Organic Gem Fertilizer Evaluation on Russet Burbank Potato

Dr. Bryan Hopkins
University of Idaho

April 10, 2003

Field Evaluation of Organic Gem Fertilizer on Russet Burbank Potato

Technical Report

submitted by:

Dr. Bryan Hopkins
Potato Cropping Systems Specialist / Certified Professional Soil Scientist
University of Idaho

February 21, 2003

Executive Summary:

This report contains the findings of a field evaluation of the Organic Gem Fertilizer Product as compared to a "standard" fertilizer program. The study was conducted by Dr. Bryan Hopkins at the University of Idaho Research and Experiment Station in Aberdeen, ID. This trial was conducted on Russet Burbank potato and involved comparison of the Organic Gem product to a "standard" fertilizer program based on the University of Idaho fertilizer recommendations. The findings of this study show improvement in both tuber yield and quality for the Organic Gem treated plots at the full rate of levels of both programs, although only the differences in US no. 1's were statistically significant. The average total yield improvement was 9-cwt./a when the Organic Gem product was applied. When adjustments were made for quality parameters (US no. 1's), the Organic Gem treated plots exhibited a 21-cwt./a difference. The difference in quality is partially related to an increase in size. The Organic Gem treated plots had 8-cwt./a less undersized tubers. It seems that the undersized tubers increased in size as evidenced by an 8-cwt./a increase in US no.1 4-10 oz. tubers and an 13-cwt.a increase in US no. 1 >10 oz tubers. In addition to the size increase, there was also a shift towards higher quality tubers as evidenced by a 12-cwt./a decrease in tubers with a grade less than US no. 1. Gross returns per acre (based on current year pricing) showed an increase of $91 per acre for the Organic Gem product at the full rate, as compared to the full rate of the standard fertilizer program. Net returns were $76 based on fertilizer pricing at time of application and $100 based on current pricing. It should be noted that the overall yields and quality were below average at this and many other fields in this area due to weather related limitations. It is likely that different results may be observed under more optimal growing conditions. Often, differences between treatments are greater as yields increase. Although these results show promise, it is important to realize that this data represents only one site year. Further evaluation is needed to more fully examine the value of this product in potatoes.

Study Design:

The trial location was at the University of Idaho Research and Experiment Station in Aberdeen, ID. Russet Burbank potatoes were planted, raised, and harvested following typical production practices. Plots consisted of three-36 inch rows 30 feet long arranged in a randomized complete block experimental design with 5 replications of each treatment (Table 1). This study was conducted in concert with another product evaluation, which data is not presented here.

Petiole (tissue connecting leaf to stem) is commonly sampled to ascertain nutritional needs during the growing season. Composite petiole samples were analyzed weekly during the vegetative, tuber initiation, and bulking stages in order to insure adequate nutrition throughout the plots. Additional phosphorus was applied to all plots once during the growing due to low phosphorus concentrations in the petiole samples. No other nutritional deficiencies were observed and, thus, no additional fertilizer (other than the treatments) was applied in-season. In addition to the composite sampling, petioles were sampled in each plot on 7/10/02 to establish differences induced by treatments.

The "standard" fertilizer program involved soil testing and application of nutrients based on soil test results according to University of Idaho potato fertilizer recommendations. The primary nutrient of interest in this trial is nitrogen. Nitrogen application for the standard program involved applying 40% of the nitrogen pre-plant as ammonium nitrate and the balance applied in-season through the irrigation system. The Organic Gem product was applied four times during the season, namely at: planting (5/1/02), flower onset (7/3/02), tuber enlargement (7/25/03), and maturity (8/15/03). The in-season application for the standard treatments occurred on the same dates. The fertilizer was applied at three rates, namely: 0, ½, and full rate. The ½ rate was 70 lbs-N/a and the full rate was 140 lbs-N/a. Alfalfa was the previous crop on this field and a credit of 80 lbs.-N/a was given. This credit, combined with the soil test data, resulted in a nitrogen recommendation for this field of 140 lbs-N/a based on the University of Idaho potato fertility recommendations.

