SUMMARY RESEARCH PROGRESS REPORT FOR 2000
AND
RESEARCH PROPOSAL FOR 2001

Submitted to:
SLV Research Center Committee
Colorado Potato Administrative Committee (Area II)

TITLE: Using Biocontrol Crops to Enhance Potato Production

PROJECT LEADER(S): Merlin A. Dillon, SLV Area Extension Agent, Agronomy

PROJECT JUSTIFICATION:
Nematodes, verticillium (early dying), and powdery scab have become important potato pests in San Luis Valley potato production. Green manure crops have shown great potential in reducing the impact of some of these pests. The effectiveness of these biocontrol crops is now well established. However, many questions remain as to how these crops grow in our environment. Dedicating one entire crop year is still very expensive (no crop income). If some biocontrol crop could be grown somehow in the same season as an income crop, this would greatly reduce the cost of growing such a crop. Fumigants and fungicides can be used to control some of these pests; however, these chemicals are also very expensive; maybe not soon available; and very destructive to beneficial organisms.

Research in Idaho and other areas has shown the benefit of sudan and rape crops. In our area, Dr. Richard Zink and I conducted 3 years research into crop rotations showing the benefit of green manure sudan or corn in reducing verticillium propagules/gram of soil. Sudan planted in early June and soil incorporated into the soil in August was highly beneficial. Now, we need to know how much sudan is required to be incorporated, how much benefit would accrue if the sudan was hayed and then turned under.

PROJECT STATUS:
Soil test funding was increased substantially last year at the request of the SLV Research Center Committee. One field was sampled and analyzed last summer; results are summarized. The analysis will be used only to compare to one after the biocontrol crop is grown.

All three fields will be sampled for verticillium prior to planting potatoes this year. All three fields will be sampled for microbial diversity and one for nematodes during the potato growing season of 2001. Funds appropriated for 2000 will be used up prior to 2001 fund availability. Funds requested for 2001 will be the same as last year; funds will be spent much the same as this last year.

SIGNIFICANT ACCOMPLISHMENTS FOR 2000:
Three on-farm field trials were established as planned in 2000. Soil samples were analyzed from one farm, establishing the baseline values prior to the biocontrol crops. The results show

only small differences in the total species diversity index (SRDT). Verticillium sampling also shows little differences except for one "hot spot". One sample tested 18 VPPG whereas all the other samples averaged 3.2 VPPG. The sampling results are base values that will be compared to sampling results in and prior to the growing potato crop of 2001.

The other two fields have no base samples but will be analyzed before and during potato production in 2001. The costs of the baseline microbial diversity analysis was $1200.00.

OBJECTIVES FOR 2001:

Three on-farm trials established last year will be monitored by soil sampling and analysis for verticillium, nematodes and microbial diversity. This will require all monies not yet used for analysis.

Three more on-farm trials will be established to prepare for sampling and analysis next year. Hopefully, these will include one with rapeseed, one with sudan baled at different stages, and possibly another one with grazed sudan. These represent the depth and interest of the potato growers and what they are wanting to do with these biocontrol crops. It may be that growers are less interested and less willing to invest in biocontrol crops this year.

FUNDING REQUEST:

2000 Allocation:

Plot materials ------------$500
Seed, seeding, fertilizer-$1000
Student labor------------ $1500
Soil analysis------------ $4500
TOTAL-------- $7500

2001 Request:

Plot materials ------------$500
Seed, seeding, fertilizer-$1000
Student labor----------- -$1500
Soil analysis------------ $4500
TOTAL------- $7500

Species Richness	1	2	3	4	5	6	7	8	9	10	11	12
Diversity Index 1/												
Heterotrophic	1.3	1.8	1.8	1.8	1.4	1.4	1.6	1.5	1.7	1.8	1.6	2
Anaerobic	1.1	1.4	1	1.1	1.5	1.5	1.6	1.4	1.4	1.7	0.7	1
Yeast&mold	0.7	0.9	0.9	1	0.5	0.3	0.5	0.7	1	0.9	1.2	0.5
Actinomycetes	1.2	1.2	1.7	1.3	1.3	1.4	1.7	0.8	0.8	1	1.1	0.9
Pseudomonads	0.6	0.9	0	0.8	1.2	1	0.5	1.1	0	0	1.3	1.2
N fix bacteria	0.4	0.6	0.4	0.4	0.7	0.6	0.7	0.7	0.5	1.1	1.1	0.3
TOTAL SRDT 2/	5.3	6.8	5.8	6.4	6.6	6.2	6.6	6.2	5.4	6.5	7	5.9

1/ The species richness diversity index is derived by weighing tht variety of species within a functional group (species richness) from a normalized analysis against the total number of microorganisms associated with that functional grou

2/ The total species richness diversity index (SRDT) is the summ of the individual SRD's for the six functional groups.

