BOTANY

Chairman: FAY DAILY, Butler University

CHARLES HEISER, Indiana University, was elected chairman for 1959

ABSTRACTS

Missing Petals in Oenothera. RALPH E. CLELAND, Indiana University.—An interesting genetic trait has appeared in several unrelated races and hybrids of Euoenothera. One, two, three or all four petals in a flower may be completely missing. When present, petals are usually perfect in structure, and they retain their proper position in the flower. When two petals are missing from a flower, the gaps may be side by side (90° apart), or they may occupy opposite positions in the flower (180° apart). An individual plant will usually have flowers ranging from 0 to 4 petals all at the same time, and even on the same shoot. Ordinarily, sepals, stamens and carpels are unaffected, but in a few crosses there has been a tendency toward the production of trimerous flowers, with 3 sepals, 3 petals, 6 stamens and 3 carpels. In such flowers, the petals are 120° apart. The missing petal character appeared originally in 1939 in the cross *muricata* x *Magnolia*. This hybrid has bred true to this character for 9 generations. It was also found in 1951 in *muricata* x *Petersburg*. More recently it has been found in the cross *Elma V* x *Iowa II*, in a race from Galeton, Illinois, and in a race of *cruciata*, probably from New Hampshire. In the last mentioned race, the petals are "cruciate," i.e., strap-shaped and sepaloid. When crossed to forms with normal petals, the progeny in some cases show the characteristic of missing petals, in other cases they do not. In some cases, only a few petals are missing, in others almost 100% of the flowers are completely lacking in petals. The cytological basis for this phenomenon is still a matter of speculation.

A Possible New Species of Callixylon From Indiana Devonian Shales. H. O. BEALS, A. T. GUARD and J. W. STIPP, Purdue University and North Vernon High School.—A specimen of petrified wood belonging to the genus Callixylon was collected from the Devonian shales near North Vernon, Indiana in the summer of 1958. This specimen measured approximately 6 x 3 x 1½ inches. Examination of thin sections of this wood revealed a possible new species of Callixylon. This species differs from other known species in the height and width of ray cells and in the grouping of the bordered pits on the radial walls.

Transmission and Development of Tobacco Ringspot Virus in Soybean. KIRK ATHOW, J. B. BANCROFT and JOHN TUITE, Purdue University.—Tobacco ringspot virus (TRSV) which causes the bud blight disease of soybean (*Glycine max* (L) Merrill) was shown to be transmitted through the seed from naturally infected field grown plants.

Seeds from plants infected early showed the highest percentage of transmission. Plants which developed from infected seeds transmitted the virus to an average of 93 percent of their progenies. Seed transmission probably is not important in the development of the disease because plants which develop from infected seeds or plants which are infected early produce little or no seed. However, seed transmission may perpetuate and disseminate the disease. The disease is most prevalent and develops very rapidly adjacent to pastures and grassy areas. A collection of 454 plants comprising 37 species from a pasture adjacent to a soybean field where bud blight had been epidemic for 2 years were indexed for TRSV. Six species; *Ambrosia artemesiifoli*, *Daucus carota*, *Erigeron strigosus*, *Taraxacum officinale*, *Trifolium repens*, and *Trifolium pratense* were found to be infected. None of the infected plants showed symptoms. Insect and soil transmission attempts have been unsuccessful.

The Production of Pectolytic Enzymes by Botryosphaeria ribis and Glomerella cingulata. J. E. WALLACE, J. KUC and E. B. WILLIAMS, Purdue University.—Two apple-rotting fungi, *Botryosphaeria ribis* (G. & D.) and *Glomerella cingulata* (Stone) produce extracellular pectin methylesterase (PME) and polygalacturonase (PG) when grown in Czapek's medium containing citrus pectin as all or part of the carbohydrate source. Neither of these fungi produce appreciable amounts of PME or PG when grown in Czapek's medium alone. *G. cingulata*, however, produces PME and PG when grown in Czapek's medium containing 0.2% L-Alanine, whereas L-alanine appears to have no effect on the production of these extracellular pectolytic enzymes by *B. ribis*. *B. ribis* and *G. cingulata* appear to produce little or no extracellular pectin depolymerase (DP) when grown in Czapek's medium alone, Czapek's medium containing pectin, or Czapek's medium containing L-alanine. When Golden Delicious apples were inoculated with *B. ribis*, the diseased tissue contained appreciable amounts of PME and PG, and healthy tissue on the same apple contained little PME or PG activity. Diseased and healthy tissue contained little or no DP. These results suggest the importance of pectolytic enzymes in the rotting mechanisms of *B. ribis* and *G. cingulata*.

