D9.5

DURABILITY AND EFFECTIVENESS OF RESISTANCE TO STRIPE RUST IN WHEAT CULTIVARS. Roland F. Line, U.S. Department of Agriculture, Pullman, WA 99164-6430 USA

Two important types of resistance to *Puccinia striiformis*, the cause of stripe rust (yellow rust) of wheat, are seedling resistance (SR) and high-temperature, adult-plant resistance (HTAPR). SR is characterized by race specificity and low infection types at all stages of plant growth and a wide range of temperatures. When used extensively over time or space, new races usually circumvent SR within 3-4 years after release of cultivars with the resistance. Use of SR in a multiline cultivar has provided protection for > 10 years. HTAPR is characterized by a range of infection types and a shift in the range depending upon temperature and stage of plant growth. As plants with HTAPR become older, they become more resistant at high temperatures, but they remain susceptible when grown at low temperatures. Seedlings and heads (ears) of cultivars with HTAPR are susceptible at a wide range of temperatures. At the higher temperatures, flag leaves are most resistant. HTAPR can be reversed by changing the temperature. HTAPR has proven to be effective when extensively exposed to many races for > 30 years. The durable HTAPR has prevented major stripe rust epidemics and wide-spread losses in many regions of the world. More than 30 genes for SR and eight genes for HTAPR have been identified, and their inheritance has been determined. HTAPR genes are recessive; SR genes are recessive or dominant depending upon the gene, pathogenic race, and/or genetic background of the host.

9.5.1

IN VIRTO SELECTION FOR RESISTANCE (TOLERANCE) TO SCLEROTINIA STEM ROT IN OILSEED RAPE. C. R. Wu. Department of Plant Protection, Huazhong Agricultural University, Wuhan 430070, China.

Oxalic acid toxin produced by Sclerotinia sclerotiorum (Lib) de Bary was found to inhibit the cell growth and reduced the viability of oilseed rape (Brassica napus L.) suspension cultures. After treatments with chemical (EMS) or physical (Co^{60} gamma rays) mutagens, cells resistant ot tolerant to oxalic acid were selected during culture in the presence of toxin, this resistance(tolerance)was evaluated by successive increase in packed cell voulme and viability that occurred in oilseed rape cultures over the five subculture cycles. Resistant plants and plants with reduced susceptibility against the pathogen could be regenerated from selected cultures previously treated with mutagens. In addition, some regenerants with increase tolerance to the toxin were also obtained from control cultures untreated with mutagens and unselected with the toxin. These results suggested that oxalic acid and rape suspension cells could be used to obtain plants with increased resistance (tolerance) to Sclerotinia stem rot.

ACKNOWLEDGEMENT
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9.5.2

THE IDENTIFICATION OF SOURCES OF RESISTANCE TO *PERONOSPORA PARASITICA* (DOWNY MILDEW) IN *BRASSICA JUNCEA*. N. I. Nashaat, R. P. Awasthi. AFRC Institute of Arable Crops Research, Rothamsted Experimental Station, Harpenden, AL5 2JQ, UK.

Thirty one *Brassica juncea* accessions were screened at the cotyledon stage for resistance to four isolates of *Peronospora parasitica* . Isolates R1 and P003 were derived from crops of *B. napus* ssp. *oleifera* in the UK. Isolates IP01 and IP02 were derived from crops of *B. juncea* in India. *B. napus* cv. Ariana, which was used as a susceptible control to isolates R1 and P003, was resistant to isolates IP01 and IP02. All *B. juncea* accessions were resistant to isolates R1 and P003 except Hatano and Line 34282 which expressed a moderate resistant and a moderate susceptibile reaction, respectively, to isolate P003. Three accessions of *B. juncea*, Chang Yang Huang Jie, Ecotype 34253 and Line 34294, expressed a moderate resistant reaction to isolates IP01 and IP02. Seedling populations of Kranti, Krishna and Varuna exhibited a heterogeneous reaction to these isolates.The mean responses of the seedling populations of Krishna and Varuna to both isolates were within the susceptible range. However, c.60% of the seedling population of Kranti expressed a resistant reaction. Resistant lines homogeneous for responses to isolates IP01 and IP02 were selected from these accessions. The mean responses of the seedling populations of all other accessions to isolates IP01 and IP02 were within the susceptible range. There was no pathogenic variation between isolates IP01 and IP02.

