SUMMARY RESEARCH PROGRESS REPORT FOR 2001
AND RESERCH PROPOSAL FOR 2002

Submitted to:

SLV Research Center Committee
and the Colorado Potato Administrative Committee (Area II)

TITLE: Vertical Distribution of Eptam, Dual Magnum, Outlook, Sencor and Matrix in Soil Based on the Amount of Water Used for Incorporation.

PROJECT LEADERS: Dr. Scott Nissen, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins.

IMPACT STATEMENT: The San Luis Valley is truly a unique and wonderful environment; however, intense production agriculture has the potential to significantly impact environmental quality. This research project, supported by the SLV potato industry, will suggest best management practices to reduce the potential for negative environmental impacts from herbicides used in potato production. The safe and environmentally responsible use of pesticide (in this case herbicides) requires that producers understand how to reduce movement below the potato root zone.

PROJECT JUSTIFICATION: The influence of water volume on herbicide distribution has been determined for Eptam in a common San Luis Valley soil. For this study, soil profiles were reconstructed from soil collected from a potato field near Monte Vista. Profiles were reconstructed in a PVC pipe made up of five sections. The sections were 0-1, 1-2, 2-3, 3-6, 7-12 inches. Eptam was incorporated with 0, ¼ , ½ and 1 inch of water followed by analysis of each section for Eptam content. Eptam remained primarily in the top one inch of soil regardless of the amount of water used for incorporation. Research results clearly indicated that using less water (¼ inch) caused more problems than using too much water, with the greatest amount of Eptam present in the soil column when ½ inch of water was used for incorporation.

Common potato herbicides differ significantly in water solubility and in another common physical parameter called the octanol/water partitioning coefficient or K_{ow} (Table 1). Octanol will not dissolve in water and so when mixed together they separate like oil and water; however, in this case the octanol floats on the water. K_{ow} is simply the ratio of herbicide dissolved in octanol (an organic solvent) divided by the amount of herbicide dissolved in water. A large number indicates that a much greater proportion of the herbicide is soluble in organic solvent than in water. In general, this indicates that the herbicide should bind readily to soil organic matter and clay. Since most agricultural soils in the SLV are low in both organic matter and clay, the vertical distribution of common potato herbicides in soil could be significantly different than in other areas.

Table 1. Water solubility and K_{ow} values for common potato herbicides.

Herbicide	Water Solubility (ppm)	K_{ow}
Eptam	370	130,000
Prowl	0.3	152,000
Dual Magnum	488	794
Sencor (metribuzin)	1100	45
**Outlook	1174	141
Matrix	7,300	0.034

****Outlook** is new product from BASF that is being registered for use in potatoes and should be available in 2002 or 2003.

While these herbicides are familiar to all potato growers there is very little information available about how herbicide movement might be affected by the volume of water used for incorporation or soil moisture conditions at application. Sencor and Outlook are similar in water solubility and yet the K_{ow} values differ by a factor of three. Dual Magnum has about half the water solubility of Sencor but has a K_{ow} 17 times higher, while Matrix is highly water-soluble and has a very low K_{ow}. Research funded by the CPAC (Area II) found that water volume may not be a significant factor in Eptam performance as long as a minimum amount is applied; therefore, water volume could be more critical with other common potato herbicides. This is especially true as water solubility increases and K_{ow} decreases.

PROJECT STATUS: Continuing

SIGNIFICANT ACCOMPLISHMENTS FOR 2001:

The experimental protocol was changed slightly from the original proposal. The experiment consisted of applying the five herbicides to soil columns that varied in soil moisture content. The applications were made to simulate irrigation volumes of 0.5 inches per acre and were applied over a period of approximately 15 minutes. The soil was collected from a field site 3 miles north of Monte Vista where previous field research with Eptam had been conducted. Soil was collected to a depth of six inches.

Soil moisture condition were established as follows:

-Soil was dried and sieved to 2mm
-Columns were constructed of seven sections with the lower part (6-10 inches) used primarily to allow for easier manipulation of the first six section.
-The upper six sections were 0-1, 1-2, 2-3, 3-4, 4-5, and 5-6 inches.
-Soil moisture was either field capacity or two inches of air-dry soil on top of soil at field capacity.
-Herbicides were applied at common field rates, except for Matrix where the herbicide rate was increased to 1 lb ai/ac to allow for detection by high performance liquid chromatography (HPLC). Residues of other herbicides were analyzed by GC/MS.
-Formulated herbicides and bromide were applied in a volume of water equivalent to 0.5 inches of water per acre and allowed to equilibrate overnight.
-Soil columns were then dismantled and soil samples analyzed for each herbicide.

Results:

This experiment required a great deal of analytical time and effort to evaluate vertical movement of five herbicides. Results were very similar to previous studies that evaluated the vertical distribution of Eptam based on the volume of water used for incorporation. It would be rare that a commercial potato field would be dry to a depth of 6 inches; therefore, an attempt was made to evaluate common management practices that might result in poor weed control or herbicide movement out of the root zone. This was accomplished by evaluating the importance of a dry soil surface compared to one with a soil profile that was at or near field capacity to the surface.

The vertical distribution of these five herbicides did not vary significantly when applications were made to a dry soil surface (**Figure 1**). That is somewhat surprising since the herbicides vary significantly in their water solubilities. This finding illustrates the importance of making any chemigation treatment to dry soil surface. Even Matrix, with a water solubility of 7,800 ppm, remained primarily in the surface inch when applied to a dry soil surface. On average, 92% of all herbicides remained in the surface inch.