Sources of Resistance to *Venturia inaequalis* and the Current Status of Apple Variety Improvement. J. R. SHAY, E. B. WILLIAMS and J. JANICK, Purdue University.—The species and varieties of Malus contain a number of gene pools for resistance to *Venturia inaequalis* (Cke.) Wint., the causal fungus of the apple scab disease. A number of single dominant genes that condition field immunity have been isolated from species native to regions of China and Russia. Very little is yet known of the interrelationship of these genes, but it appears likely that there are a number of distinctly different gene pairs. In addition, there are a number of polygenic combinations in *Malus* species and varieties of the common apple, *M. pumila*, that confer resistance ranging from partial field resistance to field immunity. Extensive use of these resistances have been made during the past decade in apple improvement programs in North America and Europe. Field-immune selections with horticultural characters more nearly like those of leading apple varieties are being made

each year. It appears that immune varieties suitable for commercial production can be obtained with continued effort. Although *V. inaequalis* is known to be variable in its pathogenic behavior on certain apple varieties, no pathogenic races have yet been observed on the Asiatic sources of resistance.

Preliminary Investigations on Apple Virus Diseases. GAYLORD I. MINK and J. R. SHAY, Purdue University.—A survey was made of commercial Indiana apple orchards for virus symptoms. No evidence of apple mosaic, rubbery wood, scar skin or dapple apple viruses was found. Stem pitting was observed on trees in all orchards visited. Scion varieties, understocks and non-topworked seedlings showed pitting symptoms. The stem-pitting virus was transmitted by budding and grafting from infected to healthy apple tissue. The anatomical abnormalities associated with stem pitting were described as hyperplasia and hypertrophy of parenchyma cells and a reduction in the functional conductive cells. A variety of *M. pumila*, R12740-7A, and certain of its progeny were shown to be sensitive indicator plants for apple mosaic, stem-pitting and a possibly new virus disease termed chlorotic leaf spot. A preliminary survey of apple varieties for latent viruses showed most of the varieties examined to be carrying both stem-pitting and chlorotic leaf spot viruses.

Observations of the Life Cycles of Some West American Rust Fungi. GEORGE B. CUMMINS, Purdue University.—Observations, substantiated in some cases by inoculations, were made in Arizona, Colorado and Montana of the life cycles of 23 species of the rust fungi. Species whose life cycles were previously unknown are *Puccinia biporula* J. W. Baxter whose aecial stage is *Aecidium subsimulans* Arth. et Mains, *P. redfieldiae* Tracy whose aecial stage is *A. anograe* Arth., and *P. vexans* Farl. whose aecial stage is *A. cannonii* Griff. Additional information about life cycles included *P. canaliculata* (Schw.) Lagh. developing aecia on *Heliopsis parvifolia* Gray, *P. conspicua* Mains developing telia on *Agrostis scabra* Willd., and *P. liatridis* (Arth. et Fromme) Bethel developing aecia (*A. arcularium* Arth.) on *Brickelia grandiflora* (Hook.) Nutt. P. *recondita* Rob. was observed to complete its life cycle on 30 different combinations of host plants. The aecial stage of *Cumminsiella mirabilissima* (Pk.) Nannf. was demonstrated to occur in North America.

