EARLY DYING OF POTATOES IN OLD AND NEW FIELDS

by
M. L. Kirkland and M. L. Powelson
Department of Botany and Plant Pathology
Oregon State University, Corvallis, Ore. 97331

Abstract

Potato plant infection by Verticillium dahliae and "early dying" disease were monitored over time in three fields planted to a single seed lot of Norgold Russet. Two plots had been cropped to potatoes for at least four years; the third plot had never been cropped to potatoes. The older plots when compared with the new plot had early onset and rapid increase in "early dying" disease and high apparent infection rates and internal stem populations of V. dahliae, which increased rapidly to high levels. Inoculum density of V. dahliae prior to planting was significantly lower in first-year ground. The infectivity of that inoculum, as indicated by the basic infection rate, was not significantly influenced by potato production history. The earlier onset of "early dying" disease and the rapid increase in symptoms in potatoes cropped to older ground would then appear to be due strictly to a greater inoculum density rather than to increased infectivity of that inoculum.

Introduction

"Early dying" disease of potatoes is characterized by a progressive chlorosis, necrosis and foliar wilt leading to premature senescence, which may result in yield reductions up to 50% in the irrigated circles of Oregon's Columbia Basin. The major pathogen associated with "early dying" of potatoes in Oregon is soil-borne Verticillium dahliae. The syndrome generally is not a limiting factor in fields new to potato production; however, after ca. 3 years of potato production, severe crop losses may be sustained, especially in susceptible varieties such as Norgold Russet, an early-maturing, fresh-market variety which accounts for ca. 20% of the commercial acreage in Oregon.

Materials and Methods

A single seed lot of Norgold Russet was planted at three locations in two of Oregon's major potato-producing regions, the Klamath Basin in southern Oregon plot KF) and the Columbia Basin in north central Oregon (plots RF and EF). The EF plot was in its first year of potato production whereas the KF and RF plots had been previously cropped to potatoes for several years. Each plot contained 17 to 19 sampling units, each consisting of a 6-m length of row with 23 cm within-row and 86 cm between-row spacing. Plots were managed according to the standard farming practices of each locality. Each plot was sampled tri-weekly by randomly pulling 5 to 10 potato stems from within each sampling unit. Surface-sterilized stem sections from 2 to 5 cm above soil-line were plated on streptomycin-ethanol water agar, incubated at 24 C for 7 days and read for incidence of V. dahliae. Internal stem populations were determined by plating two 10 mg samples of ground, dried tissue from within 10 to 15 cm of the stem apex onto Butterfield-DeVay medium. Plates were incubated at 24 C for 14 days and the number of V. dahliae colonies, each presumed to have arisen from a single propagule, were counted.

The inoculum densities of V. dahliae at both the RF and EF plots were analyzed with an Anderson sampler using the technique of Butterfield and DeVay. Twelve soil samples at a depth of 5 to 15 cm were taken from within the plot area immediately prior to planting. The samples were air dried for 4 and 6 weeks, subsampled a total of 10 times, and analyzed to determine the number of V. dahliae propagules per gram of air dried soil.

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Results

"Early dying" disease progress curves at the KF and RF plots were similar to each other, but both differed from the EF plot (Fig. 1). Symptom expression at the KF and RF plots was characterized by an early onset, with 10% "early dying" disease at 61 and 70 days, respectively, from planting, and by a rapid build-up to 90% "early dying" ca. 25 days later. However, at the EF plot, 10% "early dying" did not occur until ca. 94 days from planting with a slower increase to 64% at 152 days from planting. The plants at the KF and RF plots were dead ca. 5 and 8 weeks, respectively, prior to their respective regional harvest time. Conversely, at the EF plot, the plants were still predominantly alive at harvest time (152 days after planting). The same trends existed for potato plant infection by V. dahliae (Fig. 2).

Figure 1. Potato "early dying" disease progress curves at three locations in Oregon.

