ITEMS FROM TURKEY

ICWIP – ICARDA CIMMYT WHEAT IMPROVEMENT PROGRAM
CIMMYT International Wheat and Maize Improvement Center, Turkey Regional Office and Mexico.

The International breeding strategy for the identification of resistance in bread wheat against the soil borne pathogens dryland root tor and cyst and lesion cereal nematodes.

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Soil-borne pathogens (SBPs) including the dryland root rots and cereal nematodes are causing economic yield loss in many parts of the world where cereals dominate the cropping system and suboptimal growing conditions or cultural practices are common. One of the most effective control measures of these SBPs is the use of host resistance, whereby the inoculum level of these pathogens can be reduced to below economically damaging thresholds. CIMMYT International, in collaboration with The Turkish Ministry of Agriculture and Rural Affairs, has established an international field and laboratory-screening program for identifying spring and winter wheat accessions with resistance to SBPs. Several screening protocols for assessing resistance to both cereal root rots and nematodes have been modified and optimized. Known resistance sources to SBPs from other regions of the world have been tested against Turkish isolates of SBPs and several of these have been shown to be effective in the region. In addition, new sources of resistance with genetic variability have been identified against the prevalent SBPs. These diverse genes for resistance are being pyramided into both spring and winter bread wheat backgrounds using both conventional and molecular tools where feasible.

Introduction. Soil-borne pathogens, including dryland cereal root rots and cereal nematodes, are a major constraint to cereal production worldwide, particularly where cereals dominate rotations, and sub-optimal growing conditions and or cultural practices are common. Dryland root rots also commonly known as root, crown, or foot root rots include a complex of fungi with several species of crown root (CR) (*Fusarium* spp.) and common root rot (CRR) (*Bipolaris sorokiniana* (syns. *Helminthosporium sativum*, *H. sorokiniana*, teleomorph *Cochliobolus sativus* (Ito & Kurib.) Dresch.ex Dast.). The two most reported *Fusarium* species are *F. pseudograminearum* (formerly *F. graminearum* Group 1, teleomorph *Gibberella coronicola*) and *F. culmorum*. Furthermore, two groups of microscopic nematodes are commonly found on wheat roots and include several species of the cereal cyst nematode (CCN) *Heterodera* spp. and at least two important species of the root lesion nematode (RLN) *Pratylenchus thornei* and *P. neglectus*. Frequently, two or more SBPs can occur in the soil at one time, making a disease complex and hence a holistic approach in management principally based primarily on resistance but where possible integrated with rotational options is required.

Yield loss caused by these SBPs has been reviewed and documented in many regions of the world including Europe, America, and, in particular, the more marginal cereal production areas of West Asia, North Africa, Australia, and Canada, with losses reported between 3-50% (Diehl et al. 1983; Burgess et al. 2001; Singh et al. 2005; Nicol et al. 2001, 2004a; McDonald and Nicol 2005). Recent yield losses studies in Turkey have confirmed that cereal root rots and cereal nematodes are associated with yield losses of 42 and 45% in commonly cultivated winter wheats (Nicol et al. 2005; Hekimham et al. 2004). Considering the similarity in WANA (West Asia and North Africa), parts of South America, South Africa, and other parts of the world in relation to cropping patterns and climate, it is likely that soil-borne pathogens could cause similar economic losses in these regions.

Resistance, which is defined as a reduction in the multiplication of the pathogen, is one of the best methods to control these diseases. Although these nematodes and fungi have been considered important for several decades in certain countries, little advancement in breeding has been made. This is due to the difficulties of screening for these pathogens under field and greenhouse conditions. Currently, there are very few known effective sources of resistance against these pathogens available in commercially grown wheat cultivars, and many of the identified resistant sources are

Table 1. Sources of resistance against the soil-borne pathogens cereal cyst nematode (CCN) *Heterodera filipjevi*, root lesion nematode; *Pratylenchus thornei* (PT) and *P. neglectus* (PN); and crown rot (CR), *Fusarium culmorum*. R = resistant and MR = moderately resistant. Types of wheat are SW, spring wheat, and WW, winter wheat. Origins include MX, CIMMYT Mexico; AUS, Australia; AU UA, Australia, University of Adelaide; AU US, Australia, University of Sydney; TCI, Turkey, CIMMYT ICARDA Winter Wheat Improvement Program; TCI OR, Turkey, CIMMYT ICARDA Winter Wheat Improvement Program and Oregon State University, TK, Turkey, and TK E, Turkey, Eskisehir.

