

BOTANY

Chairman: RICHARD STARR, Indiana University

A. L. DELISLE, University of Notre Dame, was elected chairman for 1955

ABSTRACTS

Some Aspects of Sexuality and Genetics of *Cosmarium botrytis* Meneghini. RICHARD C. STARR, Indiana University.—The use of desmids in various lines of experimental research has been limited by their failure to reproduce sexually when grown in culture. Successful cultivation of desmids has been reported by a number of investigators during the past fifty years but it was not until recently that the writer isolated strains of *Cosmarium botrytis* in which sexual reproduction can be effected at will. Genetic studies show that mating type is inherited as a single gene.

A lethal factor has been shown to be present in one of the parental strains. This factor is undetectable in the haploid vegetative cell and in the heterozygous condition in the zygote. It is only when both gametes carry the lethal factor that the resulting zygote lyses shortly after formation. The lethal factor appears to be inherited as a single gene unlinked with that of mating type.

Further studies are in progress involving the inheritance of cell size and shape.

A Preliminary Report on a Study of Variation in *Spirogyra*. M. ANN ALLEN, Indiana University.—Investigations are being made on life histories of certain strains of *Spirogyra* in culture in an effort to better understand variations which have appeared. Studies are being directed to see if the variations might be correlated with nuclear behavior, chromosome number, and environmental conditions.

Filaments of at least three different widths have arisen in an original clonal culture in soil water medium. Three width types: Type 1 (15.3μ), Type 2 (23.3μ), and Type 3 (30.5μ) have been designated. Reisolated single filaments of Type 1 give cultures within which are filaments of different widths, while reisolated filaments of Types 2 and 3 give cultures which maintain their respective original widths.

All types may be induced to undergo lateral and occasional scalariform conjugation by introduction from soil water cultures to agar surfaces in light. The progressive disintegration of the male plastid into an orange carotenoid body in the mature zygospore has been followed. A successful method of germinating mature zygospores has been developed which thus enables study of width variation subsequent to germination. Experimental conditions have greatly reduced the time for one complete life cycle in as far as cells of 4-celled germlings still retained within the old zygospore cases have frequently been observed conjugating and forming new zygotes.

Cytological studies of mitoses and meioses are in progress in an attempt to explain some of the variations observed.

Genetic Control of Anthocyanin Synthesis in *Impatiens balsamina*.

CHARLES W. HAGEN, JR., Indiana University, and RALPH E. ALSTON, College of William and Mary.—Anthocyanin pigmentation in *Impatiens balsamina* is controlled by genes at three independent loci. The aglycones of the anthocyanins and the anthocyanidin derivatives of the leuco-anthocyanins present in stems, colorless buds, and mature flower parts have been identified in plants of various genotypes. From these qualitative determinations, it is possible to draw certain conclusions as to the action of the individual genes.

With recessive alleles at the three loci, plants produce white flowers and green stems, but leuco-anthocyanins are present. The dominant gene, H, leads to more reduced pigments in mature flowers, but seems to act on the leuco-pigments of the colorless buds. L leads to more highly oxidized pigments in the mature flowers and probably acts on leuco-pigments. Genes L and H show no qualitative competition, the products of both genes being found in mature flowers of appropriate genotypes. Pr intensifies all flower colors, causes red pigmentation of the stems, and probably controls the conversion of leuco-pigments to free anthocyanins. It seems to shift the leuco-pigments present in the bud toward more reduced forms, but acts at a later stage of development than H. Methylation is intense in petals, less so in sepals, and absent in stems. Methylation is unaffected by the genes considered here except as they provide or remove pigments susceptible to methylation.

Flavonols and other unidentified yellow to orange pigments vary in different stocks of *Impatiens balsamina*, but are not qualitatively altered by the genes that regulate anthocyanin pigmentation.