The label recommendations for application of Organic Gem to potatoes called for 10-12 gallons per acre from seeding to tuber initiation followed by three applications of 5-6 gallons each at flower onset, tuber enlargement, and maturity. According to product information from Advanced Marine Technologies, the Organic Gem product has the "equivalent" of 10 lbs-N per gallon. Analysis of the material shows that the material is 2-3% total N. This would result in 250-300 lbs-N/a according to the N equivalence, which would have greatly exceeding the nitrogen requirement for this particular field based on the previous crop and residual soil nitrogen concentrations. As a result, the label rates were reduced accordingly to: 6.5 gallons/a. at planting followed by three 2.5 gallon/a. applications at the dates described previously. Based on yield data from the check plots, as well as data from another nitrogen study within the same field, it is apparent that reducing nitrogen rates for this particular field was sensible.

When applied, the product was mixed with water per the label instructions at a ratio of 15:1 (water:product). The product was agitated prior to mixing to insure a homogenous mixture. The product was sprayed either in the early morning or evening to avoid tissue burn.

Harvesting operations were completed by digging 20 feet of row (center of the plots). Grading procedures were completed by a trained grading crew of UI personnel.

Statistical analysis was completed using analysis of variance (ANOVA) and mean separation by least sum differences (LSD). Differences were evaluated at an alpha level of 0.10 for the ANOVA.

Results:

The block (replications) data is presented in Table 2. Serious stress problems were observed in block 1, which was accounted for in the statistical analysis. The raw plot data (per plot) is presented in Table 3 and converted data (per acre) for the full rate treatments is presented in Table 4. Results from the 0 and 1/2 rates were perplexing due to the confounding effects of relatively low yields and high carryover nitrogen. It is apparent that the fertilizer recommendation of 140 lbs-N/a was not accurate, most likely due to the relatively low yield (approximately 100 cwt./a less than expected) and/or the previous crop credit from the alfalfa was not adequate. Moreover, growers would likely apply a full rate and, as a result, on the comparison of the full rate of Organic Gem with the full rate of "standard" fertilizer program will be emphasized heretofore.

The average total yield improvement was 9-cwt./a when the Organic Gem product was applied (Fig. 1). More importantly, the Organic Gem treated plots exhibited a 21-cwt./a increase in US no.1 yields (Fig. 1).

The difference in quality is partially related to an increase in size. The Organic Gem treated plots had 8-cwt./a less undersized tubers (Fig. 2). It seems that the undersized tubers increased in size as evidenced by an 8-cwt./a increase in US no.1 4-10 oz. tubers and an 13-cwt.a increase in US no. 1 >10 oz tubers (Fig. 3). In addition to the size increase, there was also a shift towards higher quality tubers as evidenced by a 12-cwt./a decrease in tubers with a grade less than US no. 1 (Fig. 3).

These increases in yield and quality resulted in an increase of $91 per acre for the Organic Gem product over the standard fertilizer program (Fig. 4). These gross returns are based on current year pricing at a appropriate timing for marketing based on the following: US no. 1 4-10 oz. = $6.28/cwt.; US no 1 >10 oz. = $5.61/cwt.; US no. 2 = $4.42/cwt.; and other = $2.49/cwt. The difference in gross returns is much greater ($129 per acre) if only the statistically different paramenters (US no.1's) are included in the comparison.

These potato prices are relatively higher than normal, due to the relatively low yields observed in this area during the 2002 season. Different results would be expected with an

average potato market (~$5/cwt.), but the gross returns would always be expected to be greater than zero due to the fact that all yield and quality parameters were in favor of the Organic Gem product. The net returns would depend upon pricing of the various fertilizer programs compared in this trial, which information is not currently available.

