

**SUMMARY REPORT OF 2012 SOIL AMMENDMENT RESEARCH STUDIES**  
**USING SOIL AMENDMENTS TO IMPROVE ROOT GROWTH, NUTRIENT UPTAKE,**  
**AND OPTIMIZE PROFITABILITY IN POTATO PRODUCTION**

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***Executive Summary:***

Two soil amendment products were used independently to evaluate the effect of the products on root development, nutrient uptake, and potato tuber yield. An economic analysis was performed to evaluate the economic returns of using the soil amendment products in potato production. Both products when applied to the soil increased root dry matter yield, plant nutrient uptake, and potato tuber yield. Economic analysis performed indicated that using soil amendment maximized net returns in Rio Grande Russet potato production in the San Luis Valley.

***Effect of Nutrisorb Application on Potato Performance***

Nutrisorb was applied at the rate of 18 pints/A. Root dry matter yield was increased with nutrisorb application (fig 1).

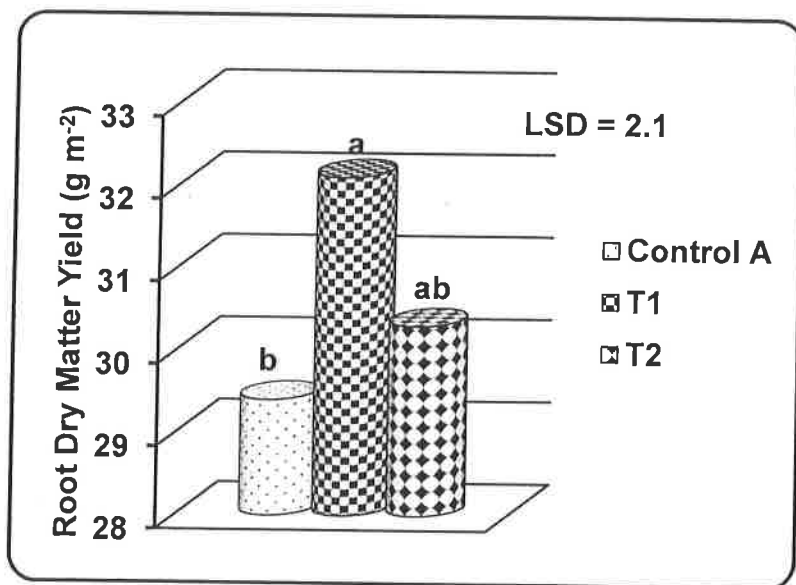


Figure 1 Interactive effect of nutrisorb and nitrogen fertilizer application rate on root dry matter yield of Rio Grande Russet potato.

Control A = Recommended rate of nitrogen fertilizer application;

T1 = Recommended N fertilizer rate + nutrisorb; T2 = 20% reduced N rate + nutrisorb;

When the data was averaged over nitrogen application rate, nutrisorb application was observed to increase plant nutrient concentration (nutrient uptake) for all macro and micro nutrients evaluated in this study, with the exception of Zn (Table 1).

The application of nutrisorb increased total tuber yield and the yield of all marketable size tuber profiles (Table 2). With the application of nutrisorb, total, > 4 oz, > 6 oz, and > 10 oz tuber yield was increased by 16%, 24%, 30%, and 59%, respectively. Over 59% of the tubers produced from the nutrisorb applied field were in the premium size (> 10 oz) distribution group, compared to 47% in the control treatment.

Table 1 Effect of Nutrisorb application averaged over Nitrogen application rate on plant nutrient concentration in Rio Grande Russet potato

Treatment	Total		P	K	Ca	Zn	Fe	Mn	B	NO3-N
	N	mg/kg								
Control	3.6	0.31	5.5	2.4	60	1041	131	42	6380	
Nutrisorb Applied	4.1	0.34	5.8	2.6	53	1169	141	46	7482	

Table 2. Effect of Nutrisorb application on tuber yield and tuber size distribution of Norkotah – 8, 2012

Treatments	Yield (cwt/ac)			
	Total	< 4oz	> 4oz	> 6oz
Control	570b	75a	495b	429b
Nutrisorb Applied	662a	48b	615a	557a
LSD	38	26	63	51
CV	3	18	5	5

Treatments	Tuber size distribution			
	10 -- 16oz	> 10oz	6 -- 16oz	6 -- 16oz
Control	183b	247b	364b	364b
Nutrisorb Applied	265a	393a	429a	429a
LSD	56	39	30	30
CV	11	5	3	3

Economic analysis performed indicated that with the price of nutrisorb estimated at \$30.00 per liter, and the price of Russet potato at \$6.00 per hundredweight (cwt), one could maximize net returns by using nutrisorb as a soil amendment.

