Nitrogen Management for Michigan Potatoes
Michigan State University
Michigan State University Extension
S.Snapp, D. Smucker and M.Vitosh(retired), Department of Crop and Soil Sciences
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S. Snapp, D. Smucker and M. Vitosh (retired)
Crop and Soil Sciences Dept.

Optimizing nitrogen (N) use achieves multiple goals. It enhances tuber quality and storability, preserves groundwater quality and minimizes costs. Matching the supply of nitrogen and plant demand is the key to improving fertilizer efficiency.

Multiple, split applications of nitrogen provide a continuous supply that matches plant demand and insures even growth (Table 1). Note that Table 1 takes into account the nitrogen stored in the soil, yield goal and the fact that late-harvested and high N-demanding varieties (e.g., Snowden) require more N.

Table 2 shows how plant nitrogen demand changes during the growing season, and how peak demand corresponds with tuber initiation and bulking. It is important to do a critical assessment of nitrogen stored in the soil or supplied from nonfertilizer sources, e.g., irrigation water and manure. (See "nitrogen credits" discussion.)

Table 1. Michigan potato nitrogen recommendations, including residual soil nitrogen (Vitosh, 1990).

	Yield goal (cwt./acre)	**Low N-demanding variety (lbs. N/acre)**	**High N-demanding variety (lbs. N/acre)**
Sandy soil, no residual N	300	150	190
(pre-plant soil test	400	180	220
inorganic N<20 ppm)	500	210	250
Soil with residual N	300	90	130
or organic matter >3%	400	120	160
(soil test inorganic N>20ppm)*	500	150	190

*Assumes that 20 ppm x 3.0 = 60 lbs. N/acre available for plant uptake.

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Table 2. Recommendations for nitrogen application based on growth stages and tests for plant nitrogen levels (Vitosh et al., 1997).

Developmental stage	Percent nitrogen uptake	Tools to determine your nitrogen status*	
		Petiole nitrate concentration (ppm, dry)	Chlorophyll meter** (% SPAD reading of window plot, compared to high N)
Stage I (early growth)	15-35%		
Stage II (early tuber initiation, tuberization)	35-45%	> 14,000	> 96%
Stage III (enlargement of tubers, bulking)	30-40%	> 12,000	> 96%
Stage IV (tuber maturation)	0%	> 10,000	

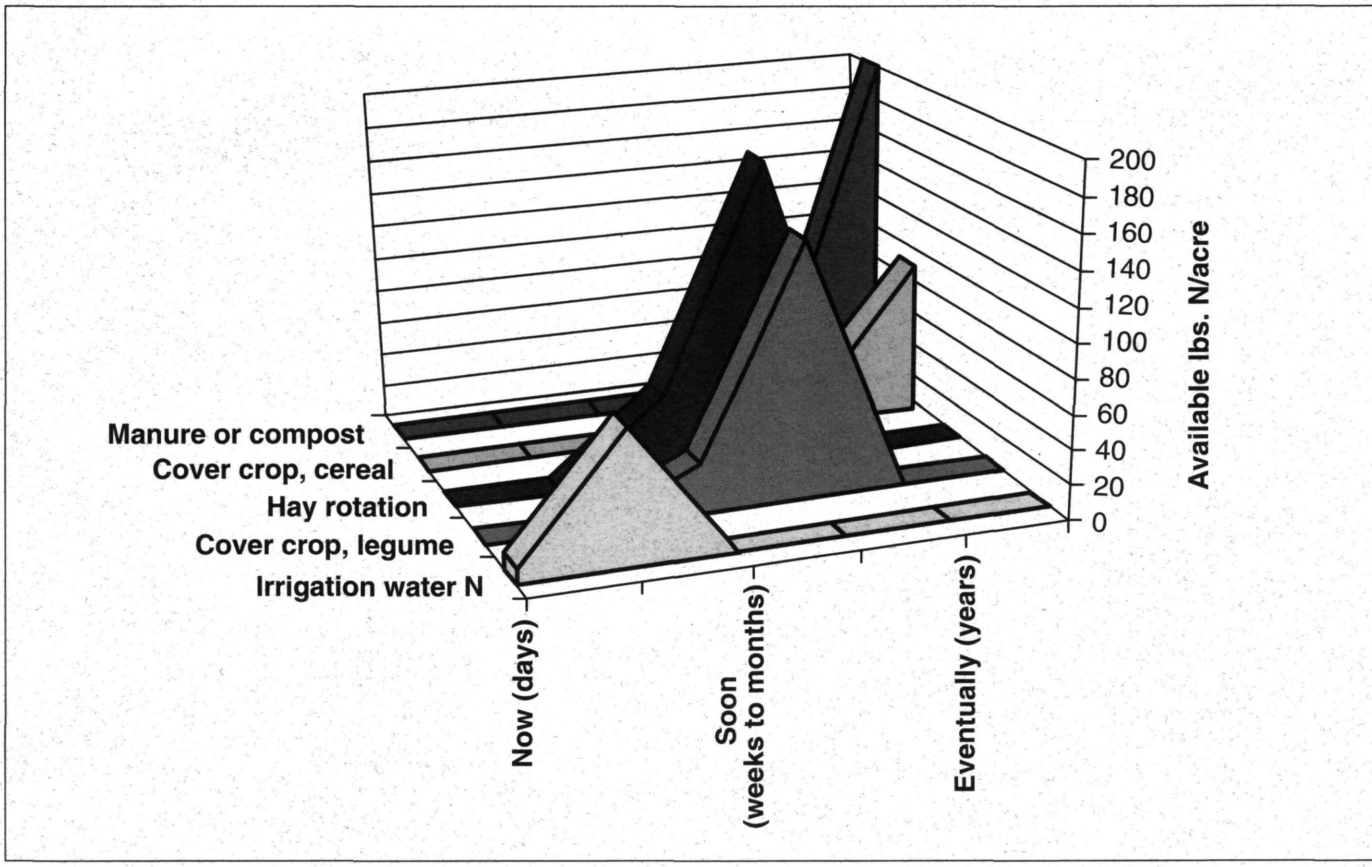
*Measured values that fall below the minimum shown in Table 2 suggest that the crop is N-deficient and that sidedress applications of N are required.
**Chlorophyll readings should remain above 96% for Stage II and Stage III.