Host Reaction to Infection by *Synchytrium australe*. JOHN S. KARLING, Purdue University.—The reaction of malvaceous hosts to infection by *Synchytrium australe* is manifested primarily by cell enlargement and division but not by cell differentiation. Infection by zoospores which develop into prosori results generally in cell division and enlargement of the host cell, but infection by potential or incipient resting spores usually causes only cell enlargement. The composite multicellular sporangial galls are derived from a single infected epidermal cell, and the healthy neighboring epidermal cells are only rarely if at all involved in normal gall development. The enlarged host cell begins to divide a few days after infection, cutting of tangential cells which in turn divide and grow around it to form the enveloping sheath of mature galls. The cells which are cut off first appear to get a head start in growth and division so that the sheath develops more rapidly over one surface of the host cell. As a result the mature galls become assymmetrical in shape with the aperture or pore to the infected cell in a subapical position. The nucleus of the infected cell may enlarge in proportion to the increase in size of the host cell, but it does not become distorted in shape or altered in fundamental structure. It may persist until the prosorus and sorus are mature. No marked increase in cytoplasm or accumulation of residue around the sorus occurs in the sporangial galls.

The resting spore galls are predominantly simple and unicellular. Accordingly, the host reaction consists primarily of enlargement of the

infected epidermal cell, although cell division occasionally occurs to produce multicellular galls. In infected cells of *Modiola caroliniana* a marked increase in cytoplasm and residue occurs so that the host cell usually is filled with a reddish-brown material at maturity. In *Althaea rosea*, on the other hand, very little residue is present around the resting spores. In neither the sporangial nor resting spore galls has any marked thickening, lignification, or dissolution of the cell walls been observed.

A fairly large number of galls abort on various hosts, and this appears to be due to the death of the parasite. The infected cell eventually dies and may become invaginated by the adjacent healthy cells. In relatively resistant hosts like *Gossypium herbaceum* and *Circaea latifolia* infection of epidermal cells and their subsequent death may result in division of the palisade and mesophyll parenchyma whereby cushion- or dome-shaped protuberances are formed.

Host Range of and Reaction to *Synchytrium brownii* Karling. JAMES T. SINSKI, Purdue University.—*Synchytrium brownii* was found as a parasite of *Oenothera biennis* in the Ross Biological Reserve of Purdue University. In studies to determine its host range, it has been found to attack twenty-two races of *O. biennis*. The races in their respective groups include:

Group	Race
"biennis 1"	Belleville (Ill.) Birch Tree I (Missouri) Birch Tree II (Missouri) Birch Tree III (Missouri) Chicagoensis (Ill.) Iowa I Paducah (Ky.)
"biennis 2"	Elma (N. Y.) LaSalle III (N. Y.) Shulliana (N. J.) Waterbury (Vt.)
"biennis 3"	Newfound Gap (Tenn.)
"biennis ?"	Camas (Wash.)
grandiflora (?)	Grandiflora de Vries (Ala.)
"hookeri"	Franciscana de Vries
"Jamesii"	Parras (Mexico)
"parviflora"	Muricata (Europe and Pa.)
strigosa	Clarks (Nebr.) Cockerelli (Colo.) Fruitland (Idaho) Iowa II Spooners (Wis.)

In addition it may attack *O. laciniata* and *O. missouriensis*. No infection has been obtained on *Guara biennis* and *Circaea quadrisulcata*, other species of the Onagraceae.

As the result of leaf infection, the host reacts to form either unicellular or multicellular galls on the majority of plants used. The unicellular galls consist of the enlarged epidermal cell which may project into or from the mesophyll. The multicellular galls consist of the enlarged epidermal cell plus cells surrounding it. The origin of these surrounding cells has not been determined.

Infections the same age as the above in the Paducah (Ky.) race produced notable results. Most galls were unicellular and greatly reduced in size. Around numerous infected cells a cell barrier filled with an unidentified deeply stained substance was found.

Resting Spore Germination in *Synchytrium* in Relation to Classification. B. T. LINGAPPA, Purdue University.—In the most recent key to the subgenera of *Synchytrium* the occurrence of summer and resting spores and their mode of germination are important criteria in the classification. In a study of the life-cycle of several of the long- and short-cycled species of *Synchytrium*, the author has succeeded in germinating the resting spores of 21 terrestrial species and from these results it is now possible to classify them in their proper subgenera. Among the long-cycled species studied, the resting spores of *S. rytzii*, *S. wurthii*, *S. collapsum*, *S. lepidagathidis*, *S. sesomicola*, *S. akshaiberi*, *S. brownii*, *S. nyctanthidis*, *S. zorniae*, *S. cassiae*, *S. oroxyli*, *S. maculans*, *S. launeae*, *S. crustatum*, *S. biophyti*, and *S. cookii* functioned as prosori in germination and because their summer spores also function as prosori in germination they may be assigned to the subgenus *Microsynchytrium*. Among the short-cycled species which produce only the resting spores, germination has been obtained in *S. thirumalachari*, *S. ajarekari*, *S. viticola*, *S. rhinchosiae*, and *S. meliloti*. Here also the resting spores functioned as prosori in germination and may now be placed in the subgenus *Pycnochytrium*.

