PLANT PATHOLOGY

R. L. Kiesling, Chairman

From 1956 to 1960 three plant pathologists, supported by funds from the Agricultural Research Service, United States Department of Agriculture, were located in the North Dakota Agricultural Experiment Station. H. Flor researched on flax diseases but worked primarily on flax rust; R. Timian worked initially on all barley diseases but turned to full-time research on barley virus diseases in 1960; and F. Gough researched on stem rust of cereals. W. Hoyman worked on potato diseases and was supported by funds from the North Dakota Agricultural Experiment Station, the North Dakota State Seed Department and the Agricultural Research Service, USDA. When Hoyman left Fargo in 1958, he was replaced by A. Benson and the support of the potato plant pathologist's position was taken over by the North Dakota Agricultural Experiment Station.

W. Brentzel was chairman of the Plant Pathology Department, North Dakota Agricultural Experiment Station, until he retired in 1959. Professor Brentzel conducted research on cereal seed treatments and fungicide control of wheat stem rusts during this period.

In 1959 a grant was received from the Malting Barley Improvement Association of Milwaukee, Wisconsin, to support a plant pathologist to investigate the causes and controls of foliar diseases of barley. Donald Morton was hired and Timian shifted the emphasis of his program to barley virus diseases. Brentzel retired as chairman in 1959.

Dean Arlon Hazen reorganized the department in 1959-60 to include all teaching and research activities in a single Plant Pathology Department. Prior to this reorganization, the teaching of plant pathology had been carried out in the Botany Department, College of Arts and Sciences, and research in plant diseases was conducted by plant pathologists associated with the Agricultural Experiment Station. R. L. Kiesling was hired as the department chairman in 1960. Additional greenhouse space was completed in the summer of 1960 and some of this new greenhouse space was assigned to the Plant Pathology Department.

Walster Hall was completed in 1962, and the Plant Pathology Department was assigned laboratory and office space on the third floor. All the staff of the department except H. Flor, USDA, moved into Walster Hall in 1962. Flor asked to remain in the office, laboratory and greenhouse space which he had occupied since 1931.

A position for the first extension plant pathologist in North Dakota was obtained in 1961 through the support of several agricultural groups. H. Bissonnette joined the Cooperative Extension Service in 1961. The addition of this extension position was one of the most important accomplishments in plant pathology in North Dakota in the early 1960's.

There were many research accomplishments in plant pathology in North Dakota during the early and mid-1960's. A program to produce virus free potato seed was initiated by W. Hoyman in the 1950's and was developed in the 1960's by A. Benson in cooperation with the North Dakota State Seed Department. R. Timian, USDA, recognized the economic importance of barley stripe mosaic and in cooperation with Agronomy Seed Stocks and the State Seed Department developed a 'flush' system of certification for barley seed production which would prevent the occurrence and increase of barley stripe mosaic in barley seed lots. The embryo test for barley loose smut was modified for adoption in North Dakota by D. Morton in cooperation with the North Dakota State Seed Department. The state seed laws were changed to control the amount of loose smut allowed in certified barley seed. A statewide fungicide spray program to control foliar diseases of wheat and barley was developed by H. Bissonnette. True seed transmission of potato spindle virus was proven for the first time by R. Singh, a graduate research assistant. A shift in flax races was immediately countered by shifting to resistant varieties already released. New genes for resistance to flax rust were identified.

Two faculty positions were approved for the 1965-67 biennium, one to conduct research on black point of durum and the other to research on flax rust resistance. The durum black point research resulted in determining that the reaction of durum cultivars to two fungi which cause black point was heritable; therefore, selection against susceptible types would improve resistance of durum cultivars to these two fungi.

The flax rust ultrastructure and resistance studies are under the direction of L. Littlefield who joined the faculty in 1965. All resistance reactions between the flax plant and the flax rust races were expressed within 36 to 48 hours after inoculation.

In 1967 the work that had been done over the previous five years on controlling foliar diseases of wheat and barley with fungicides culminated in the appointment of a full-time plant pathologist to study the foliar disease complex on spring wheat and durum. R. Hosford, Jr., was appointed to this position. This research program has gained national recognition. Sources of resistance to tan spot and Septoria have been identified, and studies

on the inheritance of resistance in wheat to the tan spot organism are now under way. Reaction of wheat and durum cultivars to several foliar pathogens has been shown to be affected by the duration of the foliar wetting period. Investigation now being conducted has shown that at least three bacterial species are involved in causing foliar lesions on wheat and durum in North Dakota.

Research on the control of barley foliar diseases is supported largely through a continuing grant from the Malting Barley Improvement Association. V. Pederson assumed the leadership of this project in 1967. Prior to 1967, E. Pepper proved that foliar disease infections of spring barley caused an increase in the protein content of barley kernels. Barley with high protein is undesirable for malting. Breeders' lines are tested annually for resistance to the three common barley foliar diseases, spot blotch, net blotch and Septoria leaf blight. This testing has resulted in the release of barley varieties with high levels of resistance to these three organisms. Resistance to loose and covered smut has also been incorporated into the barley breeding program. Breeders' lines are tested for their reaction to these two smut organisms.