Genetics of Pathogenecity in Race 104 Ind. B of Wheat Leaf Rust. NADER G. VAKILI and RALPH M. CALDWELL, Purdue University.—Race 104 Ind.B was propagated from a single spore isolation and allowed to form telia. After overwintering, telia were suspended above *Thalictrum glaucum* Desf. for germination and sporidial infection. Progenies were obtained by either fertilizaton of single monosporidial infections or mass fertilization followed by random selection of a single aeciospore infection from each aecial cluster. Reactions of the progenies were determined on 8 standard differential varieties and 6 supplemental varieties. The progenies segregated for virulence to all varieties tested except Mediteranean and Democrat. This indicated heterozygocity in the parental race 104 Ind.B. Therefore, its genotype could be considered

similar to that of an F_1 wherein the S_1 progenies would yield results similar to those of F_2 progenies. Eighty-six S_1 progenies were secured by sibbing sporidial infections of race 104 Ind.B. Segregation of these progenies showed that virulences to varieties Brevit, Loros and Kenya Farmer were conditioned by single dominant factors, V_B, V_L, V_K respectively; and that avirulences to varieties Newsar (C. I. 12530), Waban (C. I. 12992), and Wardal 2 (Purdue 4665A2-14-4) were governed by dominant factors, A_H1, A_{Wa}, and A_M2 respectively. Virulence to both Malakof and C. I. 12660 was conditioned by 2 factors, V_M1 dominant for virulence, and A_M2 dominant for avirulence and hypostatic to and independent of V_M1. Avirulences to Carina, Webster and Hussar were conditioned by complementary pairs of factors, A_C and A_M2, $A_{We}1$ and $A_{We}2$, and A_H1 and A_H2 respectively. Urediospore color was monogenically inherited. A dominant factor, C, conditioned normal (red) color while the recessive allele, c, conditioned yellow color. Nine of the 12 loci conditioning virulence and spore color were involved in 3 linkage groups. One group included loci V_M1-$c1A_H1/v_M1$-C-a_H2; the second group contained loci V_B-V_L/v_B-v_L and the third group consisted of loci a_C-A_M2-A_W1-A_{Wa}/A_C-a_M2-a_W1-a_{Wa}. Sixty-nine of the 86 S_1 progenies comprised 22 previously described races (phenotypes) and the remaining 17 progenies comprised 15 new phenotypes on the basis of the 8 standard differential varieties. The 6 supplemental differential varieties disclosed a larger number of subraces. The range of virulence varied from widely virulent uredial progenies, such as race 77, to progenies of narrowly limited virulence such as race 1. Also some of the progenies were capable of attacking Wardal 2 which had been highly resistant to all cultures of leaf rust obtained from nature.

Combinations of Resistance to Wheat Leaf Rust. JOHN F. SCHAFER, RALPH M. CALDWELL, FRED L. PATTERSON and LEROY E. COMPTON, Purdue University.—The short duration of the functional life of many rust resistant grain varieties has been a major problem in control of cereal rusts by disease resistance. One proposal to increase this functional life is to incorporate into one genetic stock several resistance genes each having a comprehensive race coverage. A pathologic technique to determine readily such gene combinations is proposed. The wheat varieties, Aniversario, Exchange, Frontana, and La Prevision 25, each possessing a broad coverage of resistance against races of leaf rust, *Puccinia recondita*, were crossed in 5 of the 6 paired combinations. Although these varieties were resistant to all *P. recondita* cultures tested, limited sporulation occurred in some instances. Uniformly resistant selections permitting distinctly less sporulation, that is, a higher resistant reaction, than either parent were obtained from all 5 crosses tested. Such a selection from each hybrid was backcrossed to both original parents. In no case did susceptible progeny occur in the subsequent F_2 generations, showing the parent and selection to have resistance genes in common in each instance. The combination of resistance genes from both parents is thus indicated by the higher type resistant reaction (a pathologic technique), and proven by a genetic test, backcrossing to both parent varieties.

