SUMMER 2001
RESEARCH IN PROGRESS

Extension Potato
Disease Control Project

Richard Zink & Robert Davidson
Colorado State University
SLV Research Center

2001 POTATO - EARLY BLIGHT FUNGICIDE TRIALS

Researchers: Richard T. Zink, Extension Potato Specialist, and Andrew Houser, Research Associate, Colorado State University, San Luis Valley Research Center, Center, CO

Location: San Luis Valley Research Center, Center, CO

Applications: All treatments applied using an R & D CO_2 charged tractor mounted plot sprayer with four 8002VS nozzles spaced seventeen inches apart at 60 psi pressure and applying 40 gallons per acre water as a broadcast application.

Spray Dates:

Plot Design: Randomized complete block
Planted: May 17, 2001
Plot Size: 4 – 20 foot rows per treatment, treatments applied to center two rows and data taken on two center rows
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Cultivar: Russet Nugget, cut seed, 2-4 oz
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer:

Herbicide:
Insecticide:
Vinekill:
Harvested:

DATA:
Disease: Early blight disease incidence based on percent leaves infected, readings taken weekly starting
Yield: 2 – 20 foot rows per treatment per replication expressed as cwt/A
Grade: Percent tubers by weight under 4 oz, 4-10 oz, over 10 oz, U.S. no. 2, and culls

Summary

2001 POTATO FUNGICIDE TRIALS
Colorado State University
San Luis Valley Research Center
Center, Colorado
All programs started on July 9, 2001

Program	Products	Rate	Itinerary/Week
1	Control, no treatment		
2	Kocide 2000	3.0 lb/A	1,2,3,4,5,6,7,8
3	Bravo Ultrex	0.7 lb/A	1,2,3,4,5,6,7,8
4	F500 (Headline)	6.1 floz/A	2,4,6
	Bravo Ultrex	0.7 lb/A	1,3,5,7,8
5	F500 (Headline)	6.1 floz/A	2,4
	Bravo Ultrex	0.7 lb/A	1,3,5,6,7,8
6	F500 (Headline)	9.2 floz/A	2,4,6
	Bravo Ultrex	0.7 lb/A	1,3,5,7,8
7	F500 (Headline)	9.2 floz/A	2,4
	Bravo Ultrex	0.7 lb/A	1,3,5,6,7,8
8	F500 (Headline)	6.1 floz/A	2,4,6
	Polyram	2.0 lb/A	1,3
	Polyram + Super Tin	2.0 lb/A + 2.5 oz/A	5,7,8
9	F500 (Headline)	9.2 floz/A	2,4,6
	Polyram	2.0 lb/A	1,3
	Polyram + Super Tin	2.0 lb/A + 2.5 oz/A	5,7,8
10	Polyram 80DF	2.0 lb/A	1,3,5,7,8
	Quadris	6.2 oz/A	2,4,6
11	Polyram 80DF	2.0 lb/A	1,3
	Quadris	6.2 oz/A	2,4
	Polyram 80DF+ Super Tin	2.0 lb/A + 2.5 oz/A	5,6,7,8
12	Polyram 80DF	2.0 lb/A	1,3
	Quadris	6.2 oz/A	2,4
	Polyram 80DF + Acrobat 50WP	2.0 lb/A + 6.4 oz/A	5,6,7,8
13	Dithane Rainshield	2.0 lb/A	2,4,6
	Quadris 2.08F	6.2 oz/A	1,3,5
	Gavel 75DF	2.0 lb/A	7,8
14	Gavel 75DF	2.0 lb/A	2,4,6,7,8
	Quadris 2.08F	6.2 oz/A	1,3,5
15	Bravo Ultrex	0.7 lb/A	2,4,6,7,8
	Quadris 2.08F	6.2 oz/A	1,3,5
16	Curzate + Manzate	3.33 oz/A + 24 oz/A	1,2,3,4,5,6,7,8
17	Curzate + Bravo Ultrex	3.33 oz/A + 1.4 lb/A	1,2,3,4,5,6,7,8
18	Equus DF	0.7 lb/A	1,2,3,4,5,6,7,8
19	GX – 687	1.5 pt/A	1,2,3,4,5,6,7,8
20	Rovral 4	1.5 pt/A	1,2,3,4,5,6,7,8
21	Manex II	1.6 qt/A	1,2,3,4,5,6,7,8
22	Manex II + Super Tin	1.6 qt/A + 2.5 oz/A	1,2,3,4,5,6,7,8
23	Dithane Rainshield	2.0 lb/A	1,3,6
	Quadris 2.08F	6.2 oz/A	2,4
24	Dithane Rainshield	2.0 lb/A	3,7
	Quadris 2.08F	6.2 oz/A	1,5

2001 PROTOCOL FOR EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF RHIZOCTONIA ON POTATO

Researcher: Richard T. Zink, Extension Potato Specialist, and Andrew Houser, Research Associate, Colorado State University