Type	Origin	Cross	Selection history	CCN	PT	PN	CR
AUS GS50AT34/SUNCO//CUNNINGHAM							
SW	MX	CMSS99Y05529T	-12M-6Y-010M-2SY-0B	R	MR		
AUS4930 5.3/Spear DH#41							
SW	MX			R			
CANADIAN/CUNNINGHAM//KENNEDY							
SW	MX	CMSS99M01564T	-040Y-0P0M-040SY-040M-040SY-17M			MR	
CROC_1/AE.SQUARROSA (224)//OPATA							
SW	MX	CMBW91Y00935S	-80Y-11KBY-1KBY-010M-1Y-2M-0Y-0SY				MR
KRICHAUFF							
SW	AUS UA				MR	MR	
MILAN							
SW	MX	CM75113	-B-5M-1Y-05M-2Y-3B-0Y-3SCM	R			
SILVERSTAR							
SW	AUS AU			R			
SLVS//BAU/MILAN							
SW	MX	CMSS99M02079S	-040M-040SY-040M-3CMME-1M		MR		
SUNCO/FRAME//PASTOR							
SW	MX	CMSS99M01589T	-040Y-0P0M-16SY-010M-010Y-8M	R			MR
SUNCO/PASTOR							
SW	MX						MR
SUNR11(GALA 2-49/(CN#133/SUNSTATE*4)//SUNSTATE)							
SW	AUS–US						MR
SUNR14 (GALA 2-49/(CN#133/SUNSTATE*4)//SUNSTATE)							
SW	AUS – US						MR
SUNR25 (GALA 2-49/(CN#133/SUNSTATE*4)//SUNSTATE)							
SW	AUS–US						MR
SUNR27 (GALA 2-49/(CN#133/SUNSTATE*4)//SUNSTATE)							
SW	AUS–US						MR
T.TAU.83.2.29/3/PRL/SARA//TSI/VEE#5/4/CROC_1/AE.SQUARROSA (224)//OPATA							
SW	MX	CMSS99M01789T	-040Y-0P0M-040SY-040M-1CMME-4M		MR	MR	
T.TAU.83.2.36/ATTILA							
SW	MX	CMSS99M02090S	-040M-8SY-010M-010Y-9M	R	MR		

Table 1 (continued). Sources of resistance against the soil-borne pathogens cereal cyst nematode (CCN) *Heterodera filipjevi*, root lesion nematode; *Pratylenchus thornei* (PT) and *P. neglectus* (PN); and crown rot (CR), *Fusarium culmorum*. R = resistant and MR = moderately resistant. Types of wheat are SW, spring wheat, and WW, winter wheat. Origins include MX, CIMMYT Mexico; AUS, Australia; AU UA, Australia, University of Adelaide; AU US, Australia, University of Sydney; TCI, Turkey, CIMMYT ICARDA Winter Wheat Improvement Program; TCI OR, Turkey, CIMMYT ICARDA Winter Wheat Improvement Program and Oregon State University, TK, Turkey, and TK E, Turkey, Eskisehir.