Factors Affecting the Germination of Milkweed Seed. B. J. ROGERS, I. SMITH and A. JACOBSON, Purdue University.—Seeds of various species of milkweed (*Asclepias*) were subjected to a variety of treatments: alternating temperatures, photoperiod variations, germination on adsorbent charcoal, and storage under various conditions. Length of storage was found to be an important factor. Germination of fresh seed varied from 10 percent for *Asclepias* species to over 75 percent for *Ampelamus albidus*. Partial seedcoat removal caused rapid and complete germination of all species.

Sprouting of Rhizomes of Johnson Grass in Vitro. M. INGLE and B. J. ROGERS, Purdue University.—Studies on the effects of environmental factors and chemicals on rhizome bud sprouting *in vitro* are being made. Isolated segments bearing buds are cultured on sterile, moistened vermiculite. Photoperiod and temperature variations affect the sprouting. Neither red nor far red light alters the growth pattern. The chemical sodium 2,2-dichloropropionate at 35 g/1 almost completely inhibits sprouting when rhizomes are soaked for ten minutes. Maleic hydrazide at 3.2 g/1 inhibits sprouting completely.

The Influence of Temperature on the Survival of the Root-Knot Nematode, *Meloidogyne incognita acrita* Chitwood 1949, in the Absence of a Host. GLENN B. BERGESON, Purdue University.—The influence of temperatures in the range of 32 to 100 degrees F. on the survival of eggs and larvae of *M. incognita acrita* was determined. Of the temperatures tested, 50 degrees F. most closely approached the optimum for survival of both larvae and eggs. At this temperature both stages survived for more than one year. Larval survival at temperatures of 32, 40, 50, 60, 70, 80, 90, and 100 degrees F. was 8, 7-14, 365, 120-150, 120-150, 90-120, 45-60, and 21 days respectively. Egg survival for these same temperatures was 90, 90-180, 365, 120-150, 120-150, 120-150, 90, and 30 days respectively. *M. hapla* was much more resistant to a temperature of 32 degrees F. in the egg stage and to 40 degrees F. in the larval stage than were eggs and larvae of *M. incognita acrita* and *M. javanica*. A comparison of resistance to 32 degrees F. between populations of *M. incognita acrita* from Indiana and California revealed no distinct differences by the end of the test period, but at subterminal periods the percentage of survival of the Indiana population appeared to be greater. Attempts to precondition larvae to lethal temperatures with a series of sublethal temperatures were unsuccessful. The hatching rate of root-knot nematode eggs proved to be very responsive to changes in temperature. At 40 and 50 degrees F. hatching was meager and dropped off rapidly within several days. At 60 degrees F. hatching continued at nearly a constant rate for at least twenty-two days. The hatching rate reached its peak between the fourth and seventh day at temperatures of 70, 80, and 90 degrees F. and then dropped off very abruptly. There was some indication that at 90 degrees F. hatching was partially inhibited, but continued when temperatures were lowered.

A Recent Study of the Dicotyledonae of the Angiospermae Flora of Gibson County, Indiana. AL J. TIEKEN, Oakland City College.—A

study of the dicotyledonae flora of angiospermae plants of Gibson County, Indiana was made during the summer of 1958. This study resulted in a list of 66 specimens in 32 genera and 21 families. The sequence of genera and the nomenclature of the specimens are in accord with that in Deam's "Flora of Indiana."

The Trisomics of Spinach. JULES JANICK and D. L. MAHONEY, Purdue University.—Trisomics in spinach, *Spinacia oleracea* L. (n = 6), were observed from cytological analyses of diploid-triploid crosses. Transmission of the seven to twelve chromosome gametes was higher through the pistillate than through the staminate triploid. Eighteen percent of the progeny were trisomic when the staminate parent was triploid as compared to thirty-two percent in the reciprocal cross. The 13 chromosome plants could be divided into six groups on the basis of their morphological appearance. These six groups were considered to represent the six primary trisomics and were named *savoy, oxtongue, star, reflex, curled* and *wild.* The morphological effects varied from no perceptible phenotypic change as compared with the diploid in *wild,* to extreme modification of leaf and plant type in *curled* and *reflex.* The frequency of the six trisomic types was approximately equal from the triploid pistillate x diploid staminate cross. However, out of 42 trisomics clasified from the diploid pistillate x triploid staminate cross, *reflex* was not observed and only one plant of *curled* was found. The extra chromosome was not transmitted through staminate trisomics, but was found to be transmitted in the two pistillate trisomics investigated (*savoy* and *curled*) varying from 7 to 34 percent. The factor for sex determination was shown genetically to be associated with the reflex trisomic.