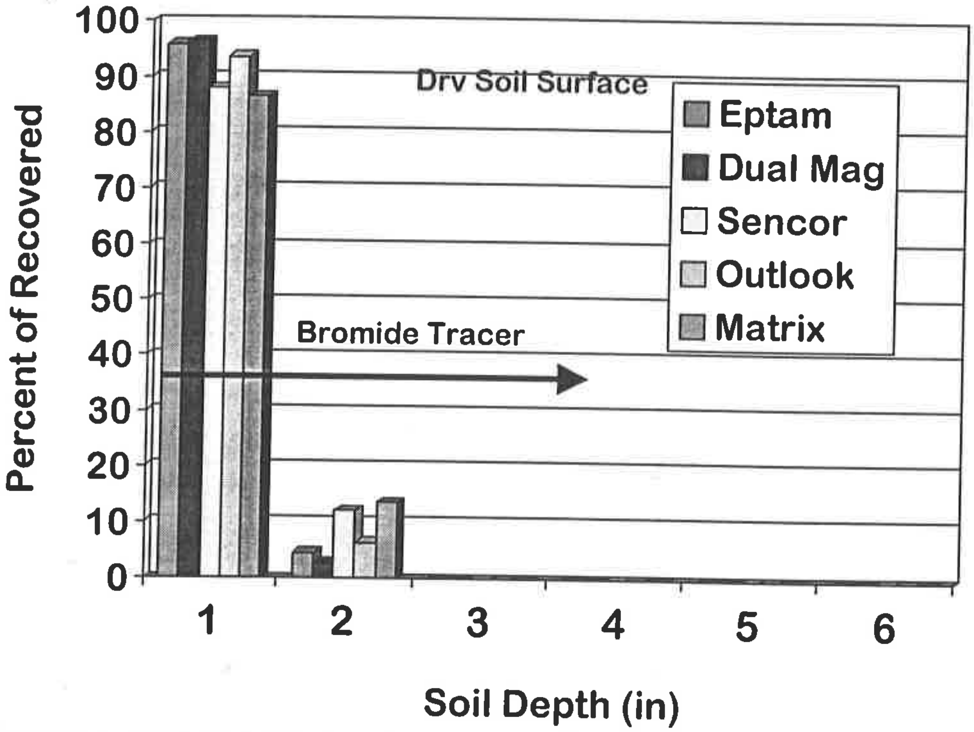

Figure 1. Vertical distribution of Eptam, Dual Magnum, Sencor, Outlook and Matrix in six inch soil column following simulated chemigation with 0.5 inches of water. Column consisted of 2 inches dry soil over 4 inches at field capacity. For all herbicides, greater than 85% of applied product remained at 0-1 inch depth. The greatest movement into the second inch occurred with Sencor and Matrix.

The vertical distribution of herbicide applied to a soil column that was at or near field capacity to the surface was very different than the previous situation (**Figure 2**). On average, the amount of herbicide retained in the surface sample dropped from 92% to 69%. Eptam, Dual Magnum, Sencor and Outlook were similar in the amount of herbicide retained in the soil surface with a range of 80% to 68%; however, only 54% of Matrix was recovered from the surface one inch. This represents a loss of 32% for Matrix when compared to dry surface application.

Detectable amounts of Etpam, Dual Magnum, Sencor and Outlook were found to a depth of three inches, while Matrix as found to a depth of 6 inches. This represents a significant dilution event for Matrix and the potential that with repeated irrigation the herbicide could move below the root zone. The vast majority of Eptam, Dual Magnum, Sencor and Outlook remained in the top two inches of soil.

Bromide was used to trace the movement of applied water. With a dry soil surface the applied water reached a depth of 4 inches, while the bromide tracer moved through the entire column when water as applied to the soil column at field capacity.

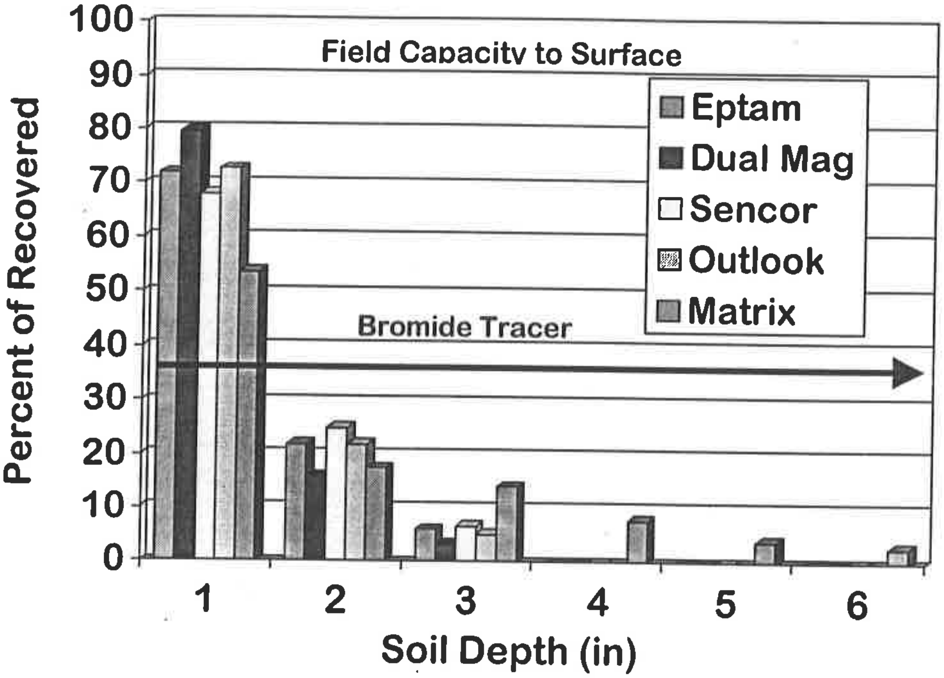

Figure 2. Vertical distribution of Eptam, Dual Magnum, Sencor, Outlook, and Matrix in six inch soil column following simulated chemigation with 0.5 inches of water. Column consisted of 6 inches of soil at field capacity. Soil moisture at application significantly reduced herbicide retention, especially for Matrix.

