EARLY STUNTING OF NORGOLD RUSSET POTATO 1/

by
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SUMMARY

In 1977 an early stunting of Norgold Russet potatoes occurred in fields planted in February or early March, but rarely in fields planted after about April 15. Some seed sources showed more stunting than others. To reduce this stunting problem, Norgold Russet potatoes should be planted when the soil temperature is increasing and at least 47°F at the 8-inch depth.

INTRODUCTION

Since 1973 we have observed plants of Norgold Russet potatoes in a few fields that were chlorotic (yellowed), stunted and non-productive as if nitrogen deficient. The roots generally were not rotted and were well anchored. Usually the seed pieces were rotted and the internal one to two inches of stem tissue above seed piece attachment was discolored. Such fields had from 0 to 15% black leg caused by _Erwinia atroseptica_ and _Erwinia carotovora._ Supposedly additional nitrogen and other major or minor elements applied after stunting did not improve growth of the stunted plants.

Fields where stunting occurred usually had been planted in February or early March in sandy loam soils and had been irrigated frequently before plant emergence with center pivot sprinklers to prevent wind erosion. It was generally assumed that either not enough nitrogen had been applied or that the nitrogen applied had been leached by excess early irrigation or lost with eroded soil in spring wind storms.

In 1977, early stunting occurred in many fields throughout the Columbia Basin in both fine- and coarse-textured soils and in sprinkled as well as rill irrigated fields. Plants from some seed lots showed more stunting than those from other seed lots. One lot had both healthy and stunted plants. Some of these lots with stunted plants reportedly yielded only 3 to 6 T/A compared to a normal yield of 16 to 23 T/A.

One common factor in fields with stunted plants was that all were planted early-- in February or early March. Stunting was not observed in commercial fields of Norgold Russet planted after about April 15. There was no stunting in the 73 lots of Norgold Russets planted as whole tubers the first week of May in the Seed Lot Trials, WSU Royal Slope Farm, even though only 100 lb N/A was applied.

METHODS AND MATERIALS

Fifty stems from early stunted Norgold Russet plants were collected from each of 7 fields. The stems were washed in running tap water and disinfected for 15 minutes in 15% Clorox R (0.007875 sodium hypochlorite). Four 1/4-inch thick cross sections from each stem were aseptically transferred to various media to determine presence of pathogenic organisms.

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Media used were: streptomycin alcohol media (2) for isolation of Verticillium albo-atrum, microsclerotial tupe; Stuart's media (7) for isolation of Erwinia spp. bacteria and Komada media (5) for isolation of Fusarium spp. Incubation of all media was at room temperature (70-72^{o}F).

RESULTS

Fusarium spp. were isolated from 5 out of 7 fields tested in 2 to 40% of the stems (Table 1). Four out of 5 fields had Verticillium albo-atrum in 4 to 48% of the stems. Two out of the 5 fields had Colletotrichum spp. in 2 to 12% of the stems. Erwinia spp. were isolated from 5 out of 7 fields in 10 to 50% of the stems. Unidentified bacteria and fungi were found in stems from all the fields.

Both pathogenic and nonpathogenic organisms may infect the host, multiply and reproduce; however, the pathogen causes harm to the host and produces observable symptoms such as yellowing, stunting, wilting and yield reduction. To prove an organism is a pathogen three procedures must be followed. First, it must be isolated repeatedly from the diseased tissue and second, isolates of the suspected pathogen must produce similar disease symptoms when reinoculated into the host and third, the organism must be reisolated. These are the procedures of final proof of the causal relations of pathogens established by Robert Koch in 1876 (4) and those followed by plant pathologists today. This paper deals with only the isolation of suspected pathogens in the stunted Norgold Russet stems. However, the behavior of certain groups of pathogens identified by Koch's procedure is known from past observation and research.

DISCUSSION

Fusarium spp. isolated by this method usually are nonpathogenic. However, they can cause plant wilting especially when the plant is under stress such as a water deficiency. It is not known if plants in the fields investigated were ever under moisture stress. Internal stem tissue in some stems from stunted plants was brown and discolored one to two inches above the seed piece attachment, but did not have the intense browning and reddening in the xylem associated with Fusarium wilt.

Verticillium wilt can cause wilting but normally not for 2 to 2 1/2 months after planting (3). It is doubtful that this organism, even though isolated from Norgold Russet stems, caused the early stunting.

Colletotrichum spp. fungi are generally considered nonpathogenic to potato. However, Collectotrichum atramentarium may infect potato stem and root tissue. It causes yellowing of lower leaves, severe root rotting and accelerates wilt symptom expression of Verticillium wilt (1). Since roots of stunted plants in all 7 fields did not appear rotted and only stems from two fields had Collectotrichum spp. it is doubtful that this organism caused this stunting.

Erwinia spp. such as Erwinia atroseptica and Erwinia carotovora cause both blackleg of plant stems and soft rot of tubers. Other Erwinia spp. are usually nonpathogenic to potato. Severe stunting of potato plants has never been reported to be caused by infection with these organisms. We purposely collected stems from stunted plants that were not expressing black leg symptoms. However, stems from 5 out of 7 fields were 10 to 50% infected with Erwinia spp., while in 2 fields we isolated no Erwinia spp. from the stems. Practically every seed piece under the stems collected was decayed, probably from Erwinia spp., or other soft rot bacteria. Erwinia spp. may have rotted the seed pieces and been transported upward into the vascular system of the stems, but we question whether they caused the stunting since we were not able to isolate Erwinia spp. from stems collected in two of the fields.

Unidentified organisms were saved for further pathogenic studies in the greenhouse.

Known fungal or bacterial pathogens do not become active at soil temperatures near or below 40^{o}F such as might occur in February or early March. However, these low temperatures may be predisposing the seed pieces or young sprouts to fungal or bacterial infection later when temperatures are more condusive to infection.

This irreversible plant stunting may be caused by an unidentified virus, viroid, or mycoplasma, expression of which occurs only at low temperatures. Potato stunt viruses which express plant or leaf symptoms have been reported in the U. S. A. and Scotland (6).

To avoid this stunting problem potatoes should be planted when the soil temperature is increasing and at least 47^{o}F at the 8-inch depth.

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Table 1. Organisms isolated from stems taken from stunted Norgold Russet potato plants.

Field Number	% stems with the following organisms[1/]					
	Fusarium spp.	Colletotrichum spp.	Verticillium albo-atrum (microsclerotial type)	Unidentified fungi	Erwinia spp. bacteria	Unidentified bacteria
1	0	--[2/]	--	28	22	30
2	2	12	4	56	12	26
3	40	--	--	4	16	16
4	40	0	0	32	50	24
5	0	2	48	84	10	20
6	4	0	16	48	0	50
7	14	0	44	78	0	68

[1/] Isolations from 50 stems per field, see text for media used.

[2/] Data not collected.