ESN - A New Nitrogen Technology For Potatoes

ESN Application Timing

Potato production is optimized when N supply is maintained at the proper level for each growth stage. This is traditionally accomplished with multiple side-dress applications and/or fertigation. ESN is designed to provide a steady, season-long N supply with a single application when used properly.

Studies to date indicate ESN usually provides the greatest benefit when applied at emergence. For most environments, the traditional starter P and K blends will provide sufficient N until ESN application. Research has shown one-time ESN application at emergence can produce greater yields and quality than traditional multiple side-dress or fertigation applications. See figures 2a. and 2b on page three.

Pre-plant ESN applications offer greater protection against N loss than pre-plant conventional N fertilizers. However, pre-plant applications are more subject to variable weather and have greater risk of N loss than applying ESN at emergence. The convenience of applying the crop's entire N needs at planting should be weighed against the greater potential for loss and reduced benefit. Pre-plant ESN application may be preferred for late planting, early maturing varieties, short growing seasons, and low potential N loss. Proper application timing should be verified by testing under local conditions.

Table 1. Recommendations for timing of ESN applications

Production Environment	Recommended ESN Timing	
	Preferred	***Acceptable***
Long growing season, high spring N-loss potential	Emergence or split applications	Planting
Long growing season, low spring N-loss potential	Emergence	Planting
Early maturing cultivar, short growing seasons, late planting	Planting	Emergence

ESN Application Rates

ESN is generally recommended at rates similar to conventional N fertilizers. When applied at normal recommended rates, increased N efficiency with ESN usually increases yields. ESN can produce yields similar to conventional N fertilizers at lower rates than conventional fertilizers. However, economic analysis usually indicates greater profitability from increased yields at recommended rates than maintaining yields at reduced N rates. Where N efficiency does not limit yields, ESN may provide greater advantage by maintaining yields with reduced N rates. Under conditions where conventional fertilizers are applied at higher-than-recommended rates to compensate for N losses, lower rates of ESN may be superior because of ESN's ability to reduce N losses and supply what the crop needs when it is needed. Local field testing should be used to fine-tune ESN programs.

ESN Placement

ESN may be broadcast and incorporated or banded. Incorporation insures consistent contact with soil moisture for the most predictable release. ESN may be banded in or near the row with a greater margin of safety than conventional N fertilizers. The ESN coating reduces the exposure of the seed and seedling to potential salt and ammonia damage.

Handling and Application Practices

ESN is suitable for blending with other granular fertilizers, but excessive blending and handling can damage ESN's coating and result in premature N release. Maximum ESN value will be obtained when ESN is handled as little as possible. To minimize blending effects, add ESN to the blender last and restrict blending time to the minimum necessary for uniform mixing. For horizontal blenders, add ESN in the last bin before blender exit to minimize contact time with augers. Belt conveyors are the preferred transfer equipment. Contact with augers should be minimized as much as possible. Augers, drag chains, and blenders should be run as full as possible and at slower speeds to reduce contact with ESN granules.

ESN application should follow recommended procedures for uniform spreading. All applicators should be in good repair and be properly calibrated for accurate rate and uniform spreading. For applications where double spreading is recommended, such as spinner spreaders, we recommend double spreading of ESN to assure uniform application.

Agrium

How can we help?

To make ESN a part of your nitrogen program, contact an authorized retailer or Agrium representative. For technical information, our agronomists can be reached during business hours.

Agrium
13131 Lake Fraser Dr. SE
Calgary, Alberta T2J 7E8

Senior Agronomist
Ray Dowbenko
(403) 225-7000
(403) 225 7174
1-800-661-6757

Agrium U.S. Inc.
4582 S. Ulster Street
Suite 1400
Denver, Colorado 80237

Senior Agronomist
Alan Blaylock
(303) 804-4479

Agrium U.S. Inc.
Okemos, Michigan
Midwest Agronomist
John Kaufmann
(517) 349-7084

Cedar Rapids, Iowa
ESN Coordinator
Mark Mangin
(303) 588-8333

Salem, Oregon
ESN Coordinator
Jim Peters
(503) 371-8337

Breese, Illinois
ESN Coordinator
John Niemeyer
(618) 526-7728

DeWitt, Michigan
ESN Coordinator
B.J. Bilas
(517) 669-5499

Agronomy Info. Line
800-661-NPKS (6757)
USA and Canada
877-265-0405 USA

email: esn@agrium.com
www.agrium.com

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A New Generation in Smart Nitrogen

ESN

Controlled Release Fertilizer

A *smarter* source of nitrogen. A *smarter* way to grow.

potato

ESN Smart Nitrogen - A Smarter Way to Grow Potatoes

ESN is a new agricultural grade controlled-release nitrogen (N) fertilizer from Agrium. ESN maximizes N-use efficiency and minimizes N losses to the environment by encapsulating N inside a special polymer coating.

