AGRO ENGINEERING

"COMPREHENSIVE AGRICULTURAL AND WATER RESOURCE CONSULTING"

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2006 *Phytopthora erythroseptica* CPAC Proposal

Introduction

Since the discovery of resistance of Pink Rot, *Phytopthora erythroseptica*, to Mefenoxam in most major potato growing areas in the United States and just recently in the San Luis Valley, growers have been searching for new chemicals and best management practices to control the fungal pathogen. Until now Mefenoxam (Ridomil) has been the only method to control Pink Rot. The San Luis Valley has been one of the last areas to record resistance to Ridomil. Colorado is now listed as the second largest potato seed producing state. Due to this and many other reasons new management practices must be integrated into regular farming operations. According to some research the *P.erythroseptica* oospores can survive in soil for at least seven years. Our constant rotation of potato-grain-potato-grain increases the rate for resistance to occur and build, suggesting that there may still be susceptible populations in the soil of a particular field and some resistant. The trend has been if a grower has historically used Ridomil, to continue to use it. If never have used Ridomil, never use it unless a problem such as *Pythium* or "water rot" has been found. The growers that have used Ridomil as part of their regiment applied it both with the "one shot" approach and the labeled "two shots" all by different methods of application. The first actual recorded problem from Pink Rot was experienced in the Valley in 2003. In 2004, however, we had some disasters, wrecks ranging from 20-80% damage, in spots in the field as well as entire fields. Growers with the "wrecks" ended up not harvesting those fields and parts that were harvested and stored later melted down in storage. This spawned many ideas for best management practices and two trials done by Agro in the 2005 season and as described later in this document.

The Russet Norkotah has been a staple variety in the valley for at least 17 years. This lead Agro to one of two trials; 16 different varieties were chosen in cooperation with a grower organization, Farm Fresh Direct. These varieties were selected based on current use and future potential. The varieties for the trial are as follows: Gem Star (9014-2), Russet Centennial, AC92009-4, Russet Burbank, Russet Nugget, Alturas, Russet Norkotah Standard, Snow White, Russet Norkotah 3, Western Russet, Durango, Fremont Russet, Yukon Gold, Purple Majesty, NDSU Red, Rio Grande Russet and Chieftain.

Agro Engineering, Inc. with cooperation with North Dakota State University sampled over 250 tubers for Pink Rot and Ridomil sensitivity. This number of samples was a record for Colorado! In years past only 1-6 tubers have been sent from Colorado, where other states are in the hundreds. Agro plans on continuing this project and the amount of samples.

The objective of these trials was to determine resistance of *P.erythroseptica* to Ridomil, Mefenoxam (Metalaxyl) in the San Luis Valley, best management practices and options if resistance is present and variety susceptibility.

2005 TRIAL ABSTRACT

Agro Engineering, Inc. planted two trials, in two separate fields, using a Russet Norkotah variety, with confirmed Pink Rot problems and preceding harvest recorded huge tuber losses. Treatment Trial I was replicated four times within the field. Treatment Trial II was replicated five times within the field. Listed is the order of treatments: A. Control, B. Ridomil at hilling, C. Ridomil and Phostrol tank mixed at hilling, D. 5ton/A Compost and 20gal/A Compost Tea after planting, E. Ridomil and Phostrol tank mixed aerial applied at row closure. The application made at row closure was made on June 30th, 2005. Trial I test rows were 50ft each. Trial II the test rows were 100ft in length, and the controls were 85ft. Early in the season, Dual II Magnum plus Sencor DF, at bottom labeled rates tank mixed, was used to control weed populations before potato plant emergence. No other chemicals used besides those used for the trials. Vines died due to frost, no vine kill method was implemented. Harvest occurred September 21st all plots were evaluated on % weight of infected tubers vs. not infected tubers. Results show the use of Phostrol tank mixed with Ridomil improved the efficacy of Ridomil than when used alone, and the use of compost decreased the amount of infection. All plots had infection. In another trial performed by Agro Engineering, Inc. in the same 2005 season 16 different potato cultivars were planted on May 18th in 30ft plots four times across 1 acre down the middle of the field, planted in six rows, of yet another confirmed field with a *P.erythroseptica* high infection rate. The variety trial was subjected to all normal in season cultural practices, herbicides were the only chemicals applied, no compost used. Harvest occurred on September 27th, all tubers were evaluated on % weight infected vs. not infected and # of tubers infected vs. not infected. Results indicate Russet Norkotah Standard most susceptible, Fremont Russet least susceptible. One thirty pound sack of the not infected tubers were collected from each treatment within each of the two trials and one sack from each 30ft plot of each cultivar then put into storage for further evaluation for late infection incidence. Tubers were also collected at harvest then later storages from fields throughout the San Luis Valley with *P.erythroseptica*, <1% or more infection to test for Ridomil resistance, application treatments and methods, use of compost, and variety were recorded. Results indicate sensitivity still present in some areas, if moderately sensitive the use of Ridomil will be limited and invite resistance to occur, next to happen is resistance.