Tissue analysis showed no significant differences for any nutrient, with the exception of nitrogen. Interestingly, the tissue from the Organic Gem plots had significantly higher total nitrogen, but less nitrate-nitrogen as compared to the standard fertilizer plots (Fig. 5). Although the same amount of nitrogen was applied to both, the Organic Gem form may have been more efficient in its conversion to N containing compounds (amino acids, proteins, etc.). It is also possible that the availability of the nitrogen from the Organic Gem material may have been more of a "slow-release" form that effectively spoon-fed the crop, which resulted in the tissue nitrogen results and possibly the yield/quality differences as well.

Summary:

The findings of this study show improvement in tuber yield and quality for Organic Gem treated plots, although only the difference in US no. 1's was statistically significant.

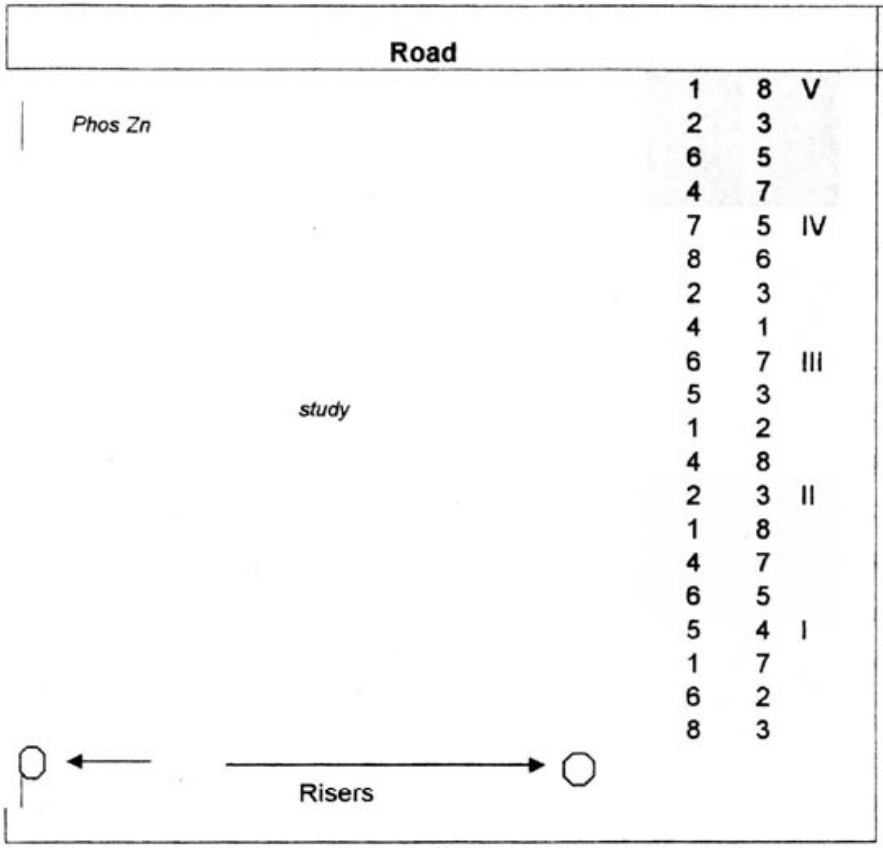
The average total yield improvement was 9-cwt./a when the Organic Gem product was applied. When adjustments were made for quality parameters, the Organic Gem treated plots exhibited a 21-cwt./a difference. The difference in quality is partially related to an increase in size. The Organic Gem treated plots had 8-cwt./a less undersized tubers. It seems that the undersized tubers increased in size as evidenced by an 8-cwt./a increase in US no.1 4-10 oz. tubers and an 13-cwt.a increase in US no. 1 >10 oz tubers.

In addition to the size increase, there was also a shift towards higher quality tubers as evidenced by a 12-cwt./a decrease in tubers with a grade less than US no. 1. Gross returns per acre (based on current year pricing) showed an increase of $91 per acre for the Organic Gem product at the full rate, as compared to the full rate of the standard fertilizer program. Based on fertilizer prices at the time of application, the net returns per acre showed an increase of $76 in favor of the Organic Gem product. However, net returns are going to fluctuate based on fertilizer pricing. For example, current pricing would result in a net return of $100 per acre in favor of the Organic Gem product.