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah, cut seed, 2-4 oz

Treatments:

1. Control, no treatment
2. A12534 on seed + Quadris, 1.5 ozai/A
3. A12777 on seed + Quadris, 1.5 ozai/A
4. Moncut 50W, 1.0 lb/A
5. Moncut 50W, 1.5 lb/A
6. Moncut 50W, 1.0 lb/A + 5pt. Blocker
7. Blocker 10G, 25 lb/A + Firbark Mancozeb
8. Blocker F, 7.5 pt/A + Firbark Mancozeb
9. Blocker F, 10.0 pt/A + Firbark Mancozeb
10. Maxim MZ on seed
11. Tops MZ on seed

Application: Treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one 8002 nozzle, at 10 gallons/acre as a directed in-furrow application.

Planted: May 16, 2001

Plot Design: Randomized complete block

Plot Size: 1 - 25 foot row/treatment/replication

Plant Spacing: 12 inches

Row Spacing: 34 inches

Replications: Four

Irrigation: Solid set sprinkler, rate based on ET

Fertilizer:

Herbicide: Dual Magnum, 1.33 pt/A + Matrix, 1.5 oz/A

Fungicide:

Vine killer:

Harvested:

DATA

Disease: Percent of stems infected and tubers after harvest by percentage of affected surface area and severity of the sclerotia.

Stand: 1-25 foot row/treatment/replication, counts taken about 30 days after planting.

Seed Piece Decay: Soft-rot and dry-rot combined rated 1-100, 0 = no decay and 100 = complete decay; 5 seed pieces/treatment/replication.

Rhizoctonia stem canker: Percent stems infected; 5 plants/treatment/replication.

Blackleg: Percent stems infected; 5 plants/treatment/replication.

Plant vigor: Rated 1-4; 1 = poor and 4 = good; 5 plants/treatment/replication.

Stems: Average number of stems per plant; 5 plants/treatment/replication.

Yield: 1-20 foot row per/treatment/replication, total yield expressed in cwt/A.

Grade: By hand, percent tubers by weight < 4 oz, 4-10 oz, > 10 oz, misshapen, and culls.

Black scurf severity index: Mean percent of affected tuber surface area, 10 tubers per treatment per replication. multiplied by the severity of the sclerotia, where 1= small sclerotia and 3 = large sclerotia.

2001 PROTOCOL FOR EVALUATION OF SEED PIECE TREATMENTS FOR CONTROL OF SEED PIECE DECAY ON POTATO

Researchers: Richard T. Zink, Extension Potato Specialist, and Andrew Houser, Research Associate, Colorado State University, San Luis Valley Research Center

Location: San Luis Valley Research Center, Center, CO

Objective: To evaluate the efficacy of various seed piece treatments in preventing disease and seed piece decay.

Treatments: All treatments applied directly to fresh cut seed and planted within twenty four hours

1. Control, no treatment
2. Maxim MZ
3. Tops MZ
4. Evolve
5. A12778
6. A12534
7. A12777
8. A12919
9. PCC553
10. PCC553-1
11. PCC553-2
12. PCC553-3

Plot Design: Randomized complete block
Planted: May 16, 2001
Plot Size: 1 - 25 foot row per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Cultivar: Russet Norkotah, cut seed, 2-4 oz
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer:
Herbicide: Dual Magnum, 1.33 pt/A + Matrix, 1.5 oz/A
Insecticide:
Fungicides:
Vine killer:
Harvested:

DATA

Disease: Percent of stems infected and tubers after harvest by percentage of affected surface area and severity of the sclerotia.
Stand: 1-25 foot row/treatment/replication, counts taken about 30 days after planting.
Seed Piece Decay: Soft-rot and dry-rot combined rated 1-100, 0 = no decay and 100 = complete decay; 5 seed pieces/treatment/replication.
Rhizoctonia stem canker: Percent stems infected; 5 plants/treatment/replication.
Blackleg: Percent stems infected; 5 plants/treatment/replication.
Plant vigor: Rated 1-4; 1 = poor and 4 = good; 5 plants/treatment/replication.
Stems: Average number of stems per plant; 5 plants/treatment/replication.
Yield: 1-20 foot row per/treatment/replication, total yield expressed in cwt/A.
Grade: By hand, percent tubers by weight < 4 oz, 4-10 oz, > 10 oz, misshapen, and culls.
Black scurf severity index: Mean percent of affected tuber surface area, 10 tubers per treatment per replication. multiplied by the severity of the sclerotia, where 1= small sclerotia and 3 = large sclerotia.