Aberrations in Fungi of the Genus *Cyathus* and their phylogenetic Significance. HAROLD J. BRODIE, Indiana University.—A highly aberrant type of fruit body has been found to be developed in cultures of two tropical species of Bird's Nest Fungi, *Cyathus poeppigii* Tul. and *C. montagnei* Tul. Normal fruit bodies of these fungi are vase-shaped and contain a dozen lenticular peridioles provided with funiculi. Cultures of the aberrant forms produce small spherical fruit bodies each containing a single large spherical peridiole devoid of funiculus. Had the aberrant fruit bodies been found in nature it would be necessary to erect a new genus or even a new order of Gasteromycetes to accommodate them.

Tendencies to variation which might lead to the production of the aberrancies described have been noted in various species of *Cyathus*. Two of the most important of these are: the tendency for the production of very small fruit bodies accompanied by reduction in the number of peridioles, in the extreme situation to one; and the tendency for loss of the funiculus.

The various aberrancies are of considerable importance in interpreting phylogeny in the Nidulariaceae.

Antibiotics from the Mucorales. I. Preliminary Survey of 150 Species. BRINTON M. MILLER and C. L. PORTER, Purdue University.—A survey of the literature on antibiotic studies of the order Mucorales indicates only a few such studies with generally negative results. This paper deals with the preliminary work in a detailed investigation of the entire order for antibiotic producing properties. Results indicate that continued research with this group of microorganisms is warranted.

Preliminary Vitamin and Mineral Requirements of a Keratin Decomposing Fungus. FREDERICK M. ROTHWELL, Purdue University.—*Phlycto-*

rhiza variabilis, isolated from soil, is a rapid decomposer of keratinized tissue such as skin, hair, hoof and horn. Mineral requirements to date have been established for zinc, copper and iron. Zinc and copper in combination favor sporulation at a concentration of 0.05 ppm; at a concentration of 0.1 ppm vegetative growth is maximum and sporulation is minimum. Vitamin studies, while yet incomplete, indicate a requirement for biotin (0.3 $\mu\text{gm}/50\text{ml}$) and folic acid (3.0 $\mu\text{gm}/50\text{ml}$). To the knowledge of the author this is the first case of a fungus requiring folic acid. Further study is in progress to confirm this apparent requirement.

The Relationships of *Helianthus laetiflorus*, *H. rigidus*, and *H. subrhomboides*. SARAH B. CLEVENGER, Indiana University.—The hexaploid species, *Helianthus laetiflorus*, *H. rigidus*, and *H. subrhomboides*, on the basis of morphological characteristics were found to comprise an intergrading series with *H. subrhomboides* as a relatively stable taxon at one extreme and with *H. rigidus* and *H. laetiflorus*, the other extreme, much more variable. It is suggested that the latter two species are the result of introgressive hybridization of *H. subrhomboides* with another hexaploid species, probably *H. tuberosus*.

Testing the Line-Strip Sampling Method Against Full Tallies in Four Forest Types. ALTON A. LINDSEY, Purdue University.—The line-strip sampling unit is a combination of line interception and quadrat methods in which only the line is surveyed. The line-strip method is shown statistically to be suitable for detailed studies in three diverse types of eastern coniferous forests (spruce-fir, red pine-white pine, and jack pine) and in a maple-beech stand. This unit has several important advantages, in both field and office work, over the quadrat as usually applied. It is ideal for permanent marking of sampling units. Strip-quadrats (fractions of the strip) can be varied in length *a posteriori* to make frequency comparisons with publications based on quadrat sampling. Although the line-strip is no better for finding the nature of dispersal, the need for this is much reduced because of a statistical property of very long sample units. Usually about eight line-strips, each 600 ft. long, and covering at least 15 per cent of the station area, should be used to obtain an acceptable per cent standard error of 20 or less for each significant species. To obtain per cent sampling errors of similar amount for density, basal area, and cover, the strip width need not exceed 20 ft. for eastern coniferous stands, but should be 24 ft. wide for maple-beech. Basal area is much more accurately sampled in coniferous stands than in maple-beech. Although introduced for coniferous stands and easier to use there, the line-strip method appears to be well adapted to hardwood stands also, since only in the maple-beech stand were cover errors the lowest ones. The method is rapid considering the area sampled and the scope of data obtained, and is well suited for judging sampling adequacy by statistical procedures.