Additionally, interesting differences were observed in-season with the nitrogen content and form in the tissue analysis. The Organic Gem product showed greater total nitrogen, but less mobile nitrogen in the nitrate form as compared to the standard fertilizer treatment.

It should be noted that the overall yields and quality were below average at this and many other fields in this area due to weather related limitations. It is possible that greater differences may be observed under more optimal growing conditions. Although these results show promise, it is important to realize that this data represents only one site year. Further evaluation is needed to more fully examine the value of this product in potatoes.

Table 1. Field plot layout of Organic Gem & Nitro + Product Evaluations



Nitro + & Organic Gem product evaluation

N Source Plots Field 411 Aberdeen R&E Center
eastern half of+A11 20' between further most west risers
10' x 30' plots

-------treatment-------		N
#	name	
1	check	0
2	1/2x N	70
3	1x N	140
4	1/2x Org Gem	70*
5	1x Org Gem	140*
6	1/2x N+	70
7	1x N+	140
8	check	0

* N Equivalents – not actual N

		1	8	V
		2	3	
		6	5	
		4	7	
		7	5	IV
		8	6	
		2	3	
		4	1	
		6	7	III
		5	3	
		1	2	
		4	8	
		2	3	II
		1	8	
		4	7	
		6	5	
		5	4	I
		1	7	
		6	2	
		8	3	

field ID	trt	block
I 20	8	V
I 19	3	V
I 18	5	V
I 17	7	V
I 16	5	IV
I 15	6	IV
I 14	3	IV
I 13	1	IV
I 12	7	III
I 11	3	III
I 10	2	III
I 9	8	III
I 8	3	II
I 7	8	II
I 6	7	II
I 5	5	II
I 4	4	I
I 3	7	I
I 2	2	I
I 1	3	I
II 20	1	V
II 19	2	V
II 18	6	V
II 17	4	V
II 16	7	IV
II 15	8	IV
II 14	2	IV
II 13	4	IV
II 12	6	III
II 11	5	III
II 10	1	III
II 9	4	III
II 8	2	II
II 7	1	II
II 6	4	II
II 5	6	II
II 4	5	I
II 3	1	I
II 2	6	I
II 1	8	I

Table 2. Block data. Block 1 was very stressed due to wind induced water stress at the corner of the field.

block	Undersized	Malformed	#1: 4-10 oz.	#1: > 10 oz.	#2: 4-10 oz.	#2: >10 oz.	total	yield
	lbs./plot (3' X 20')							cwt./a
I	3.1	6.7	12.7	7.2	2.9	3.3	36.0	261.3
II	1.9	9.4	11.6	12.3	2.4	4.6	42.2	306.1
III	3.7	5.2	18.8	10.8	2.5	2.5	43.5	316.0
IV	3.8	5.4	17.1	7.6	2.4	2.6	38.9	282.1
V	2.8	4.8	14.9	11.1	3.1	3.2	40.0	290.3

Table 3. Raw yield data.

trt	Treatment	N rate	Undersized	Malformed	#1: 4-10 oz.	#1: > 10 oz.	#2: 4-10 oz.	#2: >10 oz.
		lbs./a	lbs./plot (3' X 20')					
1	check	0	3.0	5.1	18.5	9.4	2.3	41.0
2	1/2x N	70	3.9	7.0	15.5	10.6	2.6	18.0
3	1x N	140	3.3	5.6	14.7	9.4	2.5	27.4
4	1/2x Org Gem	70	2.8	5.4	13.8	12.1	2.4	39.2
5	1x Org Gem	140	2.5	6.9	14.1	9.7	2.5	31.4

Table 4. Yields and quality parameters for the full rate comparison of Organic Gem and Standard Fertilizer programs of Russet Burbank potato.