Monitoring nitrogen: Plant nitrogen can be monitored using different tools, such as petiole sap for in-field or rapid measurements and laboratory tissue nitrate tests. Chlorophyll SPAD field measurement is a technique under investigation. It is critical to monitor throughout the season to document trends. Use a consistent technique in choosing leaves to monitor. Check with your laboratory to determine their preferred method. Generally, sampling should target fully developed leaves, such as the fourth from the top.

"Window plots" can be useful to calibrate the use of N-monitoring tools. A window plot is made by applying a reduced amount of N in a strip across a field to compare potato yields in the strip to the rest of the field. Used over several years, window plots can help optimize your overall N-management strategy by indicating plant N status at lower levels of N fertilizer.

Nitrogen credits: Credit should be given for nonfertilizer sources of nitrogen. Irrigation water can be readily tested to determine if nitrogen is present. If nitrate-N is present in irrigation water, it should be considered when calculating fertilizer requirements because it is immediately available (Figure 1). Legumes — such as alfalfa and clovers — supply some nitrogen soon after incorporation or plowdown, and some later in the season. A poor stand of alfalfa provides about 60 lbs. of N, whereas a credit of 130 lbs. N/acre is possible from a good stand of alfalfa (Vitosh, 1990). Mature manure and compost generally supply nitrogen over one to two years. Raw or fresh manure from straw bedding can be associated with potato scab disease and should not be used. Manure slurry from lagoon storage and mature manure or compost can build soil nitrogen levels without increasing scab incidence.

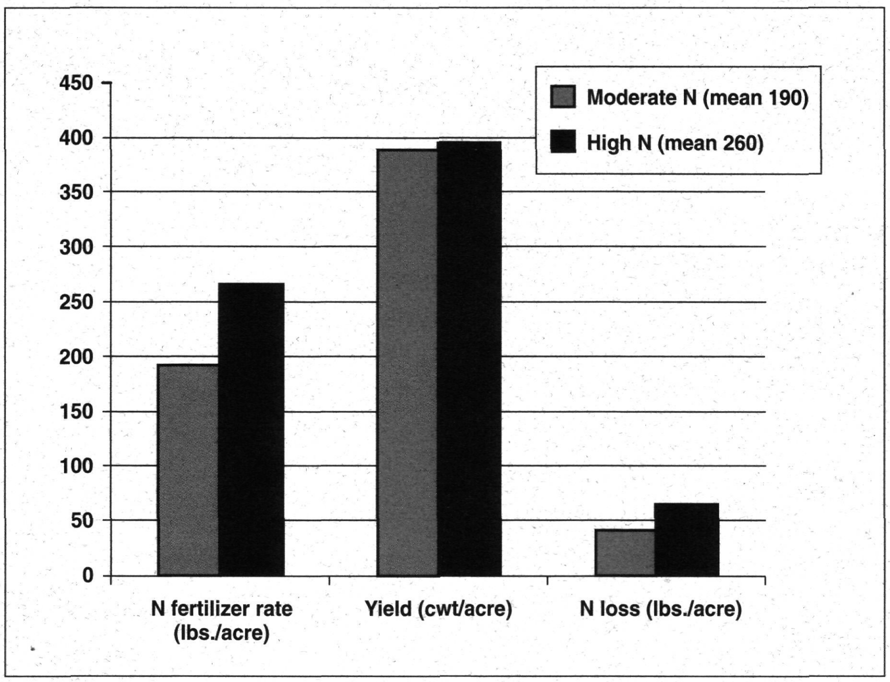
Figure 1. Nitrogen credits can come from many different sources. This figure shows potential availability of nitrogen from low and high quality sources. Subtract the estimated amount available from the total nitrogen recommended.



Water management: Careful irrigation scheduling — so as not to exceed the seasonal evapotranspiration rate by more than five inches — will maximize yield, N efficiency and specific gravity potential. Rainfall is difficult to predict, but should be taken into account when possible. Excess rain received early in the growing season can leach nitrogen below the root zone. Fertilizer with ammonium as an N source (e.g., ammonium sulfate or ammonium nitrate) can help reduce leaching losses. Planting deep-rooted cover crops, such as rye, can also help recover leached N.

Benefits of precision N management: Nitrogen rates need to be matched closely to plant demand. In extensive on-farm research conducted from 1995-97, nitrogen efficiency was increased 50 percent to 67 percent, and potential nitrogen leaching loss reduced from 135 lbs. to 50 lbs. This data (Figure 2) is from 3 years of on-farm trials. Nitrogen fertilizer was reduced by more than 70 lbs./acre without reducing tuber yields.

Figure 2. Average of three years of data from Michigan potato producers (20 on-farm trials). N fertilizer rate can be cut by 70 lbs. without reducing yields (Vitosh, et al., 1997).



References:

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