Fragaria-Potentilla **Intergeneric Hybridization.** J. R. ELLIS, Purdue University.[1]—As *Potentilla* is a larger and more diverse genus than *Fragaria,* a series of intergeneric crosses were attempted to investigate the possibilities of gene transfer from *Potentilla* to *Fragaria.* In this survey *Fragaria* (n = 7) was represented at four levels of ploidy, diploid (*F. vesca*), tetraploid (*F. vesca*), octoploid (*F. grandiflora*) and decaploid (*F. vesca-F. grandiflora* amphiploid hybrid). Four ploidy levels of *Potentilla* (n = 7) were also used, diploid (*P. fruticosa*), tetraploid (*P. erecta, P. reptans, P. sterilis*), hexaploid (*P. palustris*) and octoploid (*P. anglica*). For all pollinations the *Fragaria* species were used as the maternal parent and no attempts were made of the reciprocal crosses. Mature fruits resulted from many of the pollinations and germinable seed was obtained, though most of the hybrid seedlings died shortly after germination. Mature hybrid plants were however obtained from the crosses *F. vesca* (4x) X *P. fruticosa, F. grandiflora* X *P. fruticosa, F. grandiflora* X *P. palustris* and *F. vesca -F. grandiflora* amphiploid hybrid X *P. fruticosa,* the hybrids having the expected chromosome numbers of 21, 35, 49 and 42 respectively. All the hybrids with *P. fruticosa* were completely sterile, a feature which persisted in the colchicine-produced amphiploid hybrid with *F. grandiflora.* The

[1] These crosses were carried out in the Department of Botany, University of Manchester, England.

F. grandiflora—P. palustris heptaploid hybrids although completely male sterile were slightly female fertile, while the corresponding colchicine-produced amphiploid hybrid (14x) was highly fertile. Since fertile hybrids were obtained with *P. palustris* new desirable characters may be introduced into the cultivated strawberry.

The Effect of Isolating I_1 P_3 and I_1 P_5 on *Dryopteris* Apices. S. N. POSTLETHWAITE[1] and BRUCE VOLLERS, Purdue University and Rockefeller Institute.—I_1 P_3 and I_1 P_5 sites were isolated from the surrounding apical tissue in *Dryopters aristata* apices. Subsequent growth of these areas was studied both macroscopically and microscopically in an attempt to elucidate further the mutual influence of incipient primordia, adjacent primordia, and the apical meristem. The I_1 site thus isolated develops into a bud and the associated P_3 or P_5 continues its development into a leaf. Some vascular continuity is formed between the induced bud and the associated P_3 or P_5.

The Use of Chlorazol Black E in Staining Angiosperm Embryos. D. A. HASKELL, Purdue University.—Chlorazol black E, when used in conjunction with fast green FCF, has been found to give excellent preparations in studies of late embryogenesis in angiosperms. In paraffin sections, cellulose walls are sharply defined as hard black lines while cytoplasm is stained light green and nuclei dark gray-green. Best results have been obtained by staining lightly in alcoholic fast green FCF, then transferring the slides to a .5% solution of chlorazol black E in absolute ethyl alcohol. Staining time in the latter solution is 2 to 6 minutes. Slides should be removed when slightly overstained, washed in alcohol to remove excess stain, then differentiated by repeated dipping in 80% ethyl alcohol. This stain combination provides a high visual and photographic contrast between cell walls and protoplasm in meristematic and differentiating tissues. The technique is rapid and simple and has given results superior to the various hematoxylin schedules including the more recently contrived schedules for the angiosperm apex.

[1] This study was aided by a grant from the National Science Foundation and the Rockefeller Institute.