Treatment	N rate	trt	Undersized	Malformed	#1: 4-10 oz.	#1: > 10 oz.	#2: 4-10 oz.	#2: >10 oz.
Standard	140	3	24.9	43.0	103.8	71.1	20.3	19.8
Organic Gem	140	5	16.7	43.4	117.2	79.1	17.2	18.7
difference 1x			-8.2	0.4	13.4	8.0	-3.1	-1.1

Treatment	US no.1	Other	Yield	Gross Returns
Standard	175	108	283	$1,397.43
Organic Gem	196	96	292	$1,488.70
difference 1x	21.4	-12.0	9.4	91.3

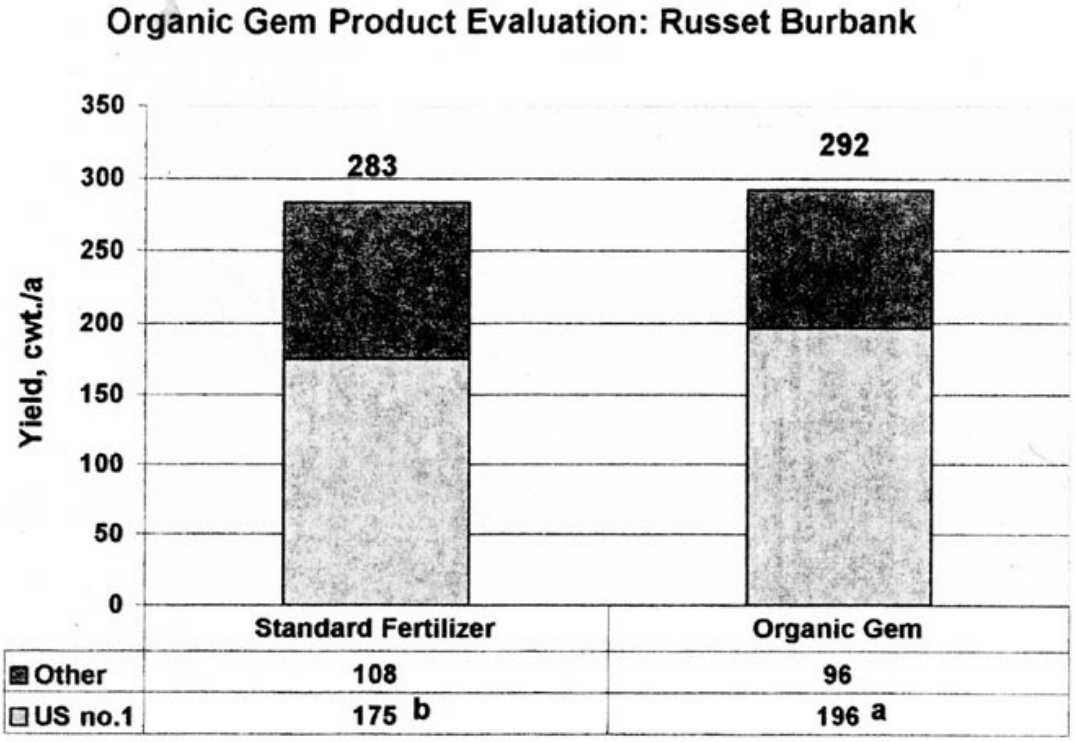


Fig. 1. Yield and overall grade information for Organic Gem fertilizer evaluation as compared to a standard UI fertilizer program. Data followed by different letters indicates a statistical difference at the alpha = 0.10 level of significance. Other differences were not statistically significant.