2001 PROTOCOL FOR EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF PINK ROT ON POTATO

Researchers: Richard T. Zink, Extension Potato Specialist, and Andrew Houser, Research Associate, Colorado State University

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah, cut seed, 2-4 oz

Treatments:
1. Control, no treatment
2. Ridomil Gold 4EC, 3.23 ozai/A (In-furrow)
3. Ridomil Gold 4EC, 3.23 ozai/A (At hilling)
4. Ridomil Gold 4EC, 3.23 ozai/A + Ridomil Gold Bravo 76.5 WP, 1.5 lbai/A
5. Quadris 2.08 SC, 2.4 ozai/A + Ridomil Gold Bravo 76.5 WP, 1.5 lbai/A
6. A12425, 5.16 ozai/A + Ridomil Gold Bravo 76.5 WP, 1.5 lbai/A
7. A12425, 5.16 ozai/A
8. Ridomil Gold 4 EC, 3.23 ozai/A + Platinum 2 SC, 1.57 ozai/A + Quadris 2.08 SC, 2.4 ozai/A (In-furrow)
9. Ridomil Gold Bravo 76.5 WP, 1.5 lbai/A
10. A12425, 5.16 ozai/A + Quadris 2.08 SC, 2.4 ozai/A
11. Ridomil Gold 4 EC, 3.23 ozai/A + Platinum 2 SC, 1.57 ozai/A + Quadris 2.08 SC, 2.4 ozai/A (At hilling)

Application: In-furrow treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one 8002 nozzle, at 10 gallons/acre.

Planted: May 14, 2001
Plot Design: Randomized complete block
Plot Size: 1 - 25 foot row/treatment/replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer:
Herbicide: Dual Magnum, 1.33 pt/A + Matrix, 1.5 oz/A
Fungicide:
Vine killer:
Harvested:

DATA

Disease: Percent tubers with pink rot at harvest and after harvest by challenge inoculation.
Yield: 1-25 foot row per treatment per replication expressed as cwt/A
Grade: By hand, percent tubers by weight < 4 oz, 4-10 oz, > 10 oz, misshapen, and culls.

2001 PROTOCOL FOR EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF POWDERY SCAB ON POTATO

Researcher: Richard T. Zink, Robert Davidson, and Andrew Houser, Colorado State University

Location: Charlotte Howey's Farm, Center, CO

Cultivar: Cherry Red, whole seed

Treatments:
1. Control, no treatment
2. Fluazinam, 7pt/A In-furrow
3. Fluazinam, 7pt/A 1/3, 1/3, 1/3 at planting
4. Fluazinam, 7pt/A on row top after closure
5. Tops MZ on seed
6. Evolve on seed
7. Moncut 50W, 1.0lb/A In-furrow
8. Moncut 50W, 1.5lb/A In-furrow
9. Moncut 50W, 2.0lb/A In-furrow
10. Manex 5qt/A In-furrow
11. SuperTin 8oz/A In-furrow
12. Quadris 4.5pt/A In-furrow
13. Planting date May 17
14. Planting date May 25
15. Planting date June 1

Application: In-furrow treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one 8002 nozzle, at 10 gallons/acre.

Planted: May 17, 2001
Plot Design: Randomized
Plot Size: 1 - 20 foot row/treatment/replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three
Irrigation: Center pivot sprinkler, rate based on ET
Fertilizer:
Herbicide: None
Fungicide:
Vine killer:
Harvested:

DATA

Disease: Galls on roots rated 0 to 5, 0 = none, 5 = heavily infected, readings taken in August. Percent tubers showing one or more powdery scab lesions at harvest.

2001 PROTOCOL FOR EVALUATION OF ADVANCED CLONES FOR RESISTANCE TO POWDERY SCAB

Researcher:	Robert Davidson, Richard T. Zink, and Andrew Houser, Colorado State University
Location:	Charlotte Howey's Farm, Center, CO
Clones:	1. Kennebec 2. Russet Burbank 3. AC91014-2RU 4. AC89536-5RU 5. AC89653-3W 6. AC87079-3RU 7. AC87138-4RU 8. CO85026-4RU 9. CO86218-2R 10. CO89097-2R 11. AC87340-2W 12. BC0894-2W
Planted:	May 17, 2001
Plot Design:	Randomized
Plot Size:	1 - 20 foot row/treatment/replication
Plant Spacing:	12 inches
Row Spacing:	34 inches
Replications:	Three
Irrigation:	Center pivot sprinkler, rate based on ET
Fertilizer:	
Herbicide:	None
Fungicide:	
Vine killer:	
Harvested:	

DATA

Disease:	Galls on roots rated 0 to 5, 0 = none, 5 = heavily infected, readings taken in August. Percent tubers showing one or more powdery scab lesions at harvest.

I. A. **Project Title:**

Utilization of Compost Made from Agricultural and Forestry Wastes for Improving the Economic and Ecological Sustainability of Agronomic Crop Production on Low Organic Matter Soils in the San Luis Valley of Colorado.