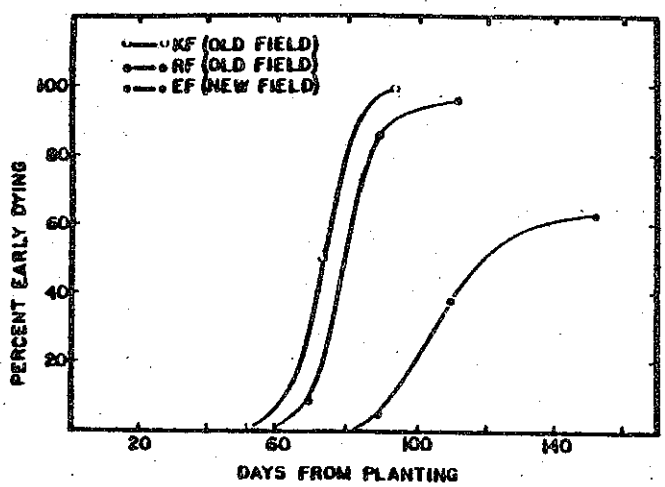
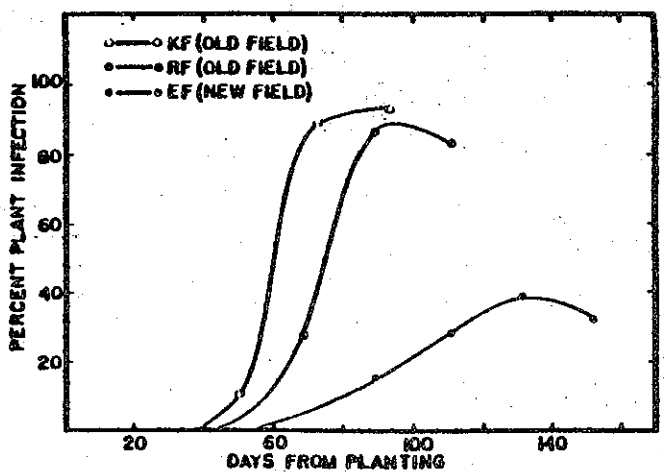


Figure 2. Development of potato plant infection with Verticillium dahliae at three locations in Oregon.



Daily apparent infection rates for V. dahliae at the KF and RF plots were significantly greater than at the EF plot (Fig. 3). For internal stem populations of V. dahliae, the same phenomenon existed: at the KF and RF plots, increase was more rapid and occurred earlier in the season than at the EF plot. In addition, internal stem populations reached much higher levels at the KF and RF plots than at the EF plot (Fig. 4). Growth rates for internal stem populations of V. dahliae were significantly greater at the KF and RF plots than at the EF plot (Fig. 5). Doubling times for internal stem populations at the KF and RF plots were 5.63 and 4.71 days, respectively; whereas at the EF plot, doubling time was 11.90 days, which was significantly greater than at the other plots. At the RF plot the inoculum density for V. dahliae was 14.38 propagules/g soil whereas at the EF plot it was only 1.13 propagules/g soil. As calculated using van der Plank's equation for determining basic infection rate from inoculum density and apparent infection rate, the basic infection rates for the RF and EF plots were 0.0058 and 0.0070 infections/propagule/day, respectively. These rates did not differ significantly from each other.

Figure 3. Daily apparent infection rates (r) for Verticillium dahliae at three locations in Oregon.

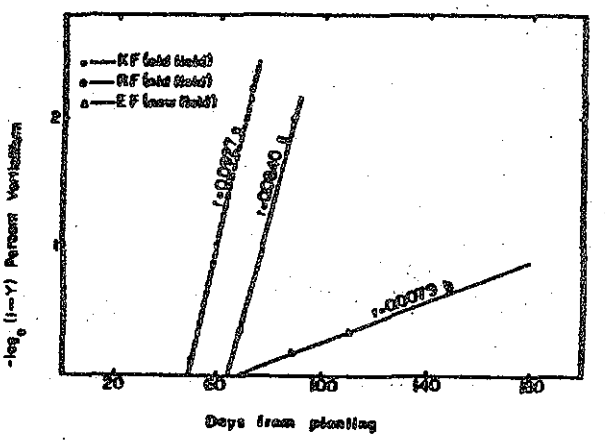


Figure 4. Development of potato internal stem of populations of Verticillium dahliae at three locations in Oregon.

