EPIDEMIOLOGY AND CONTROL OF WHEAT LEAF RUST DISEASE IN EGYPT

By

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ABSTRACT

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Leaf rust caused by *Puccinia triticina* is an epidemic disease. The present study was concerned with the epidemiology and control strategy of wheat leaf rust disease in Egypt during 2014/16 growing seasons. Spore traps were conducted in four locations in Egypt, i.e, Kafr El-Sheikh, Sharqia, Beni Suef and Alexandria. The highest number of spores were found in March at Kafr El-Sheikh, where 1700 and 2576 spores/ month in the two growing seasons, respectively. While the lowest number was 607 spores in March at Beni Suef in the second season. Spore traps were located at four different distances, radiating from each of eight directions (E, NE, N, NW, W, SW, S, SE). In directions E, SW, S and SE, the dimensions of the spore trap did not allow the installation at the largest distances. While, in directions NW, W, N and NE, the dimensions of the spore trap more allow the spores installation at the largest distances. A total of 37 and 90 virulence phenotypes were respectively described in the three Governorates under greenhouse conditions. The two most common virulence phenotypes were BBBB and BBBT that found with high frequencies throughout the tow growing seasons. The most common race group was DK-- (13.51%) followed by race group TT-- (10.81%) in 2014-15. On the other hand, race group BB-- (23.33%) was the highest frequency in 2015/16. Virulence frequency was very high against *Lr 1, 2c, 10, 11, 16, 17, 21, 24 and 26.* In contrast, virulence occurred at relatively low frequency against *Lr 2a, 2b, 3, 3ka, 9, 18 and 30.* To study the effect of climatic factors on leaf rust incidence, ten wheat genotypes were screened against leaf rust, under field conditions at Kafer El-Sheikh, Sharqia and Beni Suef governorate. All the tested cultivars were susceptible showing terms of infection types of different levels of

final rust severity. The values of final rust severity FRS%, r-value and AUDPC of most cultivars at Sharqia location were higher than in the two other locations. In general, the wheat genotypes Gemmiza-7, Sids-1, Thatcher and Morocco showed higher values of final rust severity %, R-value and AUDPC. However, the two resistant genotypes Giza-168 and Sakha-94 showed lower level of susceptibility and exhibited lower values of disease component. The average daily temperature during the four months of the study was closely related with the development and final rust severity%. The weather data indicated that most of the January and February nights of 2014/2015 were relatively cool (min. temperature <10°C) at wheat growing area. There was a big contrast in this regard with January and February of 2015/2016 at Kafr El-Sheikh, Sharqia and Beni Suef, which had relatively warm nights. Epidemic of wheat leaf rust disease started 10 to 16 days earlier during 2015/2016 rather than the 2014/2015. It depends on the favorability of weather conditions such as early warm seasons. Giza-168, Sids-13 and Sakha-94 cultivars showed lower levels of both FRS % and AUDPC which exhibited lower levels of losses as compared to the highly susceptible cultivar Gimmeza-7. The yield losses were significantly correlated with AUDPC. The cultivars Sids-1 and Gimmeza-9 showed higher levels of susceptibility to leaf rust disease. However, the average grain yield potential for both cultivars was similar to the highest yield commercial cultivars. This indicated that Sids-1 and Gimmeza-9 cultivars have high levels of tolerance to leaf rust infection under the Egyptian field condition. Spraying the highly susceptible wheat cultivar Gemmiza -7 with Acetyl salicylic acid (ASA) showed higher ability to control leaf rust as compared to Mono potassium phosphate (KH_2PO_4). In addition, the greatest effect was observed when sprayed twice. On the other hand, all fungicides applications resulted in lower disease severities and higher yields than untreated control. Spraying the highly susceptible wheat cultivar Gemmiza -7 with Amstar extra showed higher efficiency to control leaf rust as compared to Tilt. In addition, the greatest effect was observed when sprayed twice. The

electrolyte leakage and the activity of Catalase (CAT) and Peroxidase (PO) enzymes were significantly increased in susceptible wheat cultivars (Gemmiza-7) as compared to that of resistant cultivars (Gemmiza-10, sids-12, Giza-171, and Sakha-94). Polyphenol oxidase (PPO) activity was significantly decreased in resistant wheat cultivars compared with the susceptible ones. The accumulation of hydrogen peroxide (H_2O_2) was significantly increased in resistant cultivars (Sakha-94) compared with the susceptible one (Sids-1). H_2O_2 accumulate in guard cells and was also detected in mesophyll cells, especially in cell walls, surrounding the sites of infection. Microscopic observation of the host-pathogen interaction showed a higher number of the fungus germlings formed appressoria on the susceptible wheat cultivars as compared to resistant cultivar. Yellow formed auto fluorescence emission was observed which indicating a hypersensitive reaction (HR) against the pathogen invasion 24 h after inoculation. The occurrence of HR was detected in the resistant cultivar, in a height existence, than that of the susceptible one. In later stages of infection, all the cells beneath the flecks and pustules exhibit the yellow auto fluorescence. Cross sections of treated infected wheat leaves of susceptible and resistant cultivar revealed that the fungal hyphae showed less dispersion and less damage to the mesophyll cells of resistant cultivar as compared to susceptible cultivar. The susceptible treated samples showed intensive intercellular fungal hyphae causing severe damaged mesophyll cells with large pustules as compared to resistant cultivar. The bundle sheath cells began to collapse as result of invasion. On the other hand, resistant infected samples showed semi normal vascular bundles with less destructive phloem tissue and mesophyll cells.

Key words: Wheat, *Puccinia triticina*, Epidemiology, Virulence frequency, Yield losses, Host resistance, climatic factors, Induce resistance, Acetyl salicylic acid (ASA), Electrolyte leakage, Peroxidase (PO), H_2O_2.

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