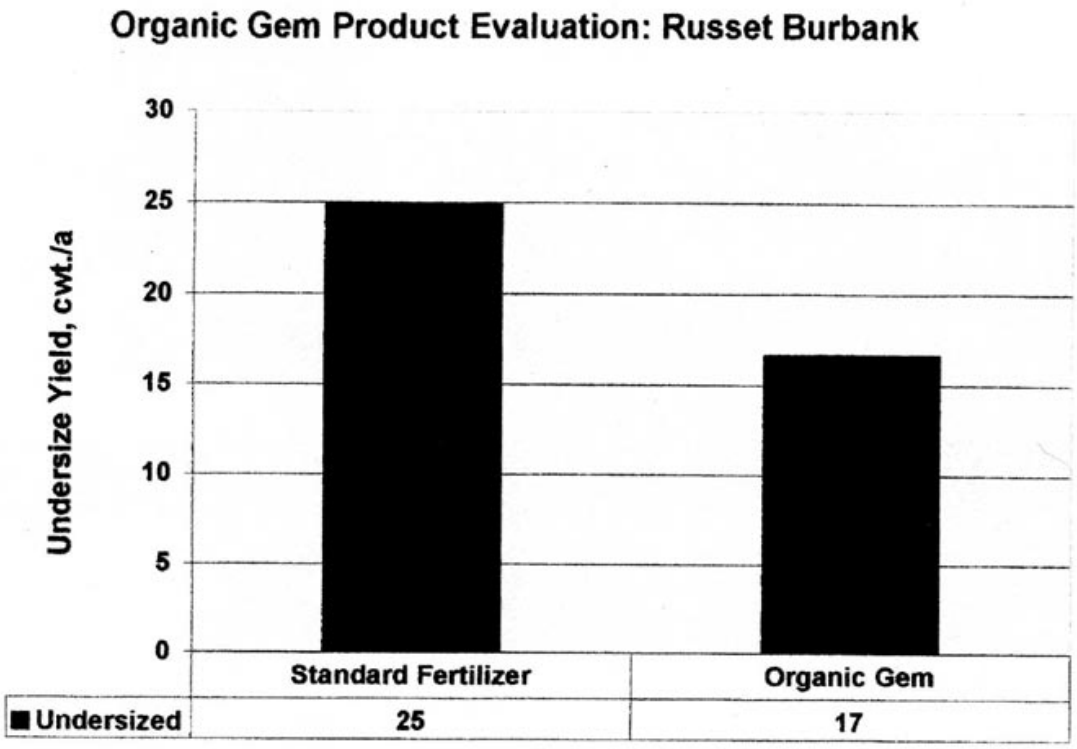


Fig. 2. Undersized (less than 4 oz) grade information for Organic Gem fertilizer evaluation as compared to a standard UI fertilizer program. Difference was not statistically significant.