***Effect of Bioblend Application on Potato Performance***

Bioblend was applied at a rate of 48 gallons per acre during the early stages of plant growth.

***Root Dry Matter Yield***

The application of bioblend with 10% less recommended N fertilizer increased root dry matter yield by 7.0%, compared to the use of recommended N fertilizer rate, with no application of bioblend (fig 2). The application of bioblend with no N fertilizer application did reduce root dry matter yield significantly.

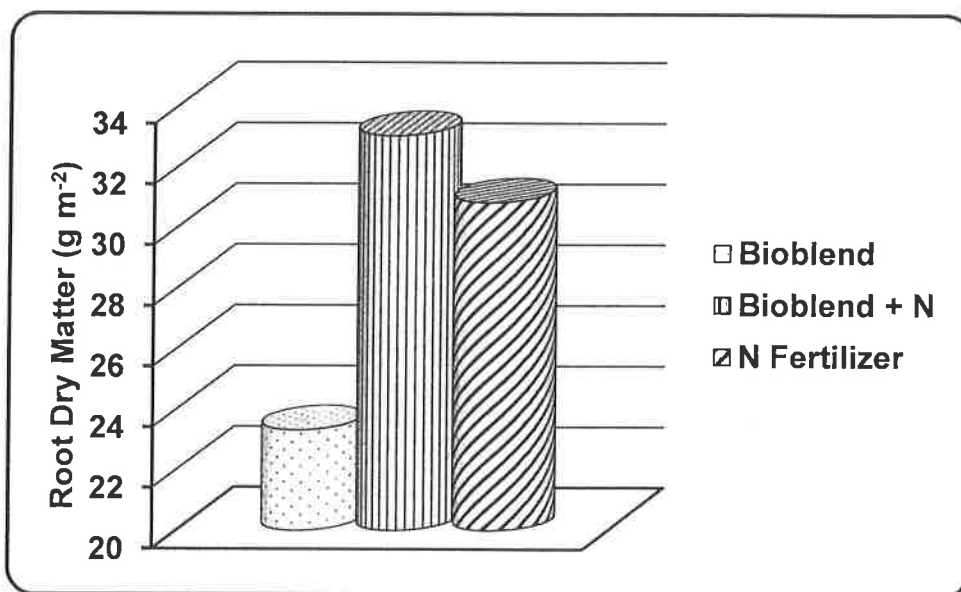


Fig 2 Effect of bioblend application on root dry matter yield of Rio Grande Russet.

Legend:  
 Bioblend + N =  
 Bioblend + 90% of  
 recommended N  
 fertilizer rate

N Fertilizer =  
 Recommended N  
 fertilizer with no  
 bioblend application

***Plant Nutrient Concentration***

The application of bioblend as soil amendment did increase plant nutrient concentration when 90% of the required N fertilizer was applied, compared to not applying any bioblend, or applying bioblend with no added nitrogen fertilizer (Table 3). The only exceptions were phosphorus, where the concentration was equal for recommended N rate and bioblend + 90% recommended N rate treatments, and Fe, where, the application of bioblend with no added fertilizer increased plant Fe concentration than all the other treatments. For all the nutrients analyzed in this study, the application of bioblend with no added N fertilizer reduced nutrient concentration in the plant, with the exception of Fe (Table 3).

Table 3 Effect of bioblend used as soil amendment on plant nutrient concentration in Rio Grande Russet potato.