The results from these trials are significant although not conclusive. More research is needed; no solid assumptions can be made from just one year worth of data. Although, we are confident of our results since they are consistent with other research done throughout the U.S. Our research has been shared with some of the leading researchers from Syngenta and has their approval.

Agro Engineering put in a great amount of time (>280 hours) and effort into this project for 2005 and took in the majority of the cost. Based on our findings we feel that some of these trials must be replicated and other questions answered, over more years of research, to become conclusive for the best management of this disease. This is important not only to the Valley and our growers but also research throughout the country and the future of potato production.

Following is Agro's plan in cooperation with Farm Fresh Direct for the 2006 season.

2006
***Phytopthora* Evaluation in Cooperation with Farm Fresh Direct LLC and Agro Engineering, Inc.**

Three main information needs

1. Best management practices and treatments to help manage pink rot.
2. Cultivar susceptibility to Pink Rot.
3. Post Harvest Management practices and treatments.

Trial 1

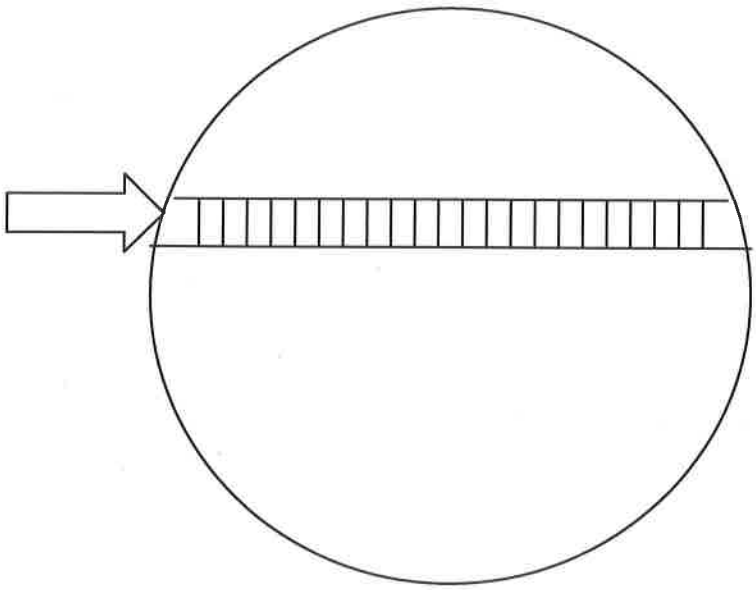
Cultivar Susceptibility to Pink Rot.

The Purpose of this trial is to best determine the susceptibility of current Norkotah and Russet varieties and possible future varieties to be grown in the San Luis Valley to Pink Rot.

Method

To address the cultivar susceptibility question we have chosen a field that has a history of pink rot and located a one-acre strip adjacent to the pivot road and will plant small blocks of cultivars, replicated, that match the maturity of the field. This would eliminate obvious reasons for pink rot problems, like watering over dead vines. Blocks would be staked out and G.P.S.
Chosen cultivars are indicated below. The plots will be evaluated at harvest by windrowing, then measuring and recording pink rot occurrence and severity.