OBJECTIVES FOR 2002:

This project developed some preliminary data suggesting that herbicides could move through the soil profile in response to soil moisture conditions at time of application. Our plan for the 2002 season is to repeat a similar experiment under field condition at the San Luis Valley Research Center. Different soil moisture levels will be established prior to herbicide chemigation. Soil samples will be collected from each treatment area to a depth of 12 inches and analyzed for herbicide by GC/MS or HPLC depending on the herbicide. In addition to the herbicides previously evaluated Spartan will also be include so that we can evaluate the movement potential of this new herbicide.

FUNDING REQUEST:

2001 Allocation: $8,000

2002 Request: $9,000

Item	**Cost**
Support staff-Lab manager -building columns -herbicide applications -extracting soil sample -GC-MS analysis -bromide analysis -data analysis	$6,000
Travel	1,000
Supplies for GC-MS	1,500
Miscellaneous Supplies	500
Total	**$9,000**

2001 –Use of Funds Report

Report on funds used rounded to the nearest dollar.

1. **Project labor**

   Laboratory Manager

-Methods development and preliminary experiments	1 month
-Actual simple analysis, quality control samples, data analysis, report generation, equipment maintenance, training hourly workers, clean up.	3 months

   Student hourly

-Construction of soil columns, weighing soils samples, sample preparation, clean up, general duties.	4 months

   Laboratory manager: 4 months @ $3,500=$14,000
   Student hourly: 4 months @1,200=$4,800

   Total Labor $18,800

2. **Project Travel: $0.0**

3. **Project Chemicals:** analytical standard from Sigma $500
   Total Chemical Costs: $500

4. **Project Ag Supplies: $0.0**

5. **Project Equipment:**

New autosampler tray	$950
Electron multiplier	$1,200

   Total equipment $2,150

6. **Project Misc.**

Sample vials	$100
Pipette tips	$200
Organic solvents	$150
Total Misc.	**$450**

Total Expenses	**$21,900**
SLVRCC	**$8,000**
Balance	**-$13,900**

SUMMARY RESEARCH PROGRESS REPORT FOR 2001
AND RESERCH PROPOSAL FOR 2002

Submitted to:

SLV Research Center Committee
and the Colorado Potato Administrative Committee (Area II)

TITLE: Comparison of Potato Vine Kill with Sulfuric Acid (simulated), Diquat, Desicate II, and Rely When Vines Remain Immature from Fungicide Applications (new title).

PROJECT LEADERS: Dr. Scott Nissen, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins.

IMPACT STATEMENT: Managing late blight to maintain the quality of SLV potatoes is a top priority; however, since most potatoes are stored for future delivery efforts most be made to insure that tubers are sufficiently mature to withstand significant handling. This research project attempts to understand the influence of aggressive late blight management on tuber maturity in order to maintain the salability stored tubers.

PROJECT JUSTIFICATION: Potato producers are concerned that intensive fungicide programs designed to manage late blight could be affecting tuber maturity by maintaining vines in an immature state. Tubers harvested without sufficient skin set could be easily bruised or skinned during handling.

In the SLV, most vines are killed with sulfuric acid. Sulfuric acid is effective and causes the most rapid rate of vine desiccation. Other vine desiccation products that could be used for potato vine kill in addition to sulfuric acid include Diquat, Desicate II or endothall and Rely. Aventis received a label for "Rely" for 2000 as a potato vine desiccant. Little information is available on potato vine desiccation with these products in the SLV.

PROJECT STATUS: Continuing

SIGNIFICANT ACCOMPLISHMENTS FOR 2001:

- We redirected research efforts on vine kill to focus on interactions between fungicide applications which prolong the immature nature of vines and vine desiccation with sulfuric acid, Diquat, Desicate II, and Rely under field conditions in the SLV. Plots were planted to Russet Nuggets and Ida Rose to evaluate differences between varieties. Nuggets produce significant vines and can been difficult to kill, while Ida Rose are often bruised or skinned during processing due to poor skin set. Two fungicide treatment levels were established using 2-3 fungicide applications with 2 Quadris applications compared to a 7 to 10 day fungicide program alternating Quadris with Bravo. Both programs begin around July 1 and were followed throughout the growing season. The two fungicide programs were successful in establishing different levels of vine maturity before vine kill. The intensive fungicide program resulted in vines that were green and erect when vine kill treatments were made on August 30. Vines in the less intense fungicide program were already senescing and had begun to drop leaves. Unfortunately, a hail storm occurred the previous week and vines were showing significant signs of hail injury.

- Vine kill treatments were applied on August 30th and consisted of natural senescence (control), hand removal of vines to simulate sulfuric acid applications, Diquat, Desicate II, and Rely. All applications were made at the higher end of the recommended use rates (especially for Diquat and Desicate II) and applied in 20 gal/ac using a CO_2 backpack sprayer. Plots were harvested on September 20th using the two row digger and graded. Subsamples were taken for immediate analysis for skin set using a variation of the torque meter test described by Halderson and Henning (Am. Pot. J. 70:132-141).