In 1968 J. Miller was assigned to the stem rust project at Fargo by the Agricultural Research Service, USDA to replace F. Gough. This stem rust project has been responsible for maintaining the high level of resistance to stem rust found in all wheat and durum cultivars released by the North Dakota Agricultural Experiment Station. More recently the research efforts have been concentrated on studies of slow rusting phenomena. Studies of the inheritance of slow rusting in the host and virulence in the fungus are also being carried out.

In 1969 the durum black point research program was concluded and research investigations into the genetics of wheat and wheat leaf rust interactions were commenced. G. Statler completed the black point research and assumed the leadership of this project. Wheat leaf rust has continued to be a serious potential threat to sustained high wheat yield in North Dakota. Host resistance has been repeatedly overcome by the fungus. The present leaf rust research program has identified host genes for resistance as well as genes in the rust for pathogenicity. Races are being developed to identify host resistance genes.

In 1969 a plant pathologist, W. Bugbee, was transferred to Fargo by the Agricultural Research Service, USDA, to work on the diseases of sugarbeet roots. Root rotting organisms had caused losses of sugar in sugarbeet piles. This research program has identified several of the organisms associated with sugarbeet decay. *Phoma betae* has been identified as the most important decay organism and sources of resistance to this fungus have been found. Germ plasm of the resistant lines was released so that sugarbeet breeders might make use of it.

North Dakota farmers were looking for crop alternatives to small grain in the late 1960's because of the low prices received for these cereal grains. Dry edible beans and sunflowers were grown as replacement crops. Both of these crops developed serious disease problems. The Agricultural Research Service, USDA transferred a plant pathologist to Fargo to work on flax and sunflowers. D. Zimmer replaced H. Flor who retired October 31, 1969, after 38 years of service at Fargo. Initially D. Zimmer's time was spent equally on flax and sunflowers, but after the first year, the research effort was largely spent on sunflowers. The three major diseases of sunflowers were downy mildew, rust and Verticillium wilt. Through the research efforts of D. Zimmer, these three diseases were controlled by resistant varieties. In eight years the sunflower industry in North Dakota increased from several hundred thousand to 1.8 million acres, and growers went from open pollinated, disease susceptible cultivars to hybrids with resistance to these three diseases.

A study of the genetics of flax rust was initiated in 1974 under the leadership of G. Statler. A new race of flax rust developed in the early 1970's which attacked some of the more widely grown flax cultivars. The immune flax cultivars were agronomically undersirable. This project has used selfing and crossing of flax rust races to identify genes for pathogenicity on flax.

Dry edible beans are affected by several bacterial diseases. The old standard control for these bacterial problems on dry edible beans was the use of bacterial free seed and three to four-year crop rotation. J. Venette was hired in 1976 to work on bean diseases. To date he has shown that bacterial free bean seed is not bacterial free, that the bacteria which cause these bean diseases are moved by wind as aerosols much further than was ever supposed previously, and that at least one of the bacterial species causing these diseases was associated with wild plants in the borders of bean fields.

White mold, caused by the fungus *Sclerotinia sclerotiorum*, attacks both dry edible beans and sunflowers. Current research is now being directed at developing a control system which will make use of less susceptible host material, cultural practices, chemicals, and plant type. No truly satisfactory control is currently available for this fungus. Several soil organisms which are able to attack the sclerotia of the white mold fungus have also been isolated.

Spray schedules for the control of bean rust were worked out earlier by H. Bissonnette and E. Lloyd.

In 1976 R. Stack was hired to work on cereal crown and root rots. R. Stack is also the project leader for the shelterbelt disease research. The root rot project has developed a model for statistically sound sampling of cereal fields to determine the incidence of root and crown rot. The research on this project has also shown that the disease development curve is not typical for a soil borne disease when infections on the subcrown internode are considered. Evidence has been obtained that there are true differences between cultivars as far as their reaction to the common root rot organism is concerned. This would indicate that improvement in the resistance of wheat, durum and barley cultivars was possible through breeding.

J. Walla joined the department in 1977 to study the causes and possible controls of shelterbelt decline in North Dakota. Sites and problems for future study are being selected.

The reorganized Plant Pathology Department has spent its entire existence under the administration of Dean Arlon Hazen. Research on the biology and control of crop pests including insects, diseases and weeds has

increased markedly during this period. In 1960 there were only two state supported plant pathologists in North Dakota. At the end of 1978 there were seven state supported plant pathologists with disease research projects on all major North Dakota crops except oats and corn. The responsibility for this increased support of crop pest research lies with Dean Arlon Hazen. As the agricultural production in North Dakota changes to higher value per acre crops, pest management will continue to increase in importance.