CULTURAL PRACTICES AND VERTICILLIUM WILT

by

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SUMMARY

Cultural management can have a significant influence on the suppression of verticillium wilt of potato. Results from two potato growing areas of Idaho have indicated positive correlations between <u>Verticillium dahliae</u> Kleb. populations in soil with the symptom expression of verticillium wilt of the Russet Burbank potato, but not from a third area. This lack of correlation was associated with the influence of cultural management practices. Cultural management practices that involved irrigation and plant nutrition were found to closely correlate with the incidence of Verticillium wilt of the Russet Burbank potato. When compared with sprinkler irrigation, this disease was more severe with gravity-flow (furrow) irrigation, and moisture stress was found to have a significant impact on disease severity -- mostly after flowering. Under conditions of plant stress that resulted from either inadequate nitrogen or phosphorous, the incidence of wilt and V. <u>dahliae</u> colonization in potato stems was shown to increase. In southeastern Idaho cultural variables associated with irrigation, N, K, and P were found to account for 71% of the field variability for this disease.

INTRODUCTION

Verticillium wilt is one of the most severe diseases of potato in the western United States. Depending on severity, time of occurence, and growing season, potato yields and tuber size may be substantially reduced. Yield losses of 50-100 cwt/A are not uncommon (2), and with these losses, the need to develop control procedures is great.

In Idaho and other arid growing regions of the western United States verticillium wilt of potato is caused by <u>V</u>. <u>dahliae</u>. Surveys of field isolates have demonstrated a uniformity of strain type in Idaho and this strain is similar to the non-defoliating strain (SS4) found in cotton (2). Recently Puhalla and Hummel (4) compared this strain with <u>V</u>. <u>dahliae</u> isolates from a worldwide collection and characterized Idaho isolates as belonging to the genetic population P-4. To date, P-4 has only been identified in the Pacific Northwest and Wisconsin and is different from European isolates.

Verticillium wilt of potato can be controlled with resistant genotypes, but marked acceptance of these cultivars has not been widespread.

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We can also control this disease by a variety of fumigation treatments, but these treatments are commonly too expensive to be justified for <u>V</u>. <u>dahliae</u> control alore. The utilization of optimal growing conditions may currently provide us with one of the viable solutions to the verticillium wilt problem in the Russet Burbank potato.

This report describes an attempt to relate the presence of the pathogen $(\underline{V}, \underline{dahliae})$ and cultural management practices to the incidence of the verticillium wilt disease of potato.

MATERIALS AND METHODS

Over a period involving several years, surveys from 159 potato fields were conducted throughout potato growing areas of Idaho. Collections were made from potato fields that had been planted with the "Russet Burbank" potato cultivar on similar planting dates. Soil samples were obtained from each location for assays of inoculum and petioles were collected and dried prior to 12 July. The incidence of stems with verticillium symptoms was determined in each field within the area from which soil samples were taken. Within this same area stems were collected Nutrient evaluations and electrical conductivity forV. dahliae assays. determinations were made by analytical services, Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow. Verticillium dahliae colonization of stem tissue and the survival of <u>Verticillium</u> spp in soil were evaluated by previously described methods (1, 3). To determine the effect of N-level on V. dahliae, replicated plots in a gravity-irrigated field were designed to evaluate the effect of N-levels ranging from 0 to 300 lbs/A and a pictume-dichloropropene mixture (Telone C $^{\rm N}$) at 30 gpa. Similarly, the effect of P-level on verticillium wilt was evaluated with replicated treatments of various P-levels in a field having high levels of V. dahliae (~40 cfu/gm of air-dried soil) and low residual levels of P (~2.5 ppm P in soil).

RESULTS AND DISCUSSION

Fields were initially sampled in the eastern, central and western areas of southern Idaho, representing three growing areas across the state. With this investigation the colony forming units (cfu) per gram of soil ranged from 0 to 106, and depending on area, inoculum density (ID) of V. dahliae was found to correlate with the severity of verticillium wilt. Among fields from the west and central regions, ID was found to correlate with wilt incidence, but not from the east -- a region with the highest ID levels. Within the east there occurred certain fields with high ID levels (>100 cfu/gm of soil) that did not develop a wilt problem. Cultural management practices that involved irrigation and plant nutrition were closely related to the incidence of verticillium wilt. Results consistently showed the method of irrigation to correlate with either wilt severity or with V. dahliae stem colonization (>disease with gravity-flow irrigation when compared with irrigation by sprinkler). Moisture stress was similarly found to have a significant impact on disease severity (2) -- mostly after flowering.