9.5.3

CRITERIA FOR ESTIMATION OF FUSARIUM SCAB RESISTANCE IN WHEAT. Mariana Ittu, N.N.Săulescu, Gh.Ittu
ICCPT (Research Institute for Cereals and Industrial Crops) Fundulea 8264, jud.Călăraşi, ROMANIA .
Different criteria to appreciate the level of resistance to Fusarium scab in wheat were investigated.
In this respect the visual score of Fusarium attack, the weight of ears, the number and the weight of each of the normal, white and shrivelled seeds, and the dynamics of infection spreading were considered after artificial and natural inoculation.
The natural Fusarium scab epidemics from 1991 allowed a comparison between these components following both types of infection. Significant coefficients of correlation for the intensity of attack ($r=0,92^{xxx}$), the number of shrivelled ($r=0,78^{xxx}$) and white + shrivelled seeds ($r = 0,72^{xxx}$) and the weight of shrivelled seeds ($r = 0,77^{xxx}$) were found between artificial and natural infection.
The dynamics of infection spreading with Fusarium scab (AUSFPC) following the artificial inoculation helped to estimate the level of resistance to Fusarium scab in wheat. Genotypes with similar final values for the intensity of Fusarium scab attack in ears, but differing in the spreading infection (AUSFPC) showed different levels of spike weight reduction (tolerance) .

9.5.4

SCREENING WHEAT (*TRITICUM AESTIVUM*) FOR SOURCES OF RESISTANCE TO KARNAL BUNT (*TILLETIA INDICA*). G. Fuentes-Davila, S. Rajaram, W. H. Pfeiffer, O. Abdalla, A. Mujeeb-Kazi, R. Rodriguez-Ramos, and M. van-Ginkel. International Maize and Wheat Improvement Center (CIMMYT), Apdo. Postal 6-641, 06600, Mexico, D. F., Mexico.

Since the early 1980's, CIMMYT initiated a project on breeding for resistance to Karnal bunt (*Tilletia indica* Mitra). This project consists of three main steps: a) identification of sources of resistance; b) hybridization in order to incorporate resistance into agronomically suitable genotypes, which also feature good quality and resistance to other diseases, particularly to leaf rust; and c) evaluation and selection of plant progenies to develop advanced lines that can be used by national programs, specially where Karnal bunt is present. Experimental germplasm is artificially tested in northwestern Mexico by syringe-inoculation during the boot stage with a sporidial suspension of 10,000/ml, injecting 1 ml per spike. Ten spikes per entry are evaluated on three planting dates. The percentage of infection of each entry, is based on the number of infected and healthy grains. Up to 1992, more than 70 lines have shown very low percentage of infection during five years of continuous testing. The most outstanding material has been that originated from China, India and Brazil. Hybridizations with these sources of resistance have produced thousands of segregating populations being in the selection process. The overall expected effects from the outcome of this project include: increased yields; reduction in rejection of grain lots by the milling industry; reduction of inoculum levels in soil and wheat area increase, overcoming field quarantines (in Mexico); increased germplasm exchange; and reduction of chemical applications to the crop.

Within the same project, it has been found that triticales and durum wheats in general, are highly resistant to Karnal bunt and that some synthetic hexaploids derived from *Triticum turgidum* X *T. tauschii* show an immune response when artificially inoculated.

9.5.5

PHYTOPHTHORA RESISTANCE IN TISSUE CULTURES. E. Scott, S. Chambers, C. Son.

Department of Crop Protection, Waite Agricultural Research Institute, University of Adelaide, Glen Osmond, South Australia 5064.

A simple, rapid *in vitro* assay for screening for resistance to root-rotting *Phytophthora* spp. in micropropagated rootstocks of almond and citrus has been developed. Shoots were multiplied on modified Murashige and Skoog or Lepoivre media with 0.2-2 mgl^{-1}, BA depending on species. Excised shoots, 1.5-2 cm long, were defoliated and placed upright in agar colonised with the fungus and development of necrosis assessed daily for up to 6 days. In almond and citrus inoculated with *P. cambivora* and *P. citrophthora*, respectively, necrosis developed more quickly on shoots of field-susceptible rootstocks than on those of field-resistant rootstocks. A differential response was obtained in 2 days with almond and 3 days with citrus rootstocks. Shoots of hybrid selections from a cross between resistant and susceptible almond rootstocks were generally intermediate in response. A period of culture on medium without BA prior to inoculation slowed the development of necrosis in citrus rootstocks but had no significant effects on response in almond rootstocks. The assay is now being evaluated for chestnut rootstocks. Differences in aggressiveness between isolates within *P. cambivora* (on almond), *P. citrophthora* (on citrus) and between the species *P. cambivora*, *P. cinnamomi* and *P. citricola* on chestnut were observed in these studies.

This assay may be useful in early stages of breeding programs for tree crops to identify susceptible material, so that only putatively resistant material need be propagated for further study.

9.5.4

SCREENING WHEAT (*TRITICUM AESTIVUM*) FOR SOURCES OF RESISTANCE TO KARNAL BUNT (*TILLETIA INDICA*).

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