Reduction of Susceptibility of Wheat to Stem Rust (*Puccinia graminis* f. sp. *tritici*) by Brome Mosaic Virus

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ABSTRACT

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Wheat plants (*Triticum aestivum*) cultivar T4 infected with brome mosaic virus (BMV) were found less susceptible to wheat stem rust (*Puccinia graminis* f. sp. *tritici*) infection than virus-free plants were. A progressive decrease in susceptibility to stem rust (as gauged by pustule size and spore yield) occurred with increasing virus concentration in infected tissue. The relevance of this finding to BMV epidemiology and to rust resistance studies is discussed.

The association of brome mosaic virus (BMV) with stem rust of wheat (*Puccinia graminis* f. sp. *tritici*) has been studied in our laboratory for a number of years. The fungus transmits the virus from plant to plant via its uredospores, which implicates it as a natural vector of the plant-pathogenic virus in field diseases of wheat (1,6). While studying the transmission of BMV by the fungus, we noticed that the virus appeared to be a natural antagonist of the fungus because rust infections did not develop well on plants that had been inoculated with virus several days earlier. This paper reports the effect of prior virus infection on development and spore yield of the stem rust fungus.

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MATERIALS AND METHODS

An isolate of BMV from a natural field infection (7) was purified as described by Rybicki and von Wechmar (5). Young wheat plants (*Triticum aestivum* cv. T4) were inoculated at the two-leaf stage with 0.5 mg/ml virus in 0.05 M Na acetate buffer, pH 5.0, using celite as an abrasive. The commercial wheat cultivar T4 (*Sr* gene 24) was selected for its strong susceptibility to both BMV and the local stem rust biotype (W138) used in this study. Inoculated plants were divided into five groups and inoculated with a suspension of nonviruliferous uredospores at 2 mg/ml (w/v) in water at 2, 4, 6, 8, and 10 days post-virus inoculation (pvi), respectively. Rust uredospores were propagated and inoculated as described by Erasmus (1). Uredospores were harvested from plants at 16 days post-rust inoculation (pri) by gently tapping the leaves over a glass petri dish. Collected uredospores were dried overnight in a desiccator containing dry silica gel. Representative leaves were photographed before spore collection (Fig. 1). Yield of dried uredospores from the representative groups was expressed as milligrams of spores per gram of leaves.

RESULTS AND DISCUSSION

A graph of uredospore yield against number of days pvi is shown in Figure 2. Each point represents the average of three dry-weight determinations and each determination is representative of six pots, each containing about 20 plants. Visual comparisons of rust pustule size presented in Figure 1 clearly illustrate a decrease in pustule size with increasing time pvi. Results illustrated in Figures 1 and 2 show that the later the plants were inoculated with rust uredospores, the less susceptible they were to fungal development as assayed both by pustule size and dry spore yield at the same time pri. In a separate experiment, it was shown that virus concentration in mechanically inoculated susceptible barley seedlings reached a peak at 5–6 days.

The antagonistic interaction between BMV and stem rust fungus of wheat appears similar to the interactions between ryegrass mosaic virus (RMV) and *Puccinia coronata* (2), tobacco mosaic virus (TMV) and *Phytophthora parasitica* var. *nicotinianae* (3), and barley yellow dwarf virus and *Erysiphe graminis* DC. f. sp. *hordei* (4). This induced protection of plants against fungus infection is probably due to triggering of protective mechanisms initiated by prior virus infection (3).

The finding that BMV infection had an adverse effect on stem rust infection has significant bearing on the occurrence of stem rust infection of plants in the Orange Free State, South Africa. The relatively low incidence of stem rust infection in the Orange Free State compared with the severe infections that occur regularly in the Western Cape Province (von Wechmar, *personal observation*) could perhaps be attributed to the endemic occurrence of BMV in wheat and natural grasses in this region (7). Because BMV infection is well established in wheat and pasture grasses in this region before the seasonal advent of stem rust infection, it is likely that these BMV-infected wheat plants have an apparent induced protection against stem rust infection. The result would be a low visible incidence of stem rust infection. Because virus infection of plants can have an antagonistic effect on fungus infection, it is important that the possible presence of virus in plants be taken into account when general screening and evaluation is done on plants growing in the field.