Type	Origin	Cross	Selection history	CCN	PT	PN	CR
VP1620 (VF304/TTAU.69.5-33//YANAC)							
SW	AUS				MR	MR	
338-K1-1//ANB/BUC/3/GS50A							
WW	TCI	TCI971351	-0SE-0YC-0YE-5YE-0YE-2YE-0YE		MR		
ALTAY 2000 ALTAY 2000							
WW	TK E		YE5470-0E-0E-0E-30E-0E	R			MR
BILINMIYEN96.7							
WW	TCI	F2.96.7	-0SE-4YA-4YC-0YC	R			MR
BILINMIYEN96.7							
WW	TCI	F2.96.7	SE-3YA-3YC-0YC			MR	MR
BURBOT-6							
WW	TCI OMM	WXD880137A	-9H-0YC-1YC-0YC-0YC-2YC-0YC-3YC-0YC				MR
ES84.24/GRK							
WW	TCI	CIT932135	-0SE-0YC-1YE-0YC-2YC-0YC				MR
ES84-24/DYNASTY							
WW	TK E	YE8224	-0E-0E-0E-1E-0E				MR
MVR27-82//LI7/LE2062							
WW	TK	AMJ20983	-6J-1YC-0YC	R			MR
SKP35/SAM2/4/55-1744/D101//MAYA.S/3/MUS.S/DRM.MAYA/ALD.S							
WW	TK E	YE8071	-0E-0E-0E-3E-0E				MR
TAM201/4/BL/AU/3/AGRI//HYS/7C/5/F134.71/NAC							
WW	TCI	CIT935155	-0SE-0YC-*-2YE-2YC-0YC				MR
TE2583A-11310/Obriy							
WW	TCI	TE4920	-1T-2T-1T-1T-2T-0T				MR
TURCAN #39							
WW	TCI						MR
4-22 WW	TK						MR
ES86-7							
WW	TK						MR
KUTLUK94							
WW	TK				MR		

Table 1 (continued). Sources of resistance against the soil-borne pathogens cereal cyst nematode (CCN) *Heterodera filipjevi*, root lesion nematode; *Pratylenchus thornei* (PT) and *P. neglectus* (PN); and crown rot (CR), *Fusarium culmorum*. R = resistant and MR = moderately resistant. Types of wheat are SW, spring wheat, and WW, winter wheat. Origins include MX, CIMMYT Mexico; AUS, Australia; AU UA, Australia, University of Adelaide; AU US, Australia, University of Sydney; TCI, Turkey, CIMMYT ICARDA Winter Wheat Improvement Program; TCI OR, Turkey, CIMMYT ICARDA Winter Wheat Improvement Program and Oregon State University, TK, Turkey, and TK E, Turkey, Eskisehir.

Type	Origin	Cross	Selection history	CCN	PT	PN	CR
SÖNMEZ2001							
WW	TK			R			
GÜN91							
WW	TK				MR		
YAKAR99							
WW	TK			R			MR
TOSUNBEY							
WW	TK			R			
BAĞCI2002							
WW	TK			R			
DOĞU88							
WW	TK						MR
LANCER							
WW	TK						MR
PALANDÖKEN97							
WW	TK						MR
FLAMURA85							
WW	TK						MR
KATE A-1							
WW	TK			R			
PEHLİVAN98							
WW	TK					MR	MR
PROSTOR99							
WW	TK						MR
SAROZ95							
WW	TK				MR		MR
ES05-KE21							
WW	TK				MR		
05BVD-1							

found in unadapted germ plasm which will require considerable breeding investment to produce commercial cultivars. Hence, a precise laboratory/field breeding strategy has been established by Turkish and CIMMYT scientists in Turkey with CIMMYT Mexico to identify and incorporate new sources of resistance, particularly those identified in well-adapted backgrounds.

Germ plasm screening for resistance to soil-borne pathogens. Over the last 4 years a clearly defined screening program has been established in Turkey in collaboration with Turkish NARs to screen against SBPs. The greenhouse resistance-screening program is at the Eskisehir ANADOLU station and the field crown rot screening program is conducted in Konya in collaboration with BDIARI (Bahri Dagdas International Agricultural Research Institute). The emphasis on screening has been with advanced lines or released cultivars and, due to the inherent variability of SBP data, at least 2 years of field or greenhouse data is deemed necessary before the line/cultivar is considered to be resistant.

