ORGANIC POTATO PRODUCTION: NITROGEN MANAGEMENT AND VARIETY TRIALS

Amber Moore, Nora Olsen, Mary Jo Frazier, and Anna Carey

INTRODUCTION

Two of the biggest challenges for organic potato growers are 1) providing enough N for optimal yield and quality and 2) selecting varieties that are both high yielding and have adequate quality when grown under an organic system. Dairy composts are one of the predominant sources of N used by organic potato growers in Southern Idaho. However, organic materials that contain more than 4 % total N, such as distillers grains (DDGS), have been shown to have more than 50% N available for plant uptake in the first growing season, while plant available nitrogen from low N sources like dairy composts (0.5 – 1.5 % total N) can almost be negligible in the same time frame (Moore et al., 2010). High N nutrient sources are of utmost importance to potato growers transitioning from conventional to organic. These growers will often use sodium nitrate as a supplemental N source, despite the fact that sodium additions can compromise soil quality. Also, growers are limited to sodium nitrate application rates of no more than 20% of the crop's nitrogen requirements.

Selecting potato varieties best suited for optimal yield and quality under an organic system is an initial step in successfully growing organic potatoes. This variety selection will also depend upon whether the intended markets are for fresh, process or both. Identifying production attributes of several varieties from the various market classes will aid growers in determining which varieties may be appropriate to grow under organic conditions.

The goals of this research study were to 1) evaluate distillers grains, chilean nitrate, and fresh dairy manure as nitrogen sources to potatoes grown on certified organic cropping systems, and 2) evaluate several potato varieties for suitability in an organic system.

MATERIALS AND METHOD

Variety trial - Methods

To evaluate how different varieties respond under an organic potato production system, certified seed of 'Russet Burbank', 'Premier Russet', 'Alpine Russet', 'Classic Russet', 'Yukon Gem', 'Red LaSoda', 'All Blue', and 'Bintje' potatoes were planted April 21, 2010, in an ISDA Organic approved field at the University of Idaho Kimberly Research and Extension Center. Plots were harvested in mid-September and evaluated for yield, size profile, quality, diseases and disorders.

Presented at the Idaho Potato Conference on January 20, 2011.

Nitrogen management study - Methods

Russet Burbank potatoes were planted in a certified organic field in 2010 following winter barley. Dried distillers grains and fresh dairy manure were incorporated to a 6-inch soil depth 4 days prior to planting at four rates. DDGS were applied at three rates (1.1, 1.6, and 2.0 dry tons/acre, or 94, 134, 173 lb total N/acre). Fresh manure was applied to designated plots at a rate of 3.1 dry ton/acre, or 28 lb N/acre. Chilean nitrate was applied to selected plots at a rate of 48 lb total N/acre over three application events (July 2, July 9, and July 20, 2010).

RESULTS AND DISCUSSION

Variety trial - Results

In 2010, the rate of emergence varied greatly between varieties and Red LaSoda, Russet Burbank and Bintje exhibited rapid emergence compared to Classic Russet, Premier Russet and Alpine Russet (data not shown). There was a significant preference by Colorado potato beetles for Classic Russet and All Blue compared to Russet Burbank (data not shown). Alpine Russet and Bintje had green and vigorous vines near the end of the growing season indicating that these two varieties would be appropriate for an organic system with the potential of lower fertility conditions.

Russet Burbank yielded 400 cwt/A and Premier Russet, Alpine Russet, Yukon Gem, Red LaSoda and Bintje all yielded over 300 cwt/A under these organic conditions, whereas Classic Russet yielded 212 cwt/A (Table 1).