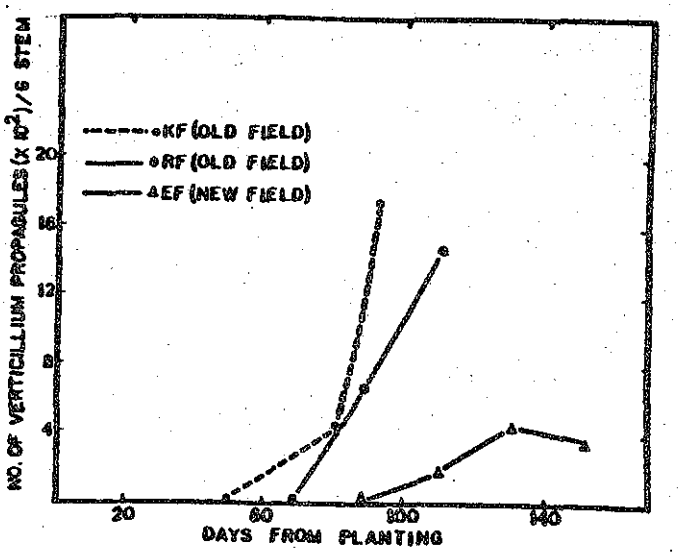
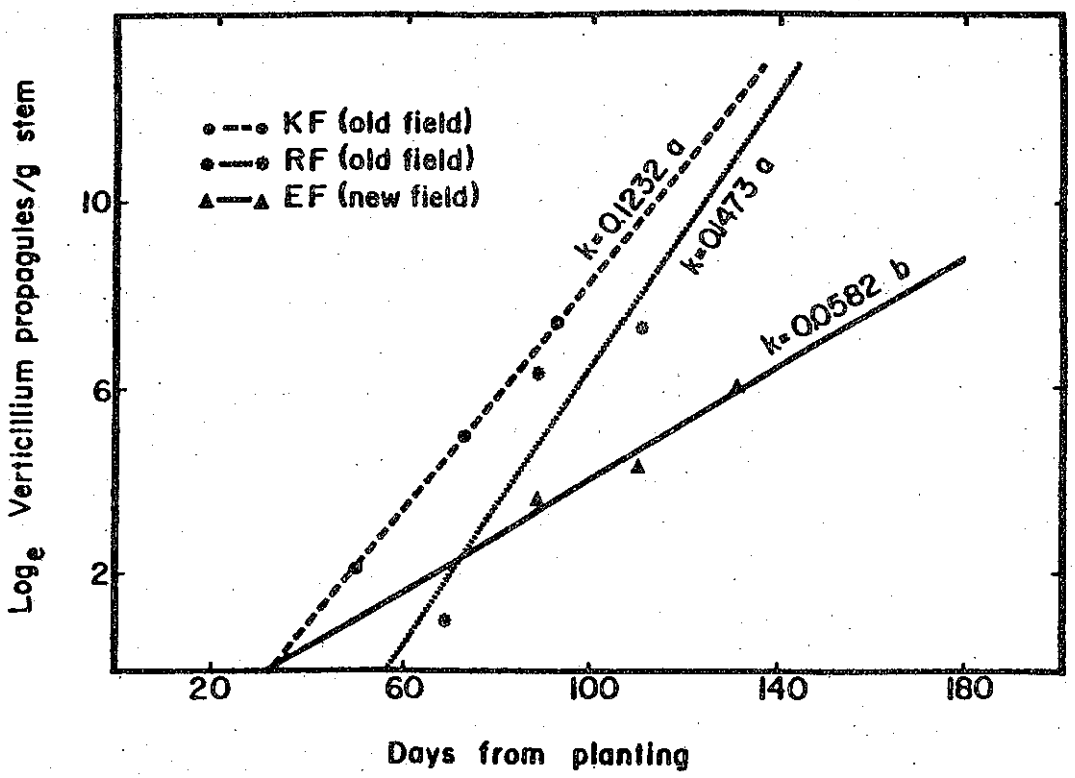


Figure 5. Growth rates for internal stem populations of Verticillium dahliae in potato at three locations in Oregon.



Discussion

"Early dying" disease progress and development over time of incidence and internal stem populations of V. dahliae were not greatly influenced by regional differences between the Columbia and Klamath Basin locations in Oregon, but they were strongly influenced by differences in potato-production history. Although inoculum density of V. dahliae just prior to planting was lower on first-year ground, the infectivity of that inoculum, as indicated by the basic infection rate, was not significantly influenced by potato-production history. The earlier onset of "early dying" and the rapid increase in symptoms in potatoes cropped to older ground would, thus, appear to be due strictly to greater inoculum density rather than to increased infectivity of V. dahliae propagules. As a single seed lot of potatoes was used in the study and dramatic differences occurred between the epidemics on new and older ground, the premise that the primary pathogen is soil-borne as opposed to seed-borne V. dahliae is supported.