Last year, more than 200 lines of germ plasm were screened for their resistances against a number of SBPs under greenhouse conditions. These germ plasm included TURKEY/CIMMYT/ICARDA (TCI) winter wheat, spring wheat from CIMMYT-Mexico, National Turkish materials, and sources obtained from international collaborators working with SBPs. Each line was screened against four SBPs including CCN (*H. filipjevi*), RLN (*P. thornei* and *P. neglectus*), and CR (*F. culmorum*), each with seven replicates, making the greenhouse throughput 5,600 plants.

As with previous years, a field-based screening program with more than 800 genotypes (making approximately 5,000 observation plots) of TCI, National, and CIMMYT Mexico for crown rot resistance was established in Konya for resistance under inoculated field conditions.

The methods used for the screening of SBP in both field and greenhouse are given in the reference Nicol et al. (2007). In all tests, commonly known check lines for both resistance and susceptibility are used for each SBP. Since the work has begun, more than 60 wheat lines have been identified with resistance or partial resistance against SBPs, which is equivalent or better than the currently known resistance. Many of the lines are high yielding adapted SW or WW and, in some cases, commercially released cultivars in both Australia and Turkey. In many cases, resistance has been found against more than one SBP, enabling the breeders to use this germ plasm against the SBP complex. The summary of the new greenhouse-screening program from 2007 are provided in Table 1 (pp. 143-145). CCN provides more complete resistance than the other three SBPs, due to major gene control of this pathogen, in comparison with both RLN and CR, which have reported quantitative inheritance controlled by several genes (Nicol and Rivoal 2008). These sources have been shared with both international and national breeding programs for both their validation and subsequent incorporation into germ plasm improvement.

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References.

Burgess LW, Backhouse D, Summerell BA, and Swan LJ. 2001. Crown rot of wheat. *In: Fusarium*: Paul E. Nelson Memorial Symposium (Summerell BA, Leslie JF, Backhouse D, Bryden WL, and Burgess LW, Eds). The American Phytopathological Society, St Paul, Minnesota. Pp. 271-294.

Diehl JA, Tinline RD, and Kochhann RA. 1983. Perdas em trigo causadas pela podridao comum de raizes no Rio Grande do Sul, 1979-1981. Fitopatologia Brasellia 8:507-511 (In Portuguese).

Hekimhan H, Bagci A, Nicol J, Arisoy Z, Taner S, and Sahin S. 2004. Dryland root rot : a major threat to winter cereal production under sub-optimal growing conditions. *In:* Proc 4th Internat Crop Sci Cong Internat Crop Sci Cong, New directions for a diverse planet, 26 Sep–1 Oct, 2004, Brisbane, Australia. http://www.cropscience.org.au/ icsc2004/poster/3/7/2/1322_nicol.htm (Poster presentation).

Nicol JM and Rivoal R. 2008. Global knowledge and its application for the integrated control and management of nematodes on wheat. *In:* Integrated Management and Biocontrol of Vegetable and Grain Crops Nematodes. (Ciancio A and Mukerji KG, Eds). Springer Academic Publishers, The Netherlands. Pp. 243-287.

Nicol JM, Bolat N, Bagci A, Trethowan RT, William M, Hekimhan H, Yildirim AF, Sahin E, Elekcioglu H, Toktay H, Tunali B, Hede A, Taner S, Braun HJ, van Ginkel M, Keser M, Arisoy Z, Yorgancilar A, Tulek A, Erdurmus D, Buyuk O, and Aydogdu M. 2007. The International Breeding Strategy for the incorporation of resistance in bread wheat against the soil borne pathogens (dryland root rot and cyst and lesion nematodes) using conventional and molecular tools. *In:* Proc 7th Internat Wheat Cong, Wheat Production in Stressed Environments (Buck HT Ed). Springer Publishers, The Netherlands. Pp. 125-137 (Invited paper).

Nicol JM, Rivoal R, Trethowan RM, van Ginkel M, Mergoum M, and Singh RP. 2001. CIMMYT's approach to identify and use resistance to nematodes and soil-borne fungi, in developing superior wheat germplasm. *In*: Proc 6th Internat Wheat Conf 'Wheat in a Global Environment' (Bedö Z and Láng L, Eds). Kluwer Academic Publishers, Netherlands, Pp. 381-389.