B. **Submitted to:** SARE: USDA/CSREES Sustainable Agriculture Research & Education program.

C. **Funding:**

	Requested Funds	Matching Funds
First Year Funding Request:	$46,798	$49,478
Second Year Funding Request:	$42,489	$37,927
Third Year Funding Request:	$51,129	$42,271
Total Funding Request:	$140,416	$129,676

D. **Project Contact:**

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Farmers
Alfalfa Growers: Louie Entz, Alamosa County; George Kirkpatrick, Alamosa County
Potato/Barley Growers: Lyle Nissan, Alamosa Co.; Lynn McCullough, Rio Grande Co.

I. **Resubmitted Proposal:** No previous proposal has been submitted.

II. **PROPOSAL SUMMARY** - **Title:** ***Utilization of Compost Made from Agricultural and Forestry Wastes for Improving the Economic and Ecological Sustainability of Agronomic Crop Production on Low Organic Matter Soils in the San Luis Valley of Colorado.***

The main objective of this SARE proposal is to improve water conservation and the sustainability of agronomic crop production on the low organic matter soils of the San Luis Valley (SLV) of Colorado. Through on-farm demonstrations this project will examine the impact field incorporating compost made from agricultural and forestry wastes has on: 1.) the potential for reducing the use of synthetic fertilizers and fungicides, by improving nutrient retention in the root zone and the health and diversity of the soil's biomass, 2.) the potential for improving water utilization and thereby reducing water and power use in center-pivot irrigation systems; 3.) crop yields and costs of production for potatoes, barley and alfalfa.

Two agricultural waste streams, sawdust and cull potatoes, being generated in the SLV have become problematic for their local industries. Logs harvested from the National Forests surrounding the valley are milled locally, generating sawdust for which there are very few feasible uses. In a 1997 Colorado State University (CSU) survey of western Colorado mill operators, the second most mentioned problem, was that of mill residues (sawdust).[1] Most of this sawdust has been just stacking up at locations near the mills. Potatoes are the valley's most economically important crop, and the foundation of the local economy. On average about 9.6% of each year's potato crop is not marketable, due to size, appearance or presence of disease.[2] These cull potatoes have become particularly problematic, since the devastating disease late blight (*Phytophthora Infestans*) is now present in the valley. Late blight spores from cull piles of infected potatoes can be transported by air to infect the new growing crop, repeating the disease cycle. Research conducted in Maine has demonstrated that properly managed, hot aerobic composting of cull potatoes with sawdust will destroy disease pathogens and produce an excellent soil conditioner, with each ton of fresh compost containing 12 lbs of nitrogen, 4 lbs of phosphorus, 9 lbs of potash, 18 lbs of calcium and about 400 lbs of organic matter.[3] The sustainability of most soils used for crop production in the SLV would be improved by the addition of this compost. Sawdust and cull potatoes are produced in the SLV on a fairly consistent basis, in close proximity to one another, and in quantities complimentary to what is needed for hot aerobic composting using the basic Maine recipe and methodology.[4] While making the compost is logistically possible, there is no established local end market for the compost, and the SLV's isolated location makes it cost prohibitive to ship to more distant markets. Local growers are reluctant to purchase and apply compost because they are trying to minimize production costs after several years of receiving low market prices, and they fear that they may be introducing disease into their crop through the compost. They don't recognize the long-term productivity gains that can be realized by improving their soils with compost.

The objectives of this project are to develop local end markets for agricultural and forestry wastes while improving the sustainability of agronomic crop production in the San Luis Valley by demonstrating the impact compost applications have in typical cropping rotations of potatoes/barley, and continuous alfalfa. The project will examine and report on changes in the diversity of the soil's microbiology and biomass, disease levels in the crops, use of fertilizers and pesticides, water utilization, nutrient retention in the root zone and net economic value of compost applications.

Results will be disseminated to farmers in the SLV to encourage the adoption of applying compost to low organic matter soils. Field tours will be given. Results will be presented at CSU's Forage & Livestock Conference and Potato-Grain Conference. Following Years 2 & 3 summary bulletins will be developed and mailed to SLV producers, and be posted on the CSU Website. Articles on the results will also be printed in the *Spud Items* newsletter of the Colorado Potato Administrative Committee.

PROPOSAL TO THE AGRICULTURE RESEARCH FOUNDATION - 2001
FOR THE SLV RESEARCH CENTER COMMITTEE AND THE
COLORADO POTATO ADMINISTRATIVE COMMITTEE (AREA II)

TITLE: Biology and Management of Columbia Root-knot Nematodes (*Meloidogyne chitwoodi*) of Potato in the San Luis Valley, Colorado

PROJECT LEADERS:

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PROJECT JUSTIFICATION:

Potato producers are required to control numerous plant pathogens present within fields in order to maintain the highest quality product. Although Columbia root-knot nematode (*Meloidogyne chitwoodi*) is not visible to the naked eye, the symptoms of their presence in tubers can not be mistaken. Nematodes developing within the tuber cause bumps (galls) on the tuber surface and minute brown spots inside the tuber as deep as the vascular ring. Both symptoms are considered a quality defect and cause for the tuber to be culled. Even a small percentage of culls within a crop may cause that crop to be devalued or rejected by buyers. While the Pacific Northwest (PNW) region has been dealing with the Columbia root-knot nematode for many decades, the San Luis Valley region of Colorado is relatively new to the problems caused by this pest. Although the presence of the nematode has been known for many years (Pinkerton and McIntyre 1987), the number of fields infested and severity of infestations appear to be increasing with time. Since tuber infection is a function of nematode density, which is dependent on soil temperature, tuber damage is much more severe in warmer growing seasons. If several warm seasons should occur in succession, the problem could be come very serious. Unfortunately, very little research has been conducted on the biology of *M. chitwoodi* in the SLV or on management procedures that are appropriate for this region.

Columbia root-knot nematode is controlled by fumigation in most areas of the PNW. Since most of these fields are infested with *Verticillium dahliae* (the major cause of early dying disease) as well as nematodes, the industry standard has become a double fumigation with metam sodium, which controls *Verticillium* but not nematodes, and Telone, which controls nematodes but not *Verticillium.* However, since the SLV generally has a shorter, cooler, growing season than other areas where Columbia root-knot nematode is found, less intensive measures may be adequate for control in the SLV.

In recent years, the control strategy for root-knot nematode in the SLV has been a fall application of metam sodium alone. This procedure is expensive (up to $175/acre), results in large amounts of pesticide (162 lb a.i./acre) added to the soil, and may non-selectively kill beneficial organisms as well as plant pathogens. Spring applications of metam sodium are not possible in the SLV due to the time required between application and planting and the short growing season. Consequently, if a field is not treated in the fall, control strategies are severely limited.

Recent research in the PNW has indicated that Vydate (oxamyl) may be effective in areas with low to moderate population pressure of *M. chitwoodi*. Vydate is currently the only nematicide registered for use on potato after emergence, and the only control option if nematodes are found after planting. Vydate is not a fumigant, but rather a "nonfumigant" nematicide, which also functions as a nematostat at lower concentrations. A "nematostat" will disorient a nematode and prevent infection without killing the nematode on contact. While Vydate has some systemic activity, it is most effective on soil-dwelling nematode stages which, for root-knot nematodes are the second stage juveniles (J2) and males, which are rare and do not damage tubers.

Periodic applications of Vydate through overhead sprinklers have proven effective in controlling root-knot nematodes when following a fumigant in the PNW. Adequate control of root-knot nematode may be accomplished by using Vydate alone in cooler growing regions, such as the SLV. Vydate is also effective on stubby-root nematode (*Paratrichodorus allius*), which vectors tobacco rattle virus to cause corky ringspot disease, and root-lesion nematodes (*Pratylenchus* spp.) that can be associated with early dying. Interestingly, Vydate is also an excellent insecticide and provides good control of aphids. Therefore, a nematode management strategy using Vydate may not need additional insecticide applications, so the comparison in cost with a fumigation management strategy should be the cost of metam sodium <u>plus</u> insecticides compared to the cost of Vydate treatments without additional insecticides. This may represent a substantial cost savings to the grower in combined nematode-insect management.

In order to achieve maximum control using Vydate, it is essential to know when the first generation of eggs hatch and release J2 into the soil, when subsequent generations hatch, and how many generations of nematodes are produced. This information can be determined by sampling for population dynamics and then can be predicted by a soil temperature degree-day model. Since Vydate has a relatively short half-life, periodic applications are required to maintain suppression of root and tuber infection. However, the optimum number of applications, timing of applications and the rate required to minimize cost and maximize control is not known. Furthermore, since the SLV has such a cool, short growing season, there may be a threshold level of *M. chitwoodi* density below which damage would not occur even if left untreated.

The purpose of this project is to benefit the potato growers in the San Luis Valley by specifically tailoring nematode research to the San Luis Valley. This will be accomplished by observing the population dynamics of Columbia root-knot nematode in the San Luis Valley, determining the threshold density that requires treatment, and determining the most cost-effective treatment, beginning with a Vydate management strategy. As more is

learned about the biology of this pest in the San Luis Valley, more effective, less expensive and/or ecologically sustainable control strategies may be developed.

PROJECT STATUS: New

OBJECTIVES :

1. Determine the density of Columbia root-knot nematodes at which unacceptable tuber damage occurs if left untreated.

2. Determine the density of Columbia root-knot nematode that can be controlled with Vydate alone.

3. Determine the optimum timing and rate of Vydate applications for effective control at the least cost.

4. Determine the effects of storage on nematode development in tubers grown in the San Luis Valley.

5. Monitor population dynamics of Columbia root-knot nematode in relation to soil temperature and develop a degree-day model to predict nematode development for the San Luis Valley.