- A killing frost occurred about 5 days after vine kill treatments were applied which probably eliminated any treatment effects due to vine kill treatments. There were no significant difference in yield due to high vs low fungicide programs and there were no difference in yield comparing vine kill treatments. Skin set within variety was not affected by fungicide or vine kill treatment, but Nugget skin set values were significantly higher than Ida Rose values. Due to space limitations treatments were replicated only three times which may have reduce our ability to evaluate treatment differences. The hail storm before and killing frost following treatments may also have added variation that masked treatment differences.

Table 1. Summary of skin set and yield data form vine kill study.

Vine Kill	Fungicide Rate	Rate Lb ai/ac	Rose Skin set oz/in	Nugget Skin set oz/in	Rose Yield Cwt/ac	Nugget Yield Cwt/ac
Control	High	-	91	102	324	324
Sulfuric (pulled)	High	-	82	97	305	361
Rely+AMS	High	0.38 + 5	88	106	277	292
Diquat NIS	High	0.5 0.25%	84	101	264	292
Desicate LI 700 AMS	High	1.0 0.5% 5	85	102	281	343
Control	Low	-	85	101	248	309
Sulfuric (pulled)	Low	-	92	105	254	337
Rely+AMS	Low	0.38 + 5	85	96	279	316
Diquat NIS	Low	0.5 0.25%	84	99	240	314
Desicate LI 700 AMS	Low	1.0 0.5% 5	87	99	246	332
			ns	ns	ns	ns

OBJECTIVES FOR 2002:

- I would like to continue this research for a second year in hopes of having better weather conditions before and after treatment. The fungicide programs did a good job of establishing different levels of vine maturity so I think we were successful in our initial goal. The weather did not cooperate and with a killing frost shortly after vine kill applications any physiological differences produced by the vine kill treatments were masked. For 2002, a better strategy would be to start the vine kill process earlier in order to see treatment differences and have enough room to have four replications as apposed to three replications in 2001.

FUNDING REQUEST:

2001 Allocation: $5,000

2002 Request: $5,000

Item	**Cost**
Field Support Salaries-technical, student hourly -establishing plots -fungicide and desiccant applications -harvest, grading, data analysis	$3,000
Travel-vehicle rental, mileage charges, lodging, food, for multiple trips for fungicide, desiccant and yield evaluations	1,500
Miscellaneous Supplies	500
Total	**$5,000**

2001 –Use of Funds Report

Report on funds used rounded to the nearest dollar.

1. **Project labor**

PI has 9 month contract (summer salary)	1 week	$1,500
Research associate	1 week	$875
Student hourly and 2 labors for two days	3@ 2 days	$480

   Total Labor $2,855

2. **Project Travel:** Three trips of two days each with meals and lodging for 2-3 people ($200/trip vehicle charges, rooms $50/night, meals $25/day).
   Total travel $1,450

3. **Project Chemicals: $0.0**

4. **Project Ag Supplies: $0.0**

5. **Project Equipment: $0.0**

6. **Project Misc.**
   Portable field scale $600
   Nozzles extra plus spray bottles $50
   Total Misc. $650

Total expenses $4,955

SLVRCC Funding $5,000

The Influence of Fungicide Programs on Potato Vine Kill

Colorado State University - Weed Science

Project Code: POT093 **Location:** Center, CO **Cooperator:** Susie Thompson
CPAC Area II

Site Description

Crop: Potatoes **Variety:** Nugget and Ida Rose **Planting Date:** May 15
Plot Width: 10 feet **Plot Width:** 25 feet **Replications:** 3

Irrigation Type: Solid set sprinkler

Soil Description

Texture	%OM	%Sand	%Silt	%Clay	PH	CEC
Loamy Sand	1.0				7.8	

Application Information

	A
Application Date	8-30-01
Time of Day	11:00 AM
Application Method	Broadcast/Backpack
Application Timing	Pre Harvest
Air Temp (F)	76
Soil Temp (F)	60
Relative Humidity (%)	24
Wind Velocity (mph)	1 to 4 SE

Application Equipment

Sprayer Type	Speed (mph)	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	PSI
Back Pack	3.0	Flat Fan	11002	18”	20”	6.7’	30	31

Summary Comments

The purpose of this field study was to evaluate the effects of different fungicide treatments on vine kill and skin set of two varieties. Greater fungicide use has resulted in potato vines that are relatively immature at harvest. This means that there is more foliage at vine kill which can reduce the efficiency of vine kill products and reduce skin set. Two fungicide programs were initiated. One program was fungicide applications every seven days, while the second program consisted of two treatments before vine kill. Vine desiccation was started on August 30. Unfortunately, the research station was hailed several days before and a hard freeze occurred 7 days after application.

The fungicide programs resulted in different vine conditions at application. The high fungicide program resulted in much greater foliage at application. Perhaps because of the killing frost 7 days after application, yields and skin set evaluation were not significantly different across treatments; however, Ida Rose had lower skin set values compared to Russet Nugget.