Sudan biocontrol crop

	3	4	5	6	10	Avg
Heterotrophic	1.8	1.8	1.4	1.4	1.8	1.64
Anaerobic	1	1.1	1.5	1.5	1.7	1.36
Yeast&mold	0.9	1	0.5	0.3	0.9	0.72
Actinomycetes	1.7	1.3	1.3	1.4	1	1.34
Pseudomonads	0	0.8	1.2	1	0	0.6
N fix bacteria	0.4	0.4	0.7	0.6	1.1	0.64
TOTAL SRDT 2/	5.8	6.4	6.6	6.2	6.5	**6.3**

Winter wheat crop

	1	2	7	8	9	Avg
Heterotrophic	1.3	1.8	1.6	1.5	1.7	1.58
Anaerobic	1.1	1.4	1.6	1.4	1.4	1.38
Yeast&mold	0.7	0.9	0.5	0.7	1	0.76
Actinomycetes	1.2	1.2	1.7	0.8	0.8	1.14
Pseudomonads	0.6	0.9	0.5	1.1	0	0.62
N fix bacteria	0.4	0.6	0.7	0.7	0.5	0.58
TOTAL SRDT 2/	5.3	6.8	6.6	6.2	5.4	**6.06**

Fallow, noncrop area

	11	12	Avg
Heterotrophic	1.6	2	1.8
Anaerobic	0.7	1	0.85
Yeast&mold	1.2	0.5	0.85
Actinomycetes	1.1	0.9	1
Pseudomonads	1.3	1.2	1.25
N fix bacteria	1.1	0.3	0.7
TOTAL SRDT 2/	7	5.9	**6.45**

107 = 10 7th Power

Enumerations

Sample	1	2	3	4	5	6	7	8	9	10	11	12
Heterotrophic-107	3.5	4.8	5.9	3.9	7.7	5.1	3.8	3.2	1.3	1.4	24	9.8
Anaerobic——106	1.6	11	11	3.4	1.3	0.85	1.6	2.6	2	3.2	12	68
Yeast&mold—104	1.7	1.8	2	1.1	0.5	0.4	0.7	1.2	1.3	1.8	1.2	92
Actinomycetes105	1.5	1.6	1.6	9.1	1.9	3.7	2.8	1.6	1	9.3	14	1.8
Pseudomonads103	4.3	18	2	5	11	7	5	6	0.9	6	49	490
N fix bacteria-104	3.5	14	17	38	3.3	4.3	2.4	1.8	56	5.3	5.3	580

Sudan biocontrol crop

	3	4	5	6	10	Avg
Heterotrophic-107	5.9	3.9	7.7	5.1	1.8	4.88
Anaerobic——106	11	3.4	1.3	0.85	1.7	3.65
Yeast&mold—104	2	1.1	0.5	0.4	0.9	0.98
Actinomycetes105	1.6	9.1	1.9	3.7	1	3.46
Pseudomonads103	2	5	11	7	0	5
N fix bacteria-104	17	38	3.3	4.3	1.1	12.7

Winter wheat crop

	1	2	7	8	9	Avg
Heterotrophic-107	3.5	4.8	3.8	3.2	1.3	3.32
Anaerobic——106	1.6	11	1.6	2.6	2	3.76
Yeast&mold—104	1.7	1.8	0.7	1.2	1.3	1.34
Actinomycetes105	1.5	1.6	2.8	1.6	1	1.7
Pseudomonads103	4.3	18	5	6	0.9	6.84
N fix bacteria-104	3.5	14	2.4	1.8	56	15.5

Fallow, noncrop area

	11	12	Avg
Heterotrophic-107	24	9.8	16.9
Anaerobic——106	12	68	40
Yeast&mold—104	1.2	92	46.6
Actinomycetes105	14	1.8	7.9
Pseudomonads103	49	490	269.50
N fix bacteria-104	5.3	580	292.65

Verticillium Propagules per gram (VPPG)

1	2	3	4	5	6	7	8	9	10
	0	0	0	4	8	18	6	2	2

Sudan biocontrol crop

3	4	5	6	10	Avg
0	0	4	8	2	2.8

Winter wheat crop

1	2	7	8	9	Avg
	0	18	6	2	6.5

Fallow, noncrop area

No samples taken

EXAMPLE ONLY

BC Laboratories, Inc.

MICROBIAL DIVERSITY ANALYSIS

Species richness is a measurement of diversity that indicates the number of different species or different types of microorganisms that are present in a sample. In soil or compost, a high species richness diversity (SRD) promotes numerous interspecies relationships and interpopulation interactions. Species richness diversity is important because it allows for a more varied and flexible response to environmental fluctuations and stress. For instance, those communities with more diverse microbial populations will be more likely to cope with disturbances and stress than those communities with low diversities.

The SRD determination of microorganisms in a particular microbial functional group is an index of the **variety** of microbes in that functional group. This index is derived from a formula that weighs the variety of species within a functional group from a normalized analysis of species richness against the total number of microorganisms associated with that functional group. This index can be compared to other samples from a similar matrix (soil, compost, or liquid) and can be used to determine the impact of various crop management and agricultural practices on microbial diversity or to compare and evaluate different microbial products.

In addition to the individual SRD determinations for various functional groups, an index for the **total** species richness diversity (SRDT) is a useful tool for the comparison of similar samples. This index is the sum of the six individual SRD's for the sample.

SRDT Index	Classification for Agricultural Soils
greater than 12.5	High Diversity
7 - 12.5	Moderate Diversity
less than 7	Low Diversity

The following table is a typical example of an agricultural soil analysis:

PARAMETER	ENUMERATIONS (Colony Forming Units/gram dry weight)	SPECIES RICHNESS DIVERSITY (SRD) INDEX
Heterotrophic Plate Count (Aerobic)	1.8×10^8 CFU/gdw	2.9
Anaerobic Bacteria (includes facultative anaerobes)	1.6×10^7 CFU/gdw	1.9
Yeasts and Molds	1.1×10^6 CFU/gdw	2.3
Actinomycetes	3.3×10^4 CFU/gdw	1.2
Pseudomonads	2.4×10^7 CFU/gdw	1.2
Nitrogen-Fixing Bacteria	3.0×10^4 CFU/gdw	0.7
Total Species Richness Diversity (SRDT)	——	**10.2 (Moderate Diversity)**

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