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Soil electrical conductivity (EC), NO_3 , K and P in petioles accounted for 71% of field variability related to V. <u>dahliae</u> colonization in potato stems -- greater colonization with higher EC and less with higher NO_2 , K, and P.

The Russet Burbank potato possesses a moderate degree of field resistance to <u>V. dahliae</u>. In potato fields that have been cropped for several years with potato, the first line of defence against verticillium wilt in Russet Burbank potatoes is optimum irrigation and soil fertility. By favoring this variety, resistance to V. dahliae is also favored.

It requires a good, well-balanced cultural management program to produce a Russet Burbank potato that can resist this disease. Although NO_3 , K, P, and EC have been shown to be closely associated with disease severity in one area, these relationships may not necessarily be the same in all areas. The factor(s) may vary by region.

An additional survey study demonstrated the importance of nitrogen as a key limiting factor. When 37 fields were selectively surveyed within a region where the disease was most severe and ID levels in soil were the highest (32-452 cfu/gm of soil), the availability of N was found to be most closely associated with wilt incidence and V. dahliae stem colonization.

In this area growers that were using anhydrous ammonia appeared to be suppressing the problem (2). When forms of nitrogen were compared in this growing region at 150 lb N/A $[NH_4 NO_3, Urea, NH_3 (anhydrous), (NH_4)_SO_4]$ treatment with NH₃ was found to provide a significant increase of petiole N-fevel. The normal mode of NH₃ application (involving a deeper incorporation depth than granular-applied fertilizers) probably resulted in better N distribution throughout the soil profile. It is doubtful that this same relationship could result in the presence of sprinkler irrigation.

With higher petiole N-level (21,200 ppm on 5 July), the disease was significantly reduced when compared to treatments that produced lower N-levels (12,400 to 14,900 ppm on 5 July).

With lower N treatments, V. <u>dahliae</u> inoculum levels were found to be closely related to wilt severity. The degree of the pathogen's colonization in stem tissue correlated with both symptom expression and petiole N-levels. Treatments were found to have no direct effect on soilborne inoculum.

There are many examples to indicate effects of N on wilt severity. Table 1 compares the effect of increased N availability and soil fumigation on wilt reduction, V. dahliae suppression, and potato yield.

The availability of P has also been shown to influence verticillium wilt of potato. When comparisons of P levels below and above 20 ppm were compared, the differences were clearly evident. With P deficiency, the verticillium wilt disease was shown to be more severe. The severity of wilt increased when the P level in soil was below 11.4 ppm. Above this level, the disease was less severe.

It is possible that close attention to cultural management practices may ultimately provide the most effective economic approach for the suppression of verticillium wilt of potato. The possibilities for success and greater cash return are many.

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LITERATURE CITED

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a server a support de la construcción de la construcción de la construcción de la construcción de la construcci La construcción de la construcción La construcción de la construcción La construcción de la construcción La construcción de la construcción Table 1. Relationships of nitrogen and fumigation treatments to Verticillium wilt severity and yield of Russet Burbank potato.

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US NA LUNIGALION	total N in petioles <u>l</u> /	petioles with <u>Y</u> . <u>Dahliae</u> 2/	stems with visible wilt $\underline{3}$ /	Yield cwt/A
0 Untreated	1.85 ab ^{4/}	13 a <u>4</u> /	62 a <u>4</u> /	164 a <u>4</u> /
0 DP ³ + 15% chloropitcrin	1.76 a	7 b	31 b	225 ab
50 Untreated	2.18 c	4 bc	42 b	221 ah
50 DP + 15% chloropicrin	2.40 d] C		22A 2
00 Untreated	2.43 d	3 hr		3 4 2 C
00 DP + 15% chlorobicrin	2.54 d	, , ,		ZII AD
		- -	17 C	254 b

periores/treatment collected 5 August. 3

>75% of stem with symptoms ranging from severe yellowing to death. 3

Different letters within columns denote significant differences at P=0.05. 4

Dichloropropene. S

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