The Influence of Fungicide Programs on Potato Vine Kill

Colorado State University

Trial ID: POTO093
Location: Center, CO

Cooperator: Susie Thompson, CPAC Area II
Investigator: CSU Weed Science, Dr Scott Nissen

Weed Code Crop Code Part Rated Rating Data Type Rating Unit Rating Date						Potato Rose +12oz Yield Cwt/ac 9-20	Potato Rose 6-12oz Yield Cwt/ac 9-20	Potato Rose 4-6oz Yield Cwt/ac 9-20	Potato Rose <4oz Yield Cwt/ac 9-20	Potato Rose Culls Yield Cwt/ac 9-20	Potato Rose 2's Yield Cwt/ac 9-20
Trt No.	Treatment Name	Fungicide	Rate	Rate Unit	Growth Stage						
1	Control	High			PREHAR	5 a	84 ab	81 a	30 a	0 a	10 abc
2	Sulfuric (Handpull)	High			PREHAR	5 a	89 a	64 a	21 a	0 a	14 a
3	Rely AMS	High	0.38 5	LB A/A LB/A	PREHAR PREHAR	2 a	58 a-d	85 a	24 a	0 a	8 abc
4	Diquat NIS	High	0.5 0.25	LB A/A % V/V	PREHAR PREHAR	0 a	58 a-d	66 a	25 a	0 a	13 ab
5	Desicate II LI 700 AMS	High	1.0 0.5 5	LB A/A % V/V LB/A	PREHAR PREHAR PREHAR	0 a	79 abc	67 a	27 a	0 a	7 bc
6	Control	Low			PREHAR	6 a	45 cd	68 a	35 a	0 a	5 c
7	Sulfuric (Handpull)	Low			PREHAR	4 a	59 a-d	59 a	30 a	1 a	7 bc
8	Rely AMS	Low	0.38 5	LB A/A LB/A	PREHAR PREHAR	4 a	64 a-d	67 a	39 a	3 a	3 c
9	Diquat NIS	Low	0.5 0.25	LB A/A % V/V	PREHAR PREHAR	8 a	43 d	56 a	29 a	0 a	9 abc
10	Desicate II LI 700 AMS	Low	1.0 0.5 5	LB A/A % V/V LB/A	PREHAR PREHAR PREHAR	2 a	50 bcd	55 a	37 a	0 a	8 abc
LSD (P=.05)						8.1	30.4	42.6	21.1	3.2	6.3
Standard Deviation						4.7	17.7	24.8	12.3	1.8	3.6
CV						132.47	28.16	37.11	41.44	426.21	43.91

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

The Influence of Fungicide Programs on Potato Vine Kill

Colorado State University

Trial ID: POTO093
Location: Center, CO

Cooperator: Susie Thompson, CPAC Area II
Investigator: CSU Weed Science, Dr Scott Nissen

Weed Code						Potato	Potato	Potato	Potato	Potato	Potato
Crop Code						Nuggets	Nuggets	Nuggets	Nuggets	Nuggets	Nuggets
Part Rated						+12 oz	6-12 oz	4-6 oz	<4 oz	Culls	2's
Rating Data Type						Yield	Yield	Yield	Yield	Yield	Yield
Rating Unit						Cwt/ac	Cwt/ac	Cwt/ac	Cwt/ac	Cwt/ac	Cwt/ac
Rating Date						9-20	9-20	9-20	9-20	9-20	9-20
Trt No.	Treatment Name	Fungicide	Rate	Rate Unit	Growth Stage						
1	Control	High			PREHAR	7 a	86 a	84 a	30 a	0 a	4 a
2	Sulfuric (Handpull)	High			PREHAR	28 a	98 a	67 a	28 a	1 a	7 a
3	Rely AMS	High	0.38 5	LB A/A LB/A	PREHAR PREHAR	10 a	77 a	64 a	30 a	2 a	9 a
4 4	Diquat NIS	High	0.5 0.25	LB A/A % V/V	PREHAR PREHAR	14 a	61 a	68 a	38 a	3 a	4 a
5	Desicate II LI 700 AMS	High	1.0 0.5 5	LB A/A % V/V LB/A	PREHAR PREHAR PREHAR	22 a	92 a	70 a	30 a	3 a	9 a
6	Control	Low			PREHAR	10 a	66 a	78 a	37 a	4 a	4 a
7	Sulfuric (Handpull)	Low			PREHAR	20 a	75 a	77 a	35 a	0 a	11 a
8	Rely AMS	Low	0.38 5	LB A/A LB/A	PREHAR PREHAR	15 a	82 a	67 a	39 a	0 a	0 a
9	Diquat NIS	Low	0.5 0.25	LB A/A % V/V	PREHAR PREHAR	22 a	82 a	64 a	31 a	1 a	3 a
10	Desicate II LI 700 AMS	Low	1.0 0.5 5	LB A/A % V/V LB/A	PREHAR PREHAR PREHAR	8 a	91 a	68 a	40 a	0 a	4 a
LSD (P=.05)						21.9	42.6	27.0	18.2	4.2	12.1
Standard Deviation						12.7	24.8	15.7	10.6	2.5	7.1
CV						81.83	30.65	22.3	31.46	195.34	126.26

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

The Influence of Fungicide Programs on Potato Vine Kill

Colorado State University

Trial ID: POTO093
Location: Center, CO

Cooperator: Susie Thompson, CPAC Area II
Investigator: CSU Weed Science, Dr. Scott Nissen