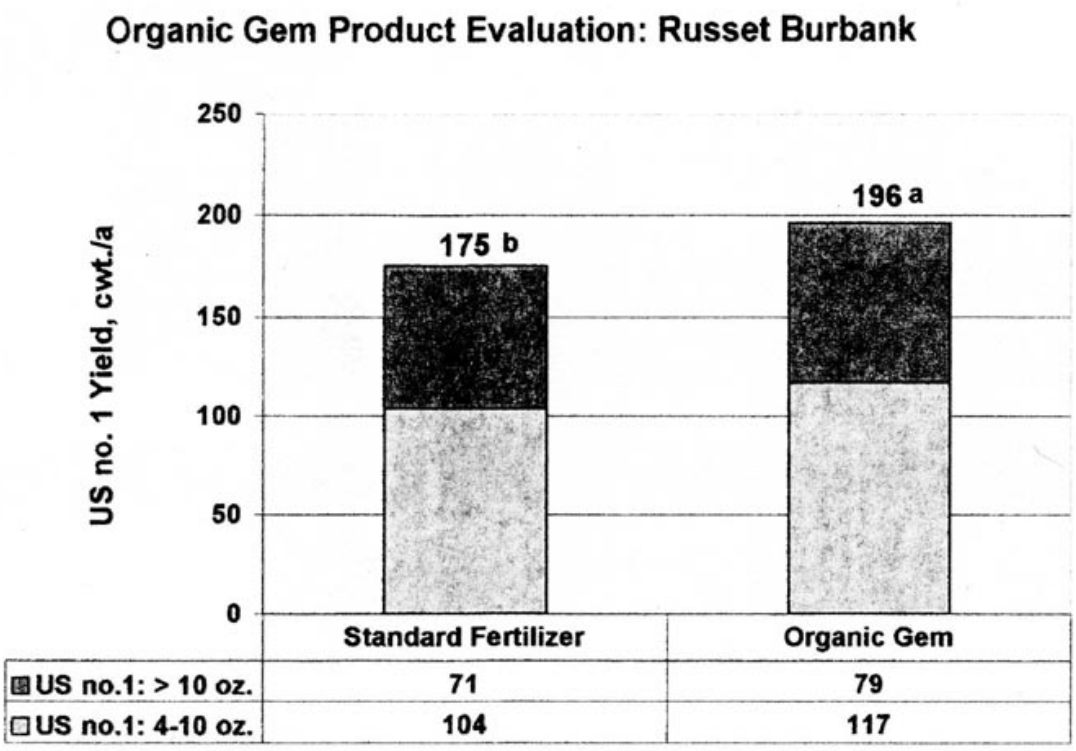


Fig. 3. Grade information for Organic Gem fertilizer evaluation as compared to a standard UI fertilizer program. Data followed by different letters indicates a statistical difference at the alpha = 0.10 level of significance. Other differences were not statistically significant.

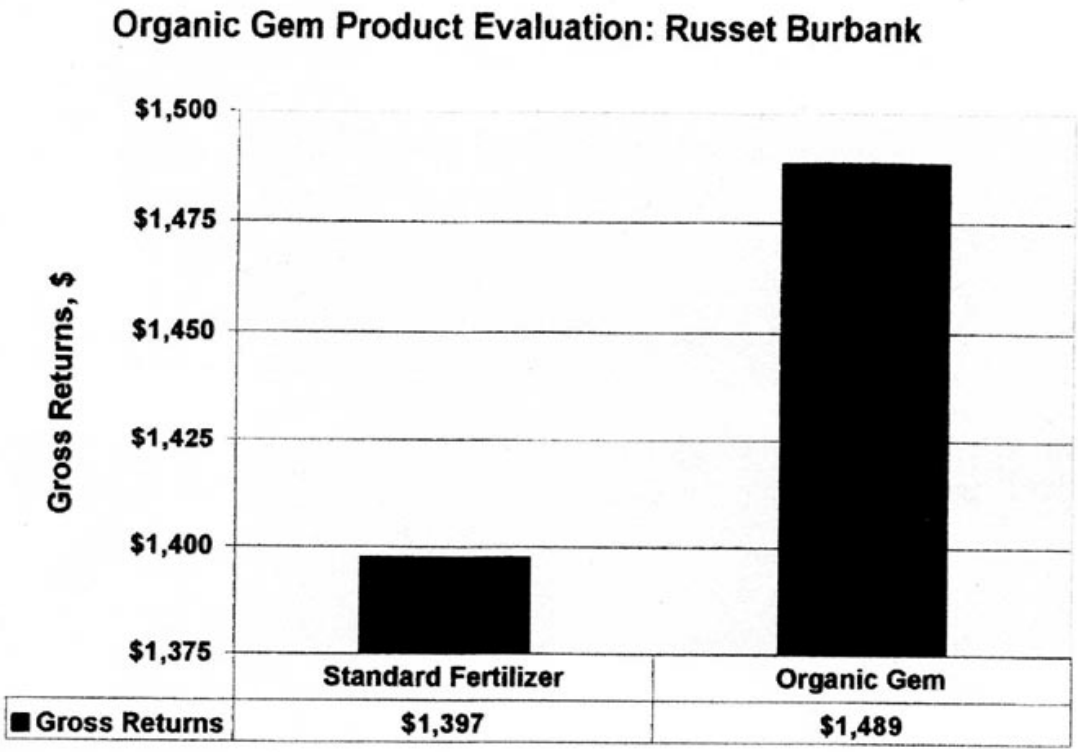


Fig. 4. Gross returns for Organic Gem fertilizer evaluation as compared to a standard UI fertilizer program.