There were significant differences between varieties in size profile. Processing quality for Premier, Alpine, Classic, Yukon Gem, Bintje and Russet Burbank harvested tubers were acceptable as indicated by specific gravity and fry color and sugar profiles (data not shown). Russet Burbank potatoes had the poorest processing quality of the varieties evaluated. External and internal visual evaluations for disease and disorders were made at harvest. Primary issues observed were black scurf and wireworm damage. Russet Burbank had a significantly higher level of black scurf and wireworm damage was high in all varieties except All Blue and Yukon Gem had lower incidence of damage (data not shown). Premier Russet and Classic Russet had higher levels of hollow heart observed.

Table 1. 2010 total yield, marketable yield, culls, and yield of US#2 grade (cwt/A).

Variety	Total Yield (cwt/A)	US#1 (cwt/A)	US#2 (cwt/A)	>14 oz (cwt/A)	10-14 oz (cwt/A)	6-10 oz (cwt/A)	4-6 oz (cwt/A)	<4 oz (cwt/A)
Russet Burbank	400	349	38	33	10	144	75	48
Premier Russet	335	311	6	36	33	126	44	23
Alpine Russet	320	275	13	6	11	139	79	43
Classic Russet	212	203	9	51	15	64	19	9
Yukon Gem	349	290	2	3	5	145	104	59
Red Lasoda	394	369	3	53	27	165	52	24
All Blue	282	143	7	1	65	41	89	136
Binjte	385	272	33	0	66	95	129	111
LSD0.05	46	29	12	17	3	27	20	17

Nitrogen management study-Results

Overall, 2010 results supported similar findings from 2009 results of this study. Petiole nitrate concentrations trended higher for all Chilean nitrate treatments compared to treatments not receiving Chilean nitrate applications, as was also seen in 2009 (table 2). The combination of distillers grains and Chilean nitrate as well as distillers grains only applications appeared to increase yields, while the addition of Chilean nitrate alone had no effect on yield (table 2). Fresh dairy manure was applied at a rate of 7.1 wet tons/acre prior to planting (table 2), but did not significantly increase yields or petiole nitrate concentrations at the rates that were used in this study. Plant available nitrogen in the soil (12 inch depth) followed DDGS application rates closely, with soil N concentrations decreasing with application rate (figure 1). Plant available nitrogen was also significantly greater in 2010 than 2009, suggesting that the compost that has been fall-applied yearly on the entire organic site may be breaking down enough to release significant amounts of plant available N. There were no differences in processing quality of tubers between the fertility treatments except higher tuber sucrose levels were observed in the manure plots. This may indicate a difference in maturity of this plot at the time of vine kill and harvest (data not shown).

Table 2. 2010 Total yield, marketable yield, culls, and yield of US#1 grade (cwt/A). Values in the same column followed by the same letters are not significantly different at p≤ 0.10.

Preplant treatment	Preplant rate (ton dry matter/ acre)	Preplant rate (total lb N/acre)	In-season Chilean nitrate (total lb N/acre)	Total Yield (cwt/A)	US#1 (cwt/A)	Petiole NO3 7/13/10 (ppm)	Petiole NO3 7/23/10 (ppm)
Dairy manure	3.1	28	0	336 bc	273	7050 c	2325 c
None	0	0	0	318 bc	267	7275 c	2850 c
			48	311 c	250	13875 ab	11175ab
DDGS	1.1	94	0	348 abc	279	10125 bc	5175 c
			48	395 a	309	14100 ab	10725 ab
	1.6	134	0	371 ab	290	13875 bc	6675 bc
			48	353 abc	268	17775 a	12975 a
	2.0	173	0	356 abc	274	12975 ab	6525 bc
			48	344 abc	271	16200 a	12450 a
LSD p≤ 0.10				52.5	nsd*	4872	4989