The Relationship Between the Age of the Tree and the Rooting of Cuttings in White Pine. ALBERT L. DELISLE, University of Notre Dame.—Further experiments have confirmed the observation that one of the most important factors in the vegetative propagation of white pine cuttings is the age of the tree from which the cuttings were taken. On one-year-old

cuttings, rooting ability falls off in inverse proportion with increasing age of the tree. Although auxin treatment definitely increases the percentage and quality of rooting, it does not eliminate the effect of the age of the tree on the rooting of cuttings taken from it.

Experiments were undertaken to test the percentage of rooting of one-year-old cuttings taken from trees previously rooted by cuttings. The original cuttings, planted in 1938, were allowed to grow into 4-year-old saplings from which cuttings were taken in 1942. These rooted cuttings were allowed to grow into young trees until 1946 from which cuttings were again taken to test their rooting ability. This process was repeated in 1950 and 1954.

Results from these experiments indicated a marked decrease in rooting ability with each subsequent replication. Some saplings produced cones in 1953-54, indicating a transition to the reproductive stage.

It is postulated that a physiological age-factor affects the vegetative propagation of white pine.

An Interference Effect on Apparent Rates of Recombination in Regions Adjacent to Heterozygous Inversions. J. R. SINGLETON, Purdue University.—A simple mechanism is proposed to account for at least part of the increase in recombination frequency in regions adjacent to an inverted segment in inversion heterozygotes, such as have recently been observed in maize. This mechanism may be outlined as follows:

(a) Depending upon the intensity of interference between the inverted segment and a segment adjacent to it, chromatids which are crossovers in the adjacent segment will tend not to be crossovers in the inverted segment, and vice-versa.

(b) Chromatids which are single crossovers in the inverted segment will be eliminated, and will not be represented in the population of recovered meiotic products in which recombination is measured.

(c) Since the eliminated chromatids will tend to be non-crossovers in the adjacent segment, the proportion of chromatids which are crossovers for this region will be higher in the population of recovered meiotic products than in the initial population. The net effect will be an increase in the rate of recombination observed for the adjacent segment over the actual rate of crossing-over at meiosis.

Since several factors will affect the meiotic rate of crossing-over, one can, at best, estimate only the maximum observable increase which such a mechanism might cause. Simple algebraic formulations have been developed to give this estimate for varying levels of interference and crossing-over in various types of inversions. These indicate that an increase may be expected with pericentric inversions, and with paracentric inversions in the male. In females of the *Drosophila* ordered-tetrad type, paracentric inversions may result in an apparent decrease through this mechanism.

The Lyophilization of Some Algae. W. A. DAILY and J. M. MCGUIRE, The Lilly Research Laboratories.—The lyophile process was investigated as a means of preserving in a desiccated state 32 cultures of algae. Seventy-five per cent survived lyophilization. These remain on periodic viability tests, and when cultured recently at from four to ten months after lyophilization they were still viable.

Response of Spring Wheats to Photoperiod and Temperature. GEORGE A. GRIES and FOREST STEARNS, Purdue University.—Spring wheats were grown at all combinations of day and night temperatures of 60° F., 70° F. and 80° F. under both 12- and 16-hour photoperiods. In the 12-hour series earliness was associated with cool temperatures while in the 16-hour series it was associated with warm temperatures. The experimental data indicate that although both day and night temperatures are important in eliciting these responses, night temperature is the more critical. Some evidence is available to indicate that cool temperatures and long days are conducive to induction of flower primordia and that warm temperatures and long days are most favorable for maturation. On this evidence it may be assumed that plants grown at 16 hours are induced early regardless of temperature so that the influence of temperature on maturation becomes critical in determining date of maturity. In the case of the 12-hour photoperiod series it is assumed that those plants at the cool temperatures are induced so much earlier that they mature at an earlier date in spite of the relatively unfavorable temperature for maturation.