With the high priority that breeding for

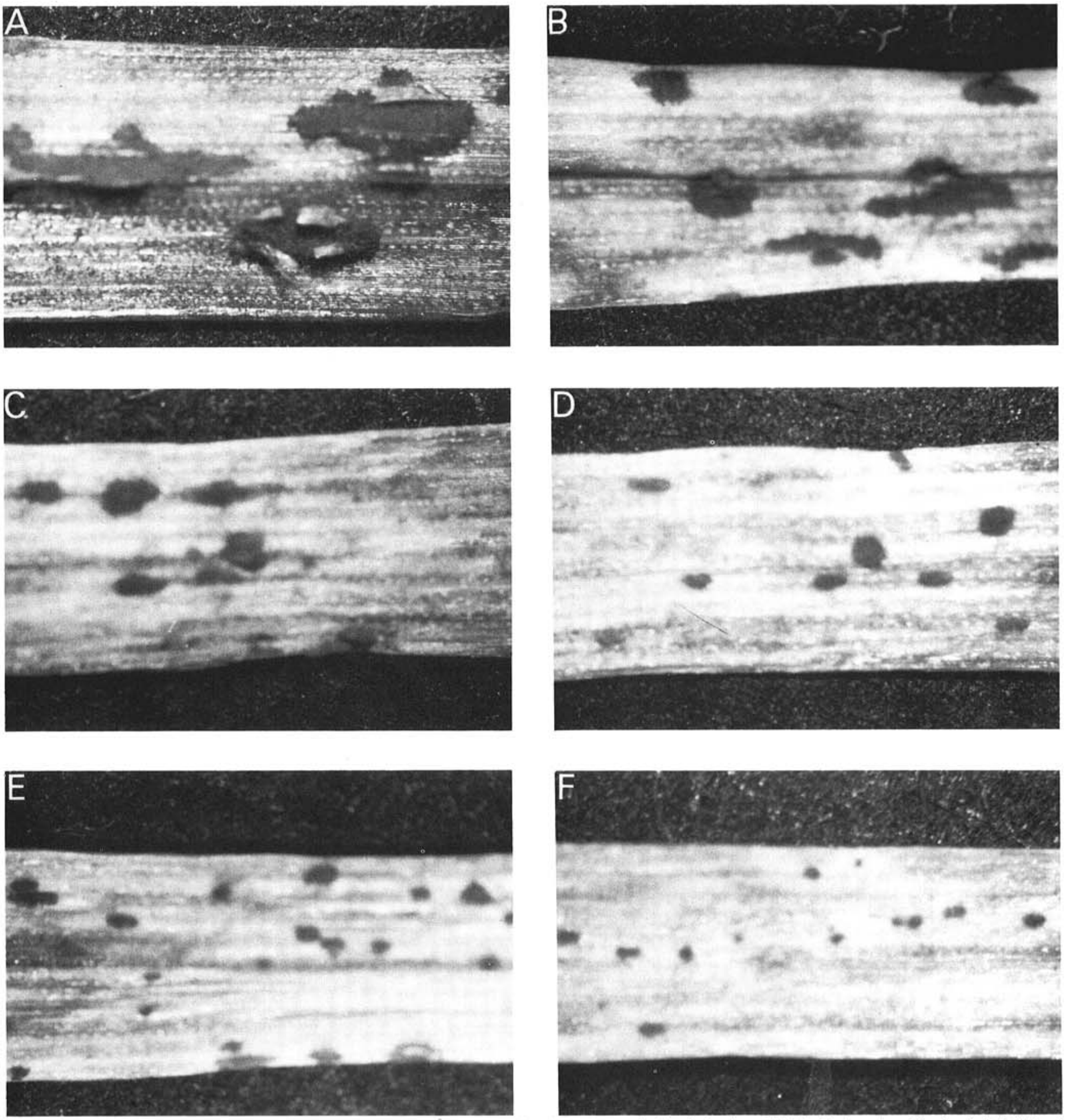

Fig. 1. Reduction in size of uredia of *Puccinia graminis* f. sp. *tritici* caused by brome mosaic virus infection. **(A)** Uredia in a virus-free leaf. **(B–F)** Uredia in leaves infected with BMV 2, 4, 6, 8, and 10 days, respectively, before inoculation with the rust pathogen.

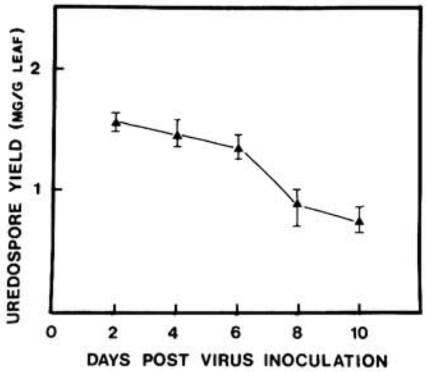

Fig. 2. Effect of brome mosaic virus infection in wheat on the yield of uredospores of *Puccinia graminis* f. sp. *tritici.*

stem rust resistance has in wheat-improvement schemes, it may be worthwhile to reinvestigate the sudden breakdown of resistance to stem rust. A dangerous situation could arise where genetic breeding programs select for stem rust resistance in the presence of BMV and resultant new cultivars are grown in BMV-free regions.

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