Nicol J, Rivoal R, Taylor S, and Zaharieva M. 2004a. Global Importance of cyst (*Heterodera spp*.) and lesion nematodes (*Pratylenchus spp*.) on cereals: yield loss, population dynamics, use of host resistance and integration of molecular tools. Nemat Mono Perspect 2:233-251.

Nicol JM, Bagci A, Hekimhan H, Bolat N, Braun HJ, and Trethowan R. 2004b. Strategy for the identification and breeding of resistance to dryland root rot complex for International spring and winter wheat breeding programs. *In:* PRoc 4th Internat Crop Sci Cong 'International Crop Science Congress - New directions for a diverse planet', 26 Sep–1 Oct, 2004, Brisbane, Australia (Poster presentation).

Nicol JM, Bolat N, Yildirim AF, Yorgancilar A, Kaplan A, and Braun HJ. 2005. The Cereal Cyst Nematode is causing economic damage on rainfed wheat production systems of Turkey. *In:* Joint Meeting Annual Western Soil Fungus Conf and Amer Phytopath Soc, Portland, OR, 28 June–1 July, 2005.

McDonald A and Nicol JM. 2005. Chapter 5: Nematode Parasites of Cereals 2005. *In:* Plant Parasitic Nematodes in Tropical and Subtropical Agricultural (Bridge J, Sikora R, and Luc M, Eds). CABI Publishing, Wallingford, Oxon, United Kingdom. Pp. 131-191.

Mitter V, Zhang MC, Liu C, Ghosh R, Ghosh M, and Chakraborty S. 2006. A high throughput bioassay to detect crown rot resistance in wheat germplasm. Plant Pathology 55:433-441.

Singh RP, Huerta-Espino J, Fuentes G, Duveiller E, Gilchrist L, Henry M, and Nicol JM. 2005. Resistance to diseases, Chapter 10. *In:* Durum Wheat Breeding: Current Approaches and Future Strategies (Royo C, Nachit M, Di Fonzo N, Araus J, Pfeiffer WP, and Slafer G, Eds). Food Product Press, New York, USA, Haworth Press Inc. ISBN 1-56022-967-5, Pp 291-327.

Tunali B, Nicol JM, Uckun Z, Buyuk O, Erdurmus D, Hekimhan H, Aktas H, Hodson D, Akbudak MA, and Bagci AS. 2008. Root and crown rot fungi associated with spring and winter wheat in Turkey. Plant Dis (In press).

Yorgancilar A, Sahin E, Nicol JM, Bolat N, and Yildirim AF. 2006. Identification of multiple resistance against cereal cyst (*Heterodera filipjevi*) and lesion (*Pratylenchus thornei* & *P. neglectus*) nematodes for International bread wheat improvement. *In:* Proc 28th Eur Soc Nematol Symp, 5–9 June, 2006, Blagoevgrad, Bulgaria (Poster presentation).

ITEMS FROM THE UKRAINE

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The impact of larvae of Eurygaster integriceps Put. on winter wheat grain.

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Winter wheat suffers from harmful organisms to a considerable extent. Among these pests, cereal insects are especially harmful not only on yield but also on grain quality of winter wheat. At present, with the reduction in the use of chemical protection, agronomical means of protection are important. Our aim is the search for zonal agnonomic methods that reduce the harmful impact of the cereal insect on the qualitative indices in winter wheat grain. We have made studies on a cultivar, forecrop, and fertilizer bases.

Material and Methods. Field experiments were at the Plant Breeding Laboratory of the Plant Production Institute NA. V.Ya. Yuriev of the UAAS (Eastern Forest-Steppe of Ukraine) in a fixed 9-course, fallow-crop rotation. The common, heavy chernozem soil has medium humus and is characterized by the following indices in the arable layer: humus, 5.25–5.38 %; pH of salt extract, 6.0–6.5; nitrogen content, 16.8–17.5, labile phosphorus, 11.2–14.8; and exchange potassium, 11.1–13.3 mg/100 g soil.