Additional opportunities to test other products with support from the product manufacturers may also occur once a nematode project is initiated in the region.

PROCEDURES:

Objective 1. Determine the density of Columbia root-knot nematodes at which unacceptable tuber damage occurs if left untreated.

Objective 2. Determine the density of Columbia root-knot nematode that can be controlled with Vydate alone.

A grower's field has been identified that has a wide range in density of Columbia root-knot nematode, including areas with very high populations. The field will be treated commercially with Vydate in 2001, but a wedge of the circle near the pivot road will be left untreated. Immediately after planting, transects will be established in the area not to be treated and an adjacent area which will be treated with Vydate. Nematode samples will be taken from fifty, 20 ft sections of row within each transect to find areas with a wide range of initial nematode density. At harvest, a tuber sample will be taken from 25 of the plots that best represent the range of nematodes recovered at planting in each of the treated and untreated areas. The level of tuber infection (see general methods below) will be determined for each of these plots and related to the initial density recovered. ***Plots with unacceptable damage from the untreated transect will establish the population density above which treatment is required. Population levels which cause unacceptable damage in the Vydate-treated transect will establish the upper population level for which Vydate will be effective.*** This field will be planted to Centennial Russet which has an intermediate growing season length and degree-day accumulation for cultivars grown in the SLV. While we would prefer to be in a field with Russet Nuggets to assess the worst case scenario of a long season cultivar, it was not possible to find a Russet Nugget field with appropriate nematode densities for 2001.

Objective 3. Determine the optimum timing and rate of Vydate applications for effective control at the least cost.

Plots 6 rows wide and 40 feet long will be established in a section of the grower's field that will not be treated and is known to have high nematode densities from previous grid samples. The treatments listed below will be applied to these plots by chemigation through individual sprinkler simulators. Each treatment will be replicated five times in a randomized block design. All data will be collected from the middle two rows.

1. Untreated Control
2. Vydate at 1.0 lb a.i./a at 950 DD_5 and then every two weeks
3. Vydate at 1.5 lb a.i./a at 950 DD_5 and then every two weeks
4. Vydate at 1.0 lb a.i./a at 950 DD_5 and then every 250 DD_5
5. Vydate at 1.5 lb a.i./a at 950 DD_5 and then every 250 DD_5

All treatments will begin at 950 degree-days at a base temperature of 5 C (DD_5). This is the predicted time that the second generation of nematodes begins hatching from eggs. Before this time, nematodes are migrating into roots where they develop and Vydate applications are not considered to be cost effective during this period. Current EPA restrictions limit Vydate applications through chemigation to 1.0 lb a.i./a (2.1 pints Vydate C-LV). Dupont is addressing this issue and their new Vydate label will recommend an application at 1.5 lb a.i./a every two weeks (treatment 3). ***However, since the growing season is cooler and shorter in the SLV than in the PNW, a lower rate of 1.0 a.i./a may be still be adequate for this region (treatments 2 and 4)***. Biologically, it may make more sense to time applications with population development rather than by the calendar. Since generations are completed every 500-600 DD_5, treatments 4 and 5 will be applied at the completion of generations. However, since the half-life of Vydate is short, it may not remain effective for 500 degree-days, so we will also apply an application halfway through the development of each generation. Therefore this strategy results in an application every 250 DD_5. (Degree-days will be monitored with Watchdog data loggers, see objective 5). This degree-day interval may change as we learn more about nematode developmental rates in the SLV. ***The important consideration concerning the two timing models is that better control may result with the degree-day schedule and, in a cool region like the SLV, fewer applications may be necessary than on a two-week schedule***. If the degree-day schedule is superior, a web site can be established that calculates degree-days for growers so they can be advised of the optimum times to treat.

Objective 4. Determine the effects of storage on nematode development in tubers grown in the San Luis Valley.

Preliminary degree-day measurements and generation calculations from 2000 suggest that many potato crops in the SLV may be harvested right at the end of the second generation. This may mean that tubers experience a heavy infection right before harvest, but do not have time to express symptoms. ***Since M. chitwoodi can continue to develop at storage temperatures, tubers placed into storage without symptoms may have symptoms when they are taken out of storage. Therefore, treatment strategies must not only control symptoms expressed at harvest but also prevent infections that may develop and express symptoms during storage.*** To guarantee the treatments we test will satisfy this criteria, two additional tuber samples will be taken from each plot. One sample will be held at ambient temperatures for three weeks to simulate additional degree-days that may accumulate with later harvest and/or a warmer growing season than that experienced during the year of the trial. The last sample will be placed in storage and evaluated for infection the following spring. Temperature data loggers will be placed in the sample bags to record the number of degree-days that accumulate during the storage period.

Objective 5. Monitor population dynamics of Columbia root-knot nematode in relation to soil temperature and develop a degree-day model to predict nematode development for the San Luis Valley.