Weed Code
Crop Code
Rating Data Type
Rating Unit
Rating Date

Trt No.	Treatment Name	Fungicide	Rate	Rate Unit	Growth Stage	Potato Rose Skin Set 9-20-01	Potato Nuggets Skin Set 9-20-01	Potato Rose Yield Cwt/ac 9-20-01	Potato Nuggets Yield Cwt/ac 9-20-01
1	Control	High			PREHAR	91 a	102 a	324 a	324 a
2	Sulfuric (Handpull)	High			PREHAR	82 a	97 a	305 a	361 a
3	Rely	High	0.38	LB A/A	PREHAR	88 a	106 a	277 a	292 a
3	AMS		5	LB/A	PREHAR				
4	Diquat	High	0.5	LB A/A	PREHAR	84 a	101 a	264 a	292 a
4	NIS		0.25	% V/V	PREHAR				
5	Desicate II	High	1.0	LB A/A	PREHAR	85 a	102 a	281 a	343 a
5	LI 700		0.5	% V/V	PREHAR				
5	AMS		5	LB/A	PREHAR				
6	Control	Low			PREHAR	85 a	101 a	248 a	309 a
7	Sulfuric (Handpull)	Low			PREHAR	92 a	105 a	254 a	337 a
8	Rely	Low	0.38	LB A/A	PREHAR	85 a	96 a	279 a	316 a
8	AMS		5	LB/A	PREHAR				
9	Diquat	Low	0.5	LB A/A	PREHAR	84 a	99 a	240 a	314 a
9	NIS		0.25	% V/V	PREHAR				
10	Desicate II	Low	1.0	LB A/A	PREHAR	87 a	99 a	246 a	332 a
10	LI 700		0.5	% V/V	PREHAR				
10	AMS		5	LB/A	PREHAR				
LSD (P=.05)						12.33	11.20	75.9	78.0
Standard Deviation						7.19	6.53	44.2	45.4
CV						8.34	6.49	16.28	14.11

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

SUMMARY RESEARCH PROGRESS REPORT FOR 2001
AND RESERCH PROPOSAL FOR 2002

Submitted to:

SLV Research Center Committee
and the Colorado Potato Administrative Committee (Area II)

TITLE: Continued Evaluations of New Herbicides for Weed Control in Potatoes

PROJECT LEADERS: Dr. Scott Nissen, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins.

IMPACT STATEMENT: Production costs continue to increase without subsequent increases in market prices for potatoes. New herbicides evaluations are designed to identify new, more effective and less expensive products for weed management in potato production and develop data necessary to commercialize these products through IR-4. Technology developed through this program could reduce weed management costs by $14/ac, saving the SLV potato industry approximately $1.2 million annually.

PROJECT JUSTIFICATION: Matrix was the first new herbicide labeled for use in potatoes in more than twenty years. The wide spread occurrence of ALS resistant kochia and carryover problems to sugar beets have producers and weed scientists concerned. Evaluating new products for weed control in potatoes has been a major focus of my research effort for the past 4 years. This work has been conducted primarily along the Front Range, but with the identification of two very promising herbicides the research needs to expand to the SLV for evaluate weed spectrum and variety tolerance issues.

Consolidation in the agricultural chemical industry and significant cut backs in funding for applied research make support from commodity groups more important then ever. Commodity support can help with initial screening studies and to develop the type of data necessary to convince a chemical company that a product fits a market that could potentially be profitable. Based on research that was largely self-funded or funded with support from Area III growers, two exciting new compounds have been identified. Spartan was discovered and is marketed by FMC and has excellent broadleaf weed control including all nightshade species, redstem filaree, pigweed, lambsquarters and common mallow. Field tests indicate that applications of Spartan at rates as low as 0.125 lb ai/ac in combination with Dual will provide season long weed control with no measurable crop response. Valor is marketed by Valent and is currently being used in the fruit tree and vine crop market. Valor also has an excellent spectrum for broadleaf weed control in potatoes because of its activity on all nightshade species. Valor is non-mobile in the soil and so would fit well in areas where herbicide movement to ground-water is an issue. These products would be applied as PRE/drag-off type treatments and so would be compatible with current weed management practices.

PROJECT STATUS: Continuing

SIGNIFICANT ACCOMPLISHMENTS FOR 2001:

We continue to generate more baseline data to support the use of Spartan and Valor as alternative herbicide modes of action for weed control in potatoes. The final hilling operation for this plot area occurred around June 1 and we arrived at the station to make our herbicide applications on June 3rd. Potatoes had emerged so we made what should have been drag-off or PRE applications to emerged potatoes. From the stand point of developing a complete understanding of how these products might be used or misused this was an excellent opportunity to evaluate potential crop response. The experiment consisted of 16 treatments that included Sencor, Matrix, Dual Magnum, Outlook, Spartan, Valor, and azafenidin (Milestone) treatments. Potato response and weed control were evaluated twice and total yield was measured on September 20th. No vine kill application was necessary due to hail and killing frost in late August and early September.

Greater crop response was anticipated since potatoes had emerged at the time of application; however, the observed injury was above acceptable levels for very few treatments. These were treatments that contained Valor or azafenidin. Crop injury was at or below acceptable levels for all treatments by July 12th evaluations. Overall weed control was good to excellent for redstem filaree, hairy nightshade and pigweed for all treatments. Valor, Spartan and azafenidin treatments that did not contain Dual Magnum, Outlook or Matrix did not provide adequate grass control. This is not surprising since these herbicides are almost exclusively activity on broadleaf weeds. Weed control with Spartan and Valor combined with Dual Magnum or Outlook was the same as Sencor+Dual Magnum or Matrix+Dual Magnum treatments. Outlook performed as well as Dual Magnum in all cases.

This means that there will be three new products that can help producers keep potato production costs under control at least from the standpoint of weed management. Spartan for example would be an alternative for Sencor and Matrix. The use rate for most potato soils would be 2.5 oz product/ac. At the suggested retail price of $61/lb, Spartan would cost less than $10 an acre, which would be significantly cheaper than Matrix and similar in cost to a low rate Sencor application.

