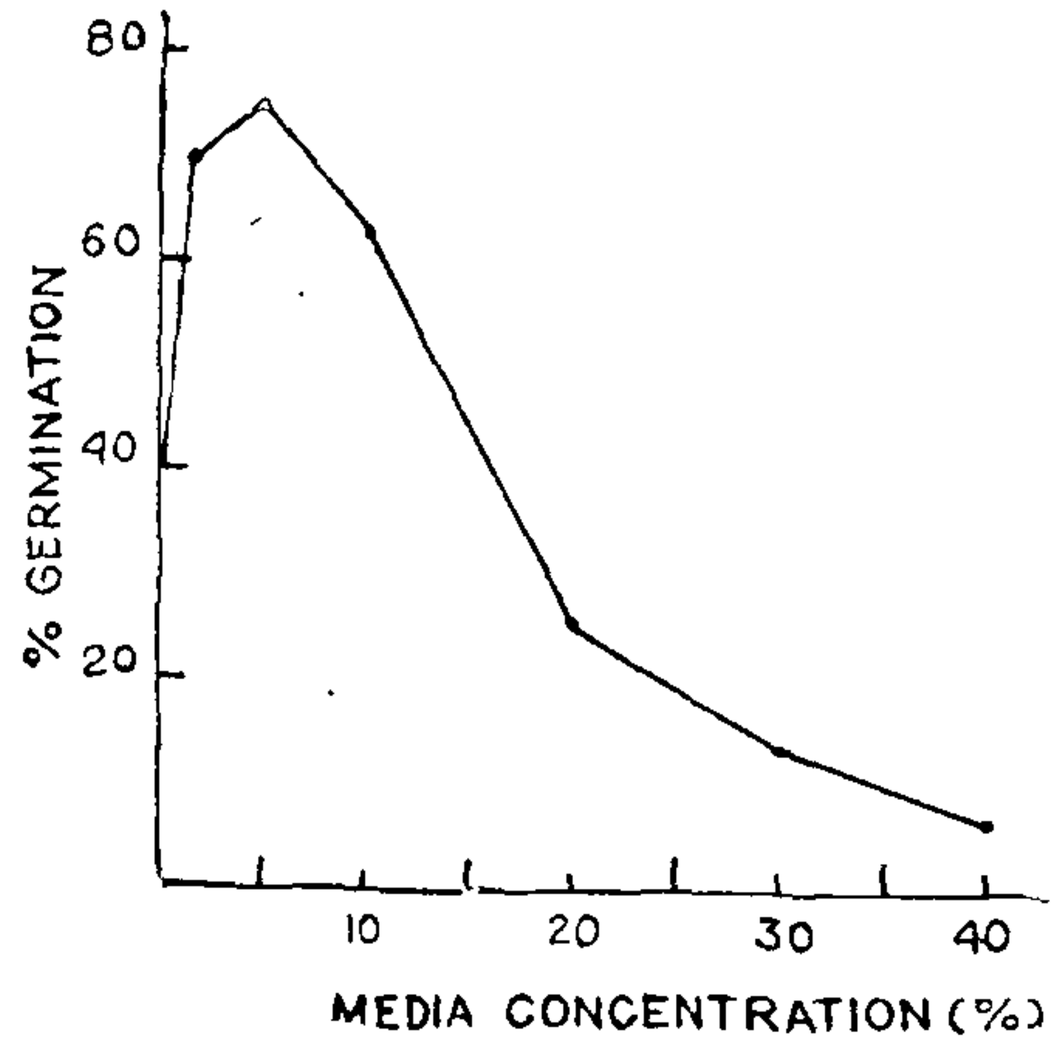

FIG. 1. Effect of sucrose on pollen germination.

Further increase of sucrose concentration did not enhance germination. Between 40–60 ppm concentration of IAA in the medium there was maximal germination of the grains (82-86·5%) associated with the formation of very long tubes (200–240 μ); other concentrations being less favourable. At these concentrations, there was more than two fold increase of pollen germination over the control. GA showed the maximum stimulatory effect at 100 ppm in the incubation mixture, the germination being slightly less than two fold over the control and only in 30–40% cases, the tube elongation was appreciably higher. When a mixture of GA (1–20 ppm) and IAA (1 ppm) was present in the incubation mixture, the germination was very high (87%) though tube elongation was not significant. The results of growth promoters have been presented in Fig. 2.

Among the inhibitors studied (Fig. 3), 2, 4–DNP showed the maximum retarding effect on pollen germination. During the first three hours, there was practically no germination at all concentrations. NaF and MH also exerted distinct inhibitory effect, the latter being more potent, specially during early hours of incubation. It is noteworthy that at all concentrations of these inhibitors, the tube elongation was significantly suppressed and these results are in agreement with previous workers[3].

The endogenous sucrose concentration of the grains may be sufficient for the pollen germination and therefore higher sucrose concentration did not increase germination percentage. Very high sucrose concentrations (30%-40%) prevented pollen germination due perhaps to the high osmotic imbalance. Both the growth promoters had exerted distinct stimulatory effect on