Since no information on nematode population development in relation to soil temperature exists for the SLV, one of the middle rows of each plot will be sampled on a one- to two–week basis. Just prior to the anticipated completion of the first generation, tuber samples will be collected and shipped to Oregon State University on a weekly basis where they will be sliced and stained to determine when tuber infection occurs and how effective the different Vydate treatments are at preventing tuber infection. Spectrum Watchdog data loggers will be established in the plot and read on a weekly basis to determine cumulative degree-day accumulations. The relation of nematode development with temperature in the SLV will then be compared to that observed from other areas to determine if there is a unique relationship for the SLV.

Routine Methods

Nematode Population Monitoring

Nematode populations will be sampled from of each plot by taking ten cores to 12 in depth from one of the middle rows of each plot and combining these cores into a single sample/plot. Samples will be taken by SLV area cooperators at Agro Engineering and shipped to Oregon State University. Soil samples will be sieved, mixed and nematodes will be extracted from a 250 g subsample by wet sieving-sucrose centrifugation (Jenkins, 1964) as modified in Ingham (1994) and counted at 50X under a dissecting microscope.

Root-knot Evaluations

Root-knot nematode infection will be assessed by examining three sets of 25 randomly selected 6-10 oz tubers from each plot. One sample will be evaluated immediately after harvest. Another sample will be evaluated three weeks later to simulate further development during a longer or warmer growing season. The last sample will be placed in storage and evaluated in the spring. Each tuber to be evaluated will be peeled under a magnifying lamp to count the number of nematode infection sites. Data recorded will include percent tuber infection (one or more infection sites), percent culled tubers (tubers with six or more infection sites), and infection index as a measure of infection intensity (0 = 0, 1 = 1-3, 2 = 4-5, 3 = 6-9, 4 = 10-49, 5 = 50-99, 6 = 100+ nematodes/tuber [Pinkerton et al., 1986]).

Corky Ringspot Evaluations

If corky ringspot disease is present in the plot area, CRS symptoms will be assessed by examining the same tubers evaluated for root-knot infection. After root-knot evaluations, each tuber will be cut longitudinally to inspect for symptoms of CRS. If no or only slight symptoms were found, the tubers will be further sliced into 1/2 in transverse slices. Only spots or arcs exceeding 1/8 in diameter will be counted. Categories will include no infection, 1-5% of internal surface blemished (No. 1 grade), 5-10% of internal surface blemished (No. 2 grade) and more than 10% of internal surface blemished (cull).

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2001 PROTOCOL FOR BACTERIAL RING ROT CLONAL EVALUATION

Researcher: Robert D. Davidson, Extension Seed Potato Specialist, and Sarah Bice, Research Associate, Colorado State University, San Luis Valley Research Center, Center, CO

Location: NW Corner, Selter's Farm, 9 North, ½ East of SLVRC

Clones:

1. AC93026-9RU
2. AC93047-1RU
3. CO93001-11RU
4. CO93016-3RU
5. CO93024-2RU
6. CO93037-6R
7. NDC5281-2R
8. TC1675-1RU
9. CO94019-1R
10. CO94024-16RU
11. CO94027-6W
12. CO94032-3W
13. CO94035-15RU
14. CO94055-8RU
15. CO94065-2R
16. CO94084-12RU
17. CO94165-3P/P
18. CO94183-1R/R
19. CO94222-6RU/Y
20. NDC6084C-2W
21. NDC6184-3R
22. VCO967-2R/Y
23. VCO967-5R/Y
24. VC1002-3W/Y
25. Huckleberry
26. FL 2027
27. FL 1900
28. FL 2025
29. FL 2006
30. FL 2020
31. Russet Burbank
32. Sangre
33. Centennial Russet
34. WNC230-14
35. Ute Russet
36. Norkotah

Planted: May 3, 2001
Plot Design: Randomized complete block
Plot Size: 37 rows per treatment
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80-60-40
Herbicide: Eptam, 4 pts/acre; and Matrix, 1.5 oz./acre
Fungicide:
Vine Killer:
Harvested:

DATA

Disease: Bacterial Ring Rot disease incidence and symptom expression based on readings taken weekly starting July 5.

2001 POTATO –Stress Guard

Researchers: Robert D. Davidson, Extension Seed Potato Specialist, and Sarah Bice, Research Associate, Colorado State University, San Luis Valley Research Center, Center, CO

Location: San Luis Valley Research Center, Center, CO

Applications: Fertilizers and herbicides applied using a injector pump for chemigation applications. Insecticides will be applied via aerial application.

Spray Dates: 5/18, chemigated fertilizer; 5/29 chemigated fertilizer; 5/31 chemigated herbicide; 6/6, chemigated fertilizer.

Plot Design: Randomized complete block
Planted: May 2, 2001
Plot Size: 2 foot rows per treatment
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three
Cultivar: Silverton Russet and Russet Norkotah interspaced with Red McClure (PVY +) tubers.

Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80-60-40
Herbicide: Eptam, 4 pints/acre; and Matrix, 1.5 oz/acre
Insecticide:

Vinekill:
Harvested:

DATA: Evaluation of stress guard as a foliar spray to control PVY spread by cleaning of the infected aphid stylet. Daughter tubers will be evaluated during post harvest testing in Oahu, Hawaii.

Disease:

Yield:
Grade:

Summary

2001 POTATO – Martinez Farms Giberillic Acid Trials

Researchers: Robert D. Davidson, Extension Seed Potato Specialist, and Sarah Bice, Research Associate, Colorado State University, San Luis Valley Research Center, Center, CO

Location: Martinez Farms, Center, CO

Vinekill:

Harvested:

DATA: Giberillic Acid was sprayed on foliage of plantlets at a concentration of 500 pm to produce minitubers and compare germination rates of treated vs. untreated.

Disease:

Yield:
Grade:

Summary

2001 POTATO – Color Intensity Study

Researchers: Robert D. Davidson, Extension Seed Potato Specialist, and Sarah Bice, Research Associate, Colorado State University, San Luis Valley Research Center, Center, CO

Location: San Luis Valley Research Center, Center, CO

Applications: Fertilizers and herbicides applied using a injector pump for chemigation applications.Insecticides will be applied via aerial application.

Spray Dates: 5/18, chemigated fertilizer; 5/29 chemigated fertilizer; 5/31 chemigated herbicide;6/6, chemigated fertilizer.

Plot Design: Randomized complete block
Planted: May 15, 2001
Plot Size: 6 rows
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three
Cultivar: Dark Red Norland, Sangre, Sangre selections

Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80-60-40
Herbicide: Eptam and Matrix
Insecticide:

Vinekill:
Harvested:

DATA: Evaluating red color intensity after visual selection of field grown tuber. Tubers will be evaluated for color intensity at harvest.

Disease:

Yield:
Grade:

Summary

2001 PROTOCOL FOR POTATO LEAFROLL CLONAL EVALUATION

Researcher: Robert D. Davidson, Extension Seed Potato Specialist, and Sarah Bice, Research Assocaite, Colorado State University, San Luis Valley Research Center, Center, CO

Location: NW Corner, Selter's Farm, 9 North, ½ mile east of SLVRC

Cultivar:

1. CO94019-1R
2. CO94024-16RU
3. CO94027-6W
4. CO94032-3W
5. CO94035-15RU
6. CO94055-8RU
7. CO94065-2R
8. CO94084-12RU
9. CO94165-3P/P
10. CO94183-1R/R
11. CO94222-6RU/Y
12. NDC6084C-2W
13. NDC6184-3R
14. VCO967-2R/Y
15. VCO967-5R/Y
16. VC1002-3W/Y
17. Russet Burbank
18. Sangre
19. Centennial Russet
20. WNC 230-14
21. Ute Russet
22. Nugget
23. Norkotah
24. PLRV (+)

Plot Design: Randomized complete block
Planted: May 2, 2001
Plot Size: 7 rows
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three

Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80-60-40
Herbicide: Eptam, 4 pts/acre; and Matrix, 1.5 oz/acre
Insecticide:

Vine Killer:
Harvested:

DATA:
Disease: Leaf Roll infection symptoms evaluated during post harvest testing, Oahu, HI.

2001 POTATO – LEAF ROLL NATURAL IN FIELD SPREAD

Researchers: Robert D. Davidson, Extension Seed Potato Specialist, and Sarah Bice, Research Associate, Colorado State University, San Luis Valley Research Center, Center, CO

Location: San Luis Valley Research Center, Center, CO

Cultivars:

1. CO94019-1R
2. CO94024-16RU
3. CO94027-6W
4. CO94032-3W
5. CO94035-15RU
6. CO94055-8RU
7. CO94065-2RU
8. CO94084-12RU
9. CO94165-3P/P
10. CO94183-1R/R
11. CO94222-6RU/Y
12. NDC6084C-2W
13. NDC6184-3R
14. VCO967-2R/Y
15. VCO967-5R/Y
16. VC1002-3W/Y
17. Russet Burbank
18. Sangre
19. Centennial Russet
20. WNC 230-14
21. Ute Russet
22. Nugget
23. Norkotah
24. Green Mountain
25. Houma
26. Katahdin
27. Keswick
28. Penobscot

Plot Design: Randomized complete block
Planted: May 2, 2001
Plot Size: 7 rows per treatment
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three

Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80-60-40
Herbicide: Eptam, 4 pts/acre; and Matrix, 1.5 oz/acre
Insecticide:

Vinekill:
Harvested:

DATA:
Disease: Leaf Roll infection - symptoms evaluated during post harvest testing, Oahu, HI.

Yield:
Grade:

Summary