1. Norkotah Std
2. Norkotah 3
3. Norkotah 8
4. Norkotah 278
5. Norkotah 296
6. Norkotah 223
7. Norkotah 112
8. Centennials
9. Nugget
10. Ranger
11. Rio Grande
12. Burbank
13. Fremont
14. AC92009-4
15. Altura
16. Crestone
17. Keystone
18. Purple Majesty-spacers on ½ of field
19. Cheiftain-spacers on ½ of field



Trial 2

Treatment Trial to Manage Pink Rot in Field

The purpose of this trial would be to evaluate different treatments and their effectiveness at managing pink rot.

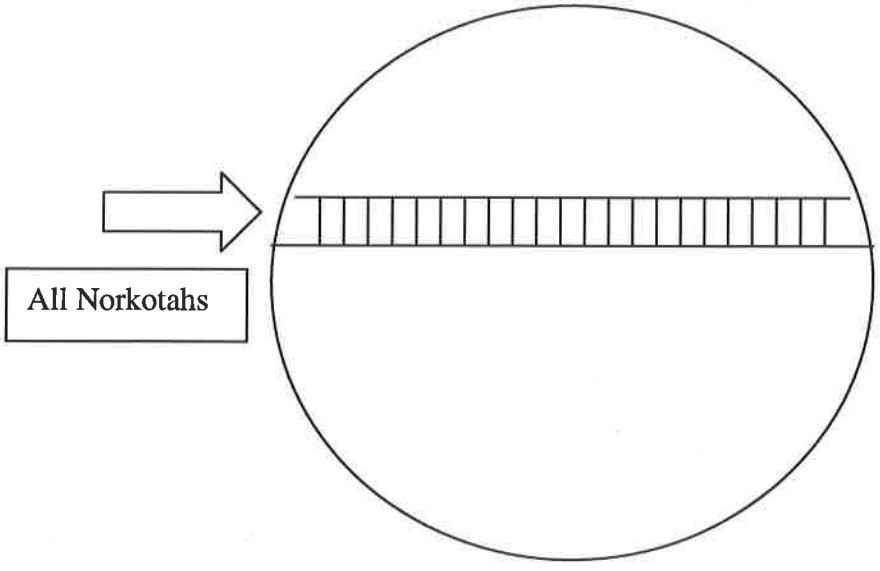
Method

On a one-acre strip adjacent to the pivot road, Norkotahs would be planted on field(s) that in 2005 had problems with pink rot. The plot would be laid out in 6 rows and replicated at least 4 times depending on number of treatments. This trial should be replicated on two different fields. Norkotahs were selected for their high susceptibility to pink rot to ensure a positive. This would also simplify seed sourcing for this trial.

Treatments to be analyzed:

1. Control
2. Ridomil 6.2oz/A direct spray @ final hilling
3. Ridomil 6.2oz/A and Phostrol 10pt/A direct spray @ final hilling
4. Ridomil 3-5X recommended rate
5. Phostrol 1 application @ 10pt/A direct spray @ final hilling
6. Phostrol 3 applications @ 10pt/A (direct spray @ final hilling, 14 days later, 14 days later)
7. Compost 1T/A + 20 gal tea @ planting
8. Compost 3T/A @ planting
9. Best biological Approach- Compost + T22 + tea
10. T22 (Trichederma) app @ or before planting, w/re-inoculation of biology
11. Reason- Bayer product??

Ridomil will be used as was used in 2005, a rate of 6.2oz/A and Phostrol at the 10pt/A rate. The plots will be evaluated at harvest by windrowing, then measuring and recording pink rot occurrence and severity. The field(s) to be used should not be 100% resistant, containing a mixed population of resistance to know that we have confirmed Pink Rot in the field, yet have a population sensitive to treatments. This will be determined from the tubers tested in 2005.