OBJECTIVES FOR 2002:

Continue evaluations of Spartan and Valor in tank mixes with Dual Magnum, Outlook, and Prowl. In 2001, space as somewhat limited so no tank mix combinations with Prowl were evaluated; however, Spartan plus Prowl could provide very cost effective weed control. If weed control and yields were comparable to other treatments this program would cost between $15-17/ac. A significant amount of data supports Spartan or Valor plus Dual Magnum or Outlook combinations, but I have not conducted extensive research on Spartan or Valor plus Prowl treatments. In a Spartan+Prowl program, Spartan would be providing all the nightshade control. Greenhouse dose response data indicates that Spartan has excellent activity on hairy nightshade and provided greater than 85% control at rates of 0.32 oz prod/ac. Comparing these treatments to standard treatments that include Matrix, Dual, and Sencor, could provide simple cost/benefit analysis to evaluate treatments. Crop response, weed control and yield information to support of future labels for these products on potatoes is the major focus of this research.

A Section 18 request for Spartan use in potatoes has been submitted by the CDA with supporting data from CSU. If the EPA grants the Section 18, I hope to make three field scale chemigation treats using off station cooperators. This would be the first large chemigation applications made for Spartan. If this product is going to have an impact on potato weed management in San Luis Valley, we need to know how it works when applied by chemigaiton. I have as small chemigation system that would allow for small pie shaped plots between 3 and 7 acres. This project does not depend on CPAC funding.

FUNDING REQUEST:

2000 Allocation: $4,000

2001 Request: $4,000

Item	**Cost**
Field Support Salaries-technical, student hourly -establishing plots -herbicide applications -handweeding of untreated plots -harvest, grading, data analysis	$3,500
Miscellaneous Supplies	500
Total	**$4,000**

2001 –Use of Funds Report

Report on funds used rounded to the nearest dollar.

1. **Project labor**

PI has 9 month contract (summer salary)	1.5 week	$2,250
Research associate	1 week	$875
Student hourly	3 days	$240

   Total Labor $3,365

2. **Project Travel:** Four trips of two days each with meals and lodging for 1-2 people ($200/trip vehicle charges, rooms $50/night, meals $25/day).
   Total travel $1,900

3. **Project Chemicals: $0.0**

4. **Project Ag Supplies: $0.0**

5. **Project Equipment: $0.0**

6. **Project Misc.**
   Total Misc. $0.0

Total expenses	**$5,265**
SLVRCC Funding	**$4,000**

Continued Evaluations of New Herbicides for Potato Weed Control

Colorado State University – Weed Science

Project Code: POTA051 **Location:** Center, CO **Cooperator:** CPAC Area II

Site Description

Crop: Potatoes **Variety:** Norkotah **Planting Date:** May 15
Plot Width: 6.7 feet **Plot Width:** 30 feet **Replications:** 3

Irrigation Type: Solid set sprinklers

Soil Description

Texture	%OM	%Sand	%Silt	%Clay	pH	CEC
Loamy Sand	1.0				7.8	

Application Information

	A
Application Date	6-3-2001
Time of Day	9:30 AM
Application Method	Broadcast
Application Timing	Post
Air Temp (F)	69
Soil Temp (F)	-
Relative Humidity (%)	18
Wind Velocity (mph)	13

Application Equipment

Sprayer Type	Speed (mph)	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	PSI
Back Pack	3.0	Flat Fan	11008	18”	20”	6.7’	20	30

Summary Comments

Valor, Spartan and azafenidin (Milestone) should be applied PRE because of potential crop response. Potatoes were emerged at application resulting in greater initial injury with some treatments containing Valor, Spartan and azafenidin. This did provide an opportunity to evaluate injury potential of these herbicides. Treatments containing Valor and azafenidin seemed to cause more early season crop response than other treatments; however, this did not result in significant differences in total yield.

Broadleaf weed control was excellent with all treatments, but Valor, Spartan and azafenidin applied alone did not provide sufficient barnyardgrass control. Combinations of Valor and Spartan with Outlook, Dual Magnum or Matrix provided excellent grass and broadleaf weed control. Matrix was used in this case to provide grass activity. Valor and Spartan would provide an alternative for control of ALS or triazine resistance kochia and pigweed.

