

Effect of Sequential or Co-inoculation of *Blumeria graminis* f. sp. *tritici* and *Parastagonospora nodorum* on disease development on Wheat

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Sequential and simultaneous infection of plants by biotrophic and necrotrophic pathogens are common under field conditions. However, data on the effect of co-infection of a host plant with these two types of pathogens are limited. We conducted a controlled greenhouse experiment to study disease development on wheat plants inoculated simultaneously and sequentially with the biotroph, *Blumeria graminis* and the necrotroph, *Parastagonospora nodorum*. Spring wheat, cv. Zebra was grown in a greenhouse compartment and sprayed with aqueous spore suspensions of (i) *B. graminis* f. sp. *tritici* alone, (ii) *P. nodorum* blotch alone, (iii) *P. nodorum* followed by *B. graminis* f.sp. *tritici* after 24hr, (iv) *B. graminis* f.sp. *tritici* followed by *P. nodorum* after 24hr, (v) both *P. nodorum* and *B. graminis* f. sp. *tritici* at the same time, and with (vi) water (control). Disease severity and incidence were assessed 7, 15 and 21 days after inoculation. We found that development of powdery mildew and glume blotch symptoms significantly vary depending on the order of inoculation ($P = 0.01$). In the first trial, 15 days after inoculation, glume blotch disease severity were 21% on *P. nodorum* followed by *B. graminis* f.sp. *tritici* inoculated plants, 55% on *P. nodorum* alone inoculated plants, 56% on both *P. nodorum* and *B. graminis* f.sp. *tritici* at the same time inoculated plants, 71% on *B. graminis* f. sp. *tritici* followed by *P. nodorum* inoculated plants, and no disease developed on the control (water sprayed) plants. Similarly, 15 days after inoculation, powdery mildew severity was more than 2-fold on *P. nodorum* followed by *B. graminis* f. sp. *tritici* inoculated plants compared to the other inoculations. The observed variation in the susceptibility of the host in the sequential inoculated plants could be due to host resistance being less efficient in recognizing the mixed infections or the second arriving pathogen may become more aggressive in the presence of another competing species. Several authors suggested that competition among different pathogens for a limited food sources could lead to the evolution of more virulent and aggressive races or to a change in the reproduction rate of the pathogen. Most research on pathogen host interactions are based on inoculations with one type of pathogen, biotroph or necrotroph, but consideration of the interactions between the two is critical for disease prediction and for designing appropriate disease management strategies.