Trial 3

Post Harvest to Manage Pink Rot in Storage

The purpose of this trial is to determine chemicals for Pink Rot control going into storage.

Method

Agro would coordinate with 4-5 growers willing to make applications to tubers going into storage and leaving out an untreated portion as a control. Two to three months later tubers will be randomly sampled in storage then evaluated and sorted based on "infected" and "not infected", same as when they would be sorted at harvest.

Treatments to be analyzed going into storage:

1. Phostrol
2. Oxidate
3. Reason?
4. Puragene?

Trial 4

Days to Harvest to Manage Pink Rot in Field

This trial will determine canopy vs. soil temperature with kill date to *Phytopthora* infection rates and levels.

Method

Date loggers will be placed in the cultivar trials in a variety with big vines, such as Norkotah 8, and one with smaller vines, and temperatures recorded.

Data loggers placed in a big vine variety, such as Norkotah 8,and different kill dates applied; plots killed on a weekly schedule starting 4 weeks out from harvest date then record soil temperatures.

Tubers randomly sampled from plots with Pink Rot infection visibly present, sent to North Dakota State University to be sampled for Ridomil resistance to confirm or deny results from trial.

Trial 5

In Season Cultural Practice to Manage Pink Rot

The purpose of this trial is to determine the cultural practice of dammer-dyking to *Phytopthora* infection in combination with soil microbiological health.

Method

Agro would coordinate with 4-5 growers whom use a dammer-dyker willing to leave out a few passes and those whom do not use one to make a few passes in their fields. At harvest the tubers would then be evaluated in both areas where passes were and were not made for *Phytopthora* levels.

Agro's Role:
To make this trial as less stressful for the growers involved in this trial Agro Engineering, Inc. will be the party involved in planting Trial 1, supervision and coordination of chemical treatments in season in Trial 2, harvesting plots, sorting potatoes after harvest, evaluating end of season results, sorting storage treatments, compiling data, reporting and presenting results.

*Full time staff @ $100/hr *Summer staff @$50/hr

- Project Coordination — 50 hours @ $100= $5000
- Planting of Cultivars for Trial 1
  - 7 Full time persons, one full day 9 hours/day
  - 7 summer staff, one full day 9 hours/day

  63 hours @ $100= $6300
  63 hours @ $50= $3150
- In Season:
  - 1 Full time, one visit per application per field on Trial 2 to supervise and assist= only 4 times needed due to overlap of treatments done at planting and hilling.
  - 1 Full time staff for installing data loggers and monitoring for Trial 4
  - 1 Full time Coordination of dammer-dyking lay out w/ grower, one visit per field, 4 fields

  8 hours @ $100= $800
- Harvest:
  - 8 Full time staff, 2 days (one day per field trial), 9 hours/day (144 hours)
  - Dammer-dyker evaluation: 6 Full time staff, 2 hours per field, 4 fields

  192 hours @ $100= $19200
- Storage:
  - 6 Full time staff, 4 hours

  24 hours @ $100=$2400
- End of trials:
  - Compiling and entering data
  - Reporting — 20 hours @ $100= $2000

TOTAL: 420 HOURS= $38850

***These prices do not include the cost of compost, compost tea or all chemicals needed for the trials, or the application costs.**
***The prices include drive time.**
***Stones supplied the chemical and labor for weed control and late season applications in the 2005 trials. Compost Technologies supplied all the compost and tea for those applications in the 2005 trials. We are planning on using their services again for 2006.**

*Due to the application restrictions from the EPA guidelines with the private applicators license Agro Engineering will be unable to make the chemical applications and either the grower will have to make the applications or another party with a commercial applicators license can do so.

Closure:

Phytopthora evaluation is expected to last the entire 2006-growing season. Results are aimed to further develop best management/cultural practices and treatments both in season and post harvest and to determine the least susceptible variety of potato to Pink Rot. Results will be presented at the next Agro Workshop in January 2007, and will be open to discussion for publication.

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