Treatment	Total N	P %	K	Zn	Fe	Mn	NO <sub>3</sub> -N
						ppm	
Bioblend	2.7	0.3	5.9	53	1427	59	215
Bioblend + 90% Recommended N fertilizer Rate	4.1	0.4	6.4	74	1127	128	9580
Recommended N fertilizer Rate	3.8	0.4	6.0	46	763	108	7570

### Tuber Yield and Tuber Size Distribution

The application of bioblend with added nitrogen fertilizer did increase total, marketable (> 4 oz.), and medium size (4-10 oz.) tuber yield significantly (fig 3 and 4). Marketable and medium size tuber yield was increased by 6 and 10%, respectively. For large marketable size (6-16 oz. and > 10 oz.) tuber yield (fig 4 and 5), some yield increase was observed when bioblend was applied with added nitrogen fertilizer; however, the yield increase was not significant. In all of the tuber size distribution groups, yield was reduced when bioblend was applied without adding any nitrogen fertilizer (fig 3-5), indicating that in using bioblend as soil amendment, nitrogen fertilizer has to be added.

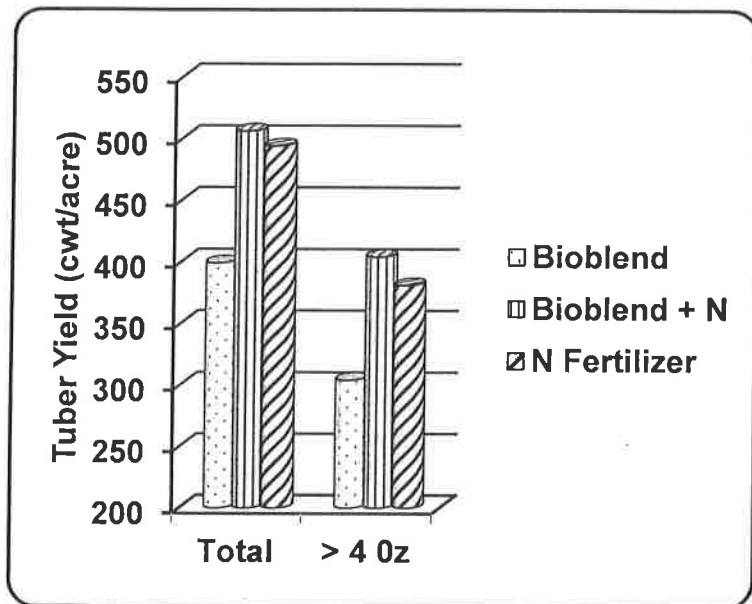


Fig 3 Effect of bioblend as soil amendment on total and marketable (> 4 oz.) tuber yield of Rio Grande Russet.

Legend:  
Bioblend + N = Bioblend + 90% of recommended N fertilizer rate

N Fertilizer = Recommended N fertilizer with no bioblend application

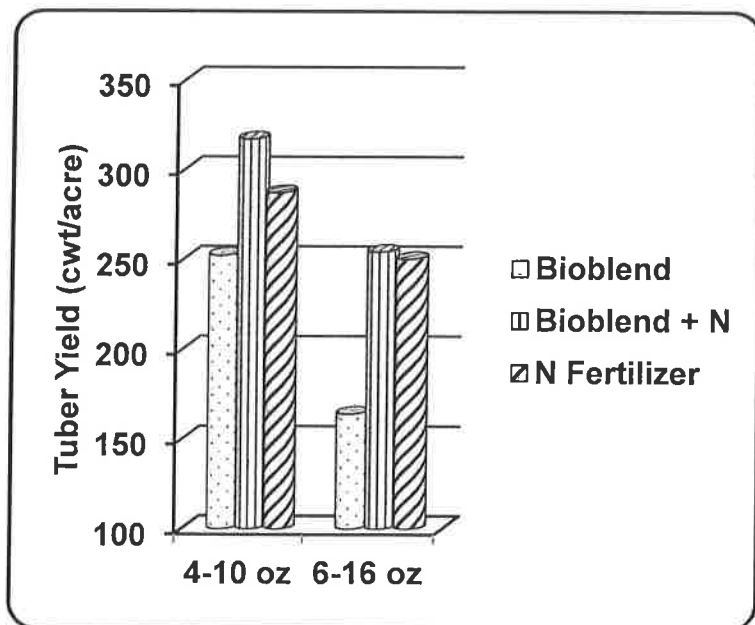


Fig 4 Effect of bioblend as soil amendment on medium size (4-10 oz.) and large marketable size (6-16 oz.) tuber yield of Rio Grande Russet.

