TECHNICAL NOTE: CIMMYT'S WHEAT

Disease Surveillance

CIMMYT gathers information for its wheat disease surveillance program from two nurseries, The Regional Disease and Insect Screening Nursery (RDISN) and the Regional Disease Trap Nursery (RDTN). Based in the Middle East, the program helps national programs gather information on sources of disease resistance and monitors developments in disease and insect problems. The information collected is distributed to national programs and to CIMMYT, which then incorporates it into its breeding program. The wheat surveillance program concentrates most of its efforts on the wheat rusts (Puccinia graminis, P. recondita and P. striiformis). Septoria tritici, Helminthosporium, smuts, bunts and powdery mildew are also included within the program's purview.

The RDISN screens approximately 2,000 lines of bread-wheat, durum, barley and triticale each year. The varieties screened usually represent advanced lines from national wheat improvement programs and selected germplasm from international institutions such as CIMMYT. Periodically, some local land-race varieties are also screened in the search for new sources of resistant genes. The RDISN is sent to about 50 locations in over 30 countries each year. Emphasis is placed on obtaining as much early information

as possible from locations where virulent or diverse pathogen populations are found; it is hoped that the three to five year lag time between the detection of a new race and its prevalance in commercial areas can be utilized by orienting breeding efforts effectively in response to early information coming out of the RDISN. It has been found that the breadwheats have the largest percentage of entries with a high degree of resistance to a single disease (Exhibit 1) and also possess resistance to a greater number of diseases than the durams and barley.

The regional Disease Trap Nursery (RDTN), composed of commercial varieties, susceptible check varieties, important sources of resistance and new promising varieties, is sent to 150 locations in approximately 50 countries to measure natural levels of disease incidence and to generate information on the epidemiological dynamics in order to begin to develop a predictive capability for epidemic diseases. The information gathered from the Trap Nursery indicates that there are at least four distinct epidemiological zones in West Asia and Africa: The Indian sub-continent, the Middle East, North Africa ans Southwest Europe, and East Africa. Although migration of windborne diseases between zones is not common, it is possible; such a migration was documented for the virulence factor in

yellow rust for the varieties selected from the Mexican cross of 8156. The possible migration from Turkey to Pakistan and Northwest India was recorded over a period of three years.

Exhibit 2 gives the average coefficients of infection to the rust diseases of local, improved and semi-dwarf breadwheat varieties in four epidemiological zones. Coefficients of infection are calculated by multiplying a resistance rating times the disease severity, expressed as a percentage of the plant tissue covered by the disease. Varieties with a mean average coefficient of infection (A.CI.) of less than 2.0 are considered highly resistant, 2.1-5 resistant, 5.1-10 moderately resistant, 10.1-15 moderately susceptible, and 15.1 or more as susceptible. Epidemic potential is extremely high for a variety with an A.C.I. of more than 25. The data in Exhibit 2 indicates that a large number of resistant sources are represented in the semi-dwarf wheats.

Diseases in Dwarf Wheats in Asia and Africa

Septoria Blight

Septoria tritici and S. nodorum have been identified from most countries. Losses due to septoria tritici are difficult to determine. Limited data suggest a great variability in loss, and one study estimated that 50 percent infection of plant tissue produces about 20 percent yield loss. Local epidemics probably occur frequently; a severe s. tritici epidemic occurred in North Africa in 1968-1969, when the growing season was unusually cool and wet. In Morocco, where the epidemic was particularly severe, dwarf wheats with a potential yield of 4,000 kg/ha. produced 500-800 kg/ha. Septoria blight is one of the major disease problems for wheat in Mediterranean coastal areas and East African highlands. In Morocco, Algeria, Tunisia, Turkey and Israel, septoria blight has epidemic potential in areas receiving 700 mm or more of annual rainfall. As annual rainfall decreases, the desease becomes progressively less of a problem.

Bunt

Bunt, the most serious smut diesase of wheat, requires relatively cool weather and is commonly found at higher elevations or more northern latitudes. Fields with 40 to 60 percent infection have been observed in Nepal and

Afghanistan. The pathogen survives as seed- or soil-borne inoculum, depending on the environment. The bunt fungi are capable of genetic change, and new physiological races that can overcome a plant's genetic resistance may evolve. Fungicidal seed treatment has been effective in reducing the incidence of bunt; in Turkey, it has been hypothesized that in the absence of a comprehensive seed treatment program, bunt would be the country's major disease problem.