Continued Evaluations of New Herbicides for Potato Weed Control

Colorado State University

Trial ID: Pota051
Location: Center, Colorado

Cooperator: CPAC Area II
Study Dir.: CSU Weed Science, Dr. Scott Nissen

Weed Code					Potato	Potato	EROCI	SOLSP	ECHCG	AMARE
Rating Data Type					Phyto	Phyto	Control	Control	Control	Control
Rating Unit					%	%	%	%	%	%
Rating Date					6-23-01	7-12-01	7-12-01	7-12-01	7-12-01	7-12-01
Trt No.	Treatment Name	Rate	Rate Unit	Growth Stage						
1	Non-Treated				4.0 hi	2.7 b	0.0 c	0.0 c	0.0 f	0.0 c
2	Sencor	.33	LB A/A	PRE	3.7 i	2.3 b	94.3 ab	95.7 b	99.3 a	99.0 ab
2	Dual Mag	1	LB A/A	PRE						
3	Matrix	.024	LB A/A	PRE	4.3 ghi	4.7 ab	94.7 ab	98.0 ab	97.3 a	97.0 b
3	Dual Mag	1	LB A/A	PRE						
4	Sencor	.33	LB A/A	PRE	6.0 e-i	4.7 ab	91.7 ab	97.3 ab	98.3 a	99.0 ab
4	Outlook	.64	LB A/A	PRE						
5	Matrix	.024	LB A/A	PRE	8.7 c-f	7.3 ab	95.7 ab	98.3 ab	100.0 a	99.0 ab
5	Outlook	.64	LB A/A	PRE						
6	Spartan	.094	LB A/A	PRE	9.7 cde	6.0 ab	85.0 b	100.0 a	76.7 bc	100.0 a
7	Spartan	.125	LB A/A	PRE	8.3 c-g	9.0 a	94.0 ab	99.0 a	81.7 b	100.0 a
8	Valor	.047	LB A/A	PRE	8.0 d-h	7.3 ab	91.7 ab	99.0 a	65.0 d	100.0 a
9	Valor	.094	LB A/A	PRE	20.0 a	6.3 ab	98.0 a	99.0 a	74.0 c	100.0 a
10	Spartan	.125	LB A/A	PRE	5.3 f-i	5.0 ab	91.7 ab	100.0 a	98.3 a	100.0 a
10	Outlook	.64	LB A/A	PRE						
11	Valor	.047	LB A/A	PRE	12.3 bc	8.3 ab	96.7 ab	100.0 a	100.0 a	100.0 a
11	Outlook	.64	LB A/A	PRE						
12	Spartan	.125	LB A/A	PRE	11.3 bcd	8.0 ab	95.0 ab	100.0 a	99.0 a	100.0 a
12	Dual Mag	1	LB A/A	PRE						
13	Valor	.047	LB A/A	PRE	15.0 b	6.0 ab	92.3 ab	100.0 a	98.0 a	99.0 ab
13	Dual Mag	1	LB A/A	PRE						
14	Spartan	.125	LB A/A	PRE	5.3 f-i	4.0 ab	87.3 ab	100.0 a	96.7 a	100.0 a
14	Matrix	.024	LB A/A	PRE						
15	Valor	.047	LB A/A	PRE	7.7 d-i	5.7 ab	91.7 ab	98.0 ab	97.3 a	99.0 ab
15	Matrix	.024	LB A/A	PRE						
16	Azafenidin	.0625	LB A/A	PRE	13.7 b	8.3 ab	90.0 ab	100.0 a	56.7 e	98.3 ab
LSD (P=.05)					3.61	5.20	10.20	2.83	7.08	1.94
Standard Deviation					2.17	3.12	6.12	1.70	4.25	1.16
CV					24.18	52.21	7.05	1.83	5.08	1.25

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Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

Continued Evaluations of New Herbicides for Potato Weed Control

Colorado State University

Trial ID: Pota051
Location: Center, Colorado
Cooperator: CPAC Area II
Study Dir.: CSU Weed Science, Dr. Scott Nissen

Weed Code					EROCI	SOLSP	ECHCG	Potato
Rating Data Type					Control	Control	Control	Yield
Rating Unit					%	%	%	Cwt/A
Rating Date					8-30-01	8-30-01	8-30-01	9-20-01
Trt No.	Treatment Name	Rate	Rate Unit	Growth Stage				
1	Non-Treated				0.0 c	0.0 c	0.0 e	354 a
2	Sencor	.33	LB A/A	PRE	94.3 ab	94.3 ab	95.7 a	382 a
2	Dual Mag	1	LB A/A	PRE				
3	Matrix	.024	LB A/A	PRE	92.7 ab	92.7 ab	94.3 a	355 a
3	Dual Mag	1	LB A/A	PRE				
4	Sencor	.33	LB A/A	PRE	93.0 ab	93.0 ab	94.0 a	398 a
4	Outlook	.64	LB A/A	PRE				
5	Matrix	.024	LB A/A	PRE	96.0 ab	96.0 ab	92.3 a	354 a
5	Outlook	.64	LB A/A	PRE				
6	Spartan	.094	LB A/A	PRE	94.8 ab	94.8 ab	71.7 b	329 a
7	Spartan	.125	LB A/A	PRE	91.7 b	91.7 b	75.0 b	369 a
8	Valor	.047	LB A/A	PRE	91.7 b	91.7 b	50.0 cd	337 a
9	Valor	.094	LB A/A	PRE	94.0 ab	94.0 ab	60.0 bc	335 a
10	Spartan	.125	LB A/A	PRE	97.3 ab	97.3 ab	95.7 a	376 a
10	Outlook	.64	LB A/A	PRE				
11	Valor	.047	LB A/A	PRE	98.0 a	98.0 a	98.3 a	360 a
11	Outlook	.64	LB A/A	PRE				
12	Spartan	.125	LB A/A	PRE	95.7 ab	95.7 ab	95.0 a	374 a
12	Dual Mag	1	LB A/A	PRE				
13	Valor	.047	LB A/A	PRE	96.3 ab	96.3 ab	96.7 a	383 a
13	Dual Mag	1	LB A/A	PRE				
14	Spartan	.125	LB A/A	PRE	95.7 ab	95.7 ab	96.0 a	420 a
14	Matrix	.024	LB A/A	PRE				
15	Valor	.047	LB A/A	PRE	95.0 ab	95.0 ab	97.3 a	413 a
15	Matrix	.024	LB A/A	PRE				
16	Azafenidin	.0625	LB A/A	PRE	96.0 ab	96.0 ab	43.3 d	367 a
LSD (P=.05)					4.95	4.95	14.47	88.1
Standard Deviation					2.97	2.97	8.66	52.8
CV					3.34	3.34	11.04	14.32

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Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)