*No significant difference

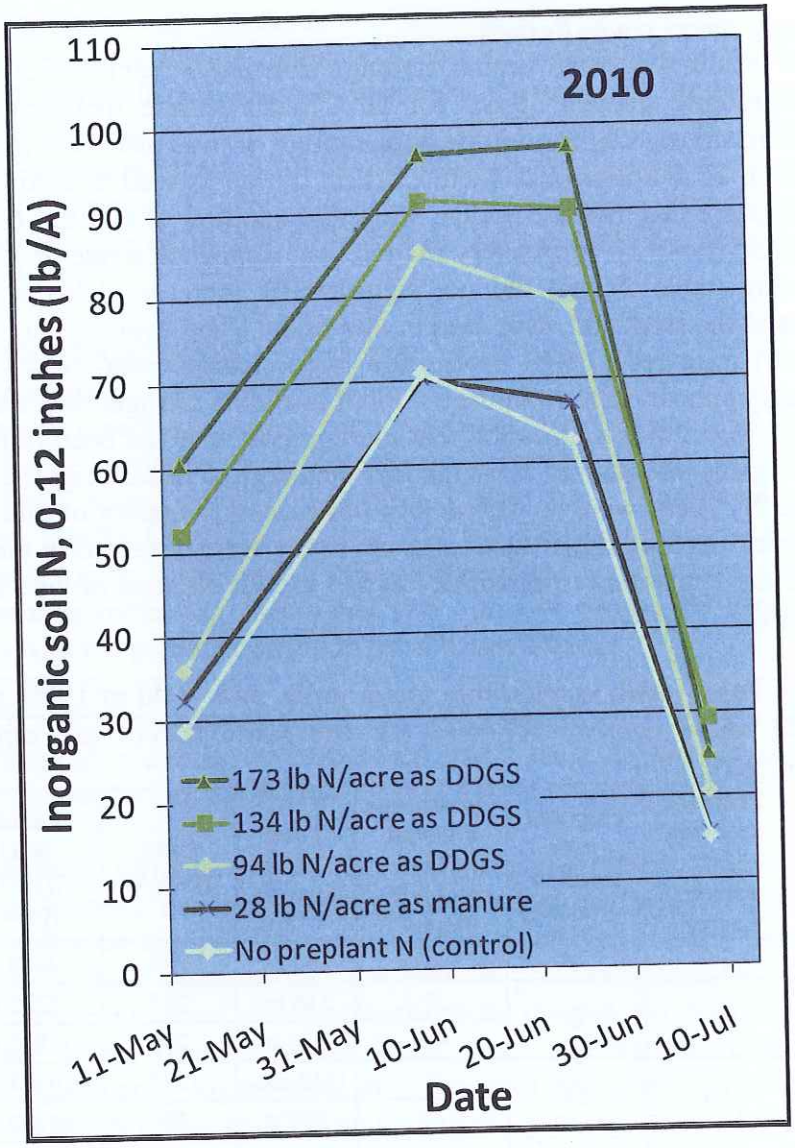

Figure 1. Soil inorganic N concentrations with varying rates of dried distillers grains

CONCLUSION

Products with 4-5% N, like distillers grains, appear to be a suitable nitrogen source for potato growers transitioning from conventional to organic production. Chilean nitrate can help increase yields for transitional growers, but may be less effective at increasing yields than products like distillers grains. After 3 years of fall compost applications, yield increases with distillers grains and/or chilean nitrate were relatively small, suggesting that yearly fall compost applications were eventually able to provide nutrient supplies comparable to current season applications of distillers grains and Chilean nitrate. In addition, plant available N concentrations in the soil stayed higher for a longer period of the growing season after 3 years of consecutive compost applications, in comparison to 2 years, which also suggests that the yearly applications of compost were increasing nutrient stores that could be used by plants. All the varieties grown under these organic conditions had acceptable yields and quality attributes. Russet potatoes varied in yield

and quality and selection of a russet variety to produce should be selected to best suit intended markets and organic system production.

REFERENCES

Moore, A.D., A.K. Alva, H.P. Collins, and R.A. Boydston. 2010. Mineralization of nitrogen from biofuel by-products and animal manures amended to a sandy soil. Communications in Soil and Plant Analysis. Vol. 41, pp. 1315-1326.