

DISEASES

DISEASES OF WHEAT IN MEXICO

Norman E. Borlaug, Alfredo Campos and Manuel Navarro

The most important diseases of wheat in Mexico are the 3 rusts, stem, stripe and leaf, and to a much lesser extent the smuts. Since most of the commercial crop is grown under irrigation during the winter months, root rots are only of very minor importance.

Stem Rust (*Puccinia graminis tritici*)

The disease which formerly limited wheat production most seriously was stem rust. This disease frequently developed into devastating epidemics in all the principal wheat-producing areas of the Republic. Since the uredinial stage of this organism survives on green cereals and grasses throughout the year in Central Mexico at elevations of 5,000 to 8,000 feet, inoculum is always present and epidemics develop and spread rapidly whenever ecological conditions become favorable.

Stem rust has been successfully controlled during the past 10 years by the use of rust-resistant varieties, although during this period it has been necessary twice to release new varieties to meet changes in the race-population of the rust pathogen. Without the use of stem-rust-resistant varieties it would have been impossible for Mexico to have become self-sufficient in wheat production. The need for stem-rust-resistant varieties today is of even more vital importance than it was before the introduction of improved cultural practices 10 years ago. Today through the heavy application of fertilizers and the resulting dense stands of plants, the ecological conditions within the grain fields are much more favorable for the pathogen, thereby creating a far greater hazard from rust were it not for the protection afforded by the resistant varieties. The best farmers now invest up to \$20 an acre in fertilizer alone, which accrues to an overall investment of \$45 or \$50 per acre in a wheat crop. Under these conditions protection from rust losses is of vital importance, much more so than when wheat was grown as a subsistence crop some 10 years ago.

Currently, virtually all the commercial wheat area is grown to stem-rust-resistant varieties, with the exception of small areas in northern Mexico in the states of Coahuila and Chihuahua, which continue to grow varieties such as Candeal, Supremo 211 and Kentana 48, which are susceptible to one or more of the prevalent stem-rust races.

The main commercial varieties being grown in Mexico at the present time are Lerma Rojo, which perhaps represents 70% of the wheat area, Yaqui 54, Gabo 55 and 56 together representing 15%, and Yaktana 5%.

Stripe Rust (*Puccinia glumarum*)

Stripe-rust is the second most important disease of irrigated wheat. This rust occurs throughout the Republic, except on the Pacific Coastal Plain (Sonora and Sinaloa) where temperatures are not favorable for its development. As a result varieties such as Yaqui 54, Gabo 55 and Gabo 56, all of which are susceptible to this disease, are restricted in their distribution to this western area. Lerma Rojo and Yaktana 54, which represent

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the great majority of the area grown to wheat in Central Mexico, are both resistant to the prevalent races of stripe-rust. Little or no inoculum is produced on either of these varieties.

The primary source of inoculum for the stripe-rust epidemics which have developed in the United States during the past 2 years undoubtedly were on susceptible varieties in northern Mexico. Candéal, a "native" variety extremely susceptible to all the common races of stripe-rust, as well as Supremo 211 and Kentana 48, all undoubtedly contributed to this build-up of inoculum. So long as these varieties continue to be grown in northern Mexico, and especially when they are heavily fertilized, they will continue to produce an abundance of stripe-rust inoculum. The Lerma Rojo and Yaktana varieties will both out-yield these varieties under northern Mexican conditions, and when the area is converted to these 2 varieties it will result in a great reduction in the amount of inoculum produced. It is expected that this goal can be largely achieved within another year.

Leaf Rust (*Puccinia rubigo-vera tritici*)

Leaf-rust was formerly the least important of the 3 rusts. This is no longer the case, since the important commercial varieties now possess adequate stem-and stripe-rust resistance. Leaf-rust develops throughout the wheat-growing areas of the country, and losses from this disease are increasing. All the commercial varieties are susceptible to one or more of the prevalent races.

Bunt (*Tilletia* spp.)

Ten years ago bunt was common throughout the country. Today it is rarely seen. This reduction in smut is the result of the combined effect of a seed disinfection campaign and the use of resistant varieties.

Loose Smut (*Ustilago tritici*)

Two of the original "native" varieties, Candéal and Pelón Colorado, which were very popular 15 years ago, were extremely susceptible to loose smut. Today loose smut is rarely seen, and when it appears it is confined to the Lerma Rojo variety which is apparently susceptible to at least 1 of the common races of this organism.

Downy Mildew (*Sclerospora macrospora*)

This disease was formerly much more widespread than it is at present. The incidence has decreased as better cultural practices have become widespread. Adequate land leveling, which prevents collecting of irrigation water in the low areas, is the most practical means of control. The disease is confined largely to alkaline or salty soils with low water permeability.

Two types of losses result from this disease. Severely infected plants are killed outright or produce no grain. Less severely infected plants produce some seed, but mature from 3 weeks to a month later than normal plants. This difference in maturity seriously complicates the harvesting operation, and the problem is accentuated in fields that are poorly leveled, where large patches of infested plants in the low areas remain green when the uninfested plants are mature.

We have been unable to find any difference in varietal resistance to this disease.

English Grain Aphid (*Macrosiphum granarium*)

The English grain aphid was prevalent throughout the Bajio Region (central Mexico) 15 years ago but produced no losses and was not considered a pest. Today in the same region it has become the most destructive pest of wheat, and the losses over the past 3 years have been greater than the combined losses from all diseases. Improved cultural practices, especially the use of heavy rates of chemical fertilizers and more adequate irrigation scheduling, have increased the yields on most farms in this region from a low of 5 to 8 bushels per acre up to 35 to 60 bushels per acre. Concurrently with this change, the micro-climate within the wheat fields has been made very favorable for the development of this pest, whereas formerly the open sparse stands of poorly developed plants did not produce a favorable environment.

This insect attacks the head of the plant when the kernels are beginning to form. Under severe conditions it can result in complete loss, although losses of 20% to 30% under epidemic conditions are the more usual. In certain years the natural predators keep this insect under control, but when this is not the case it is becoming standard practice to use aerial applications of Malathion or benzene hexachloride. The increase in importance of this pest indicates clearly the delicate balance that exists in nature; and when, changing cultural practices inadvertently modify environmental conditions, new insect or disease problems can appear with devastating consequences.