Legend:  
Bioblend + N = Bioblend + 90% of recommended N fertilizer rate

N Fertilizer = Recommended N fertilizer with no bioblend application

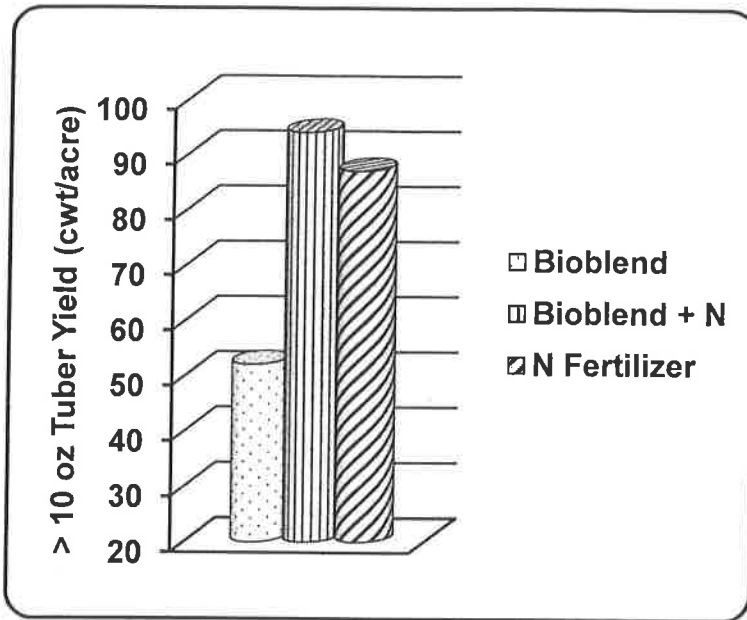


Fig 5 Effect of bioblend as soil amendment on premium size (> 10 oz) tuber yield of Rio Grande Russet.

Legend:

Bioblend + N = Bioblend + 90% of recommended N fertilizer rate

N Fertilizer = Recommended N fertilizer with no bioblend application

## SUMMARY

The purpose of this study was to evaluate the effect of applying soil amendment on potato root development, plant nutrient concentration, and tuber yield. Data from the 2012 studies indicate that the application of nuatrisorb and bioblend with added nitrogen fertilizer helped increase root development, plant nutrient uptake, and increased tuber yield. The study needs to be repeated to confirm the benefits of nutrisorb and bioblend as soil amendment.

## SUMMARY REPORT FROM DR. JORGE VIVANCO'S LAB

Dr. Samuel Essah conducted field experiments during the summer 2012 using some of the soil amendments proposed in the application such as Nutrisorb. Nutrisorb showed a positive effect on root growth and tuber development. Therefore, the Vivanco Lab devoted considerable effort searching the literature to find out a battery of genes whose expression will be correlated with the positive effects observed in the field. It was concluded that the expression of genes involved in auxin biosynthesis and transport was closely related to lateral root formation and tuberization in potato (Roumeliotis et al. 2012). Specifically, the TAA family of amino transferases, and YUCCA flavin monooxygenases are involved in tryptophan-dependent auxin biosynthesis, and *PIN1* and *PIN2* are involved in auxin polar transport. Homologues of these genes in the potato

genome were determined by performing a tBLASTn with Arabidopsis functional mRNA sequence as a query sequence to design the primer sequences specific to potato genes by employing Primer3 software for semi-quantitative RT-PCR analyses.

We gave to Dr. Essah a solution called RNA-Lock reagent that literally freezes the mRNA contained in tissues. Dr. Essah and his team collected roots of potato plants in the field treated with the soil amendments and those roots were submerged in the RNA-later solution. Briefly, the plant root samples were washed thoroughly with distilled water and cut into small pieces, and immediately immersed in the RNA-Lock reagent (1mg of tissue in 1ml reagent) to stabilize the RNA integrity and prevent degradation. Those samples were shipped to the laboratory of Dr. Vivanco at CSU. At CSU, the total RNA from the samples was extracted, cDNA was prepared and gene expression studies with the primers corresponding to the genes described above are underway. For each gene, three biological replicates per treatment will be analyzed and the level of gene expression will be calculated as fold-induction by normalizing with reference gene (eIF3e) expression followed by comparison with control.

#### **Reference**

Roumeliotis E, Kloosterman B, Oortwijn M, Kohlen W, Bouwmeester HJ, Visser RGF, Bachem CWB (2012) The effects of auxin and strigolactones on tuber initiation and stolon architecture in potato. *J Exp Bot* 63(12): 4539-4548.