Loose Smut

Loose smut is one of the best known diseases in the developing nations. The degree of infection varies greatly with the wheat varieties grown and the environment. Severely infected fields usually occur when seed stocks of a susceptible variety are maintained by a farmer for extended periods of time. Individual fields with 30-50 percent smutted heads have been observed.

Powdery Mildew

Powdery mildew is widely distributed on wheat in all countries in Asia and Africa, but is most severe at higher elevations and in coastal areas of the Mediterranean and Caspian Seas. Loss figures are unavailable, and in the plans immediately adjacent to the Himalayan Mountains in India and Pakistan powdery mildew was noted with increasing frequency in the early 1970's, perhaps as a result of the

use of more water and fertilizer and the denser plant populations in the region.

Root Rot and Seedling Blight

In the Mediterranean region, root rots and seedling blights frequently occur. In India, increased incidence of Rhizoctonia root rot and seedling blight has been noted in areas where wheat is sown after rice. Higher temperatures favor the development of wheat seedling b lights and root rots.

Downy Mildew

This disease, which has been observed in all countries, under the regional surveliiance program, occurs when the soil has been water logged by excessive irrigation. No sources of resistance have been identified, but proper irrigation should eliminate the disease.

Scab

Scab, which is prevalent in the coastal areas of North Africa, tends to appear when there is favorable moisture at heading and flowering times, and in areas where maize and wheat are rotated or cultivated as companion crops. While the potential increase of scab appears to be slight, the dwarf wheats as a group are susceptible.

Exhibit 1

Frequency of Lines Falling into Resistant (A.C.I. 0 - 5), Adequately Resistant (A.C.I. 6 - 10) & Unacceptable levels of Resistance (A.C.I. > 10) to the cereal rust diseases. Data from Regional Disease and Insect Screening Nursery 1976-76.

Average Coefficient of Infection (A.C.I.) to the Rust Diseases	DISEASE & PERCENT OF ENTRIES IN EACH A.C.I. GROUPING					
	STEM RUST			YELLOW RUST		
	BW	DUR	BAR	BW	DUR	BAR
0 - 5	62.4	22.0	8.7	48.1	39.6	3.5
6 - 10	15.7	21.8	24.7	11.7	20.6	1.8
> 10	21.9	54.7	61.7	35.3	40.0	94.7

BW = Bread Wheat DUR = Durum Wheat BAR = Barley

Exhibit 2

Comparison of the average coefficient of infection (A.C.I.) to the rust diseases of local, improved and semi-dwarf bread wheat varieties in four epidemiological zones (RDTN) 1975-76.

Rust Fungus	Wheat Variety Group	Average Coefficient of Infection by Zones			
		South Asia	West Asia	North Africa	East Africa
P. striiformis	Local	16.8	22.3	39.6	42.6
	Improved	2.9	6.4	3.4	13.5
	Dwarf	2.4	4.4	3.3	22.6
P. graminis	Local	37.8	29.5	21.0	23.9
	Improved	13.1	18.5	6.8	19.6
	Dwarf	7.0	7.4	5.3	4.3
P. recondita	Local	51.9	30.8	18.6	*
	Improved	31.4	16.9	11.4	
	Dwarf	15.8	9.0	2.0	

* Data insufficient

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Bunt

Common or hill Bunt, the most serious smut disease of wheat, requires relatively cool weather and is commonly found at higher elevations or more northern latitudes. Fields with 40 to 60 percent infection have been observed in Nepal, and

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Afghanistan. The pathogen survives as seed- or soil-borne inoculum, depending on the environment. The common bunt fungus is capable of genetic change, and new physiological races that can overcome a plant's genetic resistance may evolve. Fungicidal seed treatment has been effective in reducing the incidence of bunt; in Turkey, it has been hypothesized that in the absence of a comprehensive seed treatment program, bunt would be the country's major disease problem.

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