Predictable Nitrogen Release

ESN's coating allows water to diffuse into the granule, dissolving the N within. The N liquefies, yet remains encapsulated within the coating. The N solution moves through the coating at a controlled rate reducing N exposure to losses.

Soil Temperature

The N release rate through the coating is governed by soil temperature, which is a major factor in potato growth and nutrient demand. The rate at which water and N move through the coating is slow in cold soils and increases as the soils warm thereby increasing N supply as potato demand for N increases. ESN provides a steady N supply for the growing potato plant.

Improved Nitrogen-Use Efficiency, Better Potato Crops, and Reduced N Losses

By supplying N as the crop needs it, N-use efficiency is increased. For growers, better efficiency means increased yields, improved crop quality, and reduced workload by replacing multiple N applications with

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ESN Recommendations For Potatoes

Establish Proper Nutrient Management Practices

Sound nutrient management starts with proper soil testing. The maximum benefits of ESN will not be realized if other limiting factors are not properly managed. Take a good soil test following recommended procedures and apply other nutrients and lime as recommended. We do not recommend ESN without proper soil testing and sound crop management practices. **ESN is a tool for nitrogen management and not a substitute for proper management of other nutrients and crop production practices.**

Nitrogen Nutrition of Potatoes

Proper nitrogen (N) nutrition of potatoes is essential to high yields, optimum crop quality, and maximum profitability. N is essential for vegetative growth, protein synthesis and the photosynthesis factory that converts solar energy to carbohydrates that are stored in the tuber. Potatoes require high N rates, but N timing is a critical factor in potato yield and quality.

Potato N need is closely synchronized with specific growth stages. Five general stages are commonly used to describe potato growth and development. The growth stages are I) sprout development, II) vegetative growth, III) tuber initiation, IV) tuber bulking, and V) maturation. Sufficient N is needed in the initial stages to stimulate leaf growth, but too much N early can cause excessive vegetative growth and delay tuber initiation. Potatoes take up little N in the first month after planting (Growth Stage I), but take up about 60-80% of the total N needs during tuber initiation and tuber bulking (Stages III & IV) when most of the total dry matter is accumulated. Nitrogen uptake is nearly complete by the end of Stage IV. Figure 1. shows generalized potato growth and nitrogen uptake. Timing of specific growth stages is approximate and varies with variety and environmental conditions.

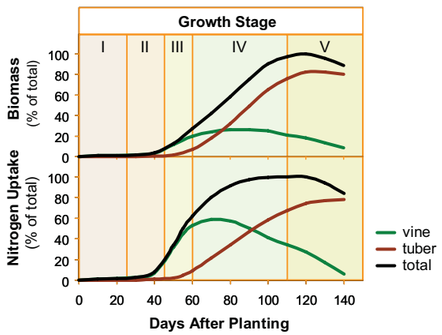


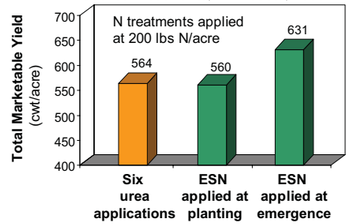
Figure 1. Generalized dry matter accumulation (as percent of total maximum dry matter) and nitrogen uptake (as percent of total nitrogen uptake) by a Russet Burbank crop. The five stages of growth are provided for reference: I = sprouting, II = vegetative, III = tuber initiation, IV = tuber bulking, V = maturation. Growth stages are approximate and may vary with variety and environment.

From C. Rosen, Univ. of Minnesota, 2006.

ESN can improve the profitability of potato production by supplying the right amount of N at the right time. ESN is designed to release the bulk of its N during the period of greatest crop demand. Controlled N release simplifies N management by replacing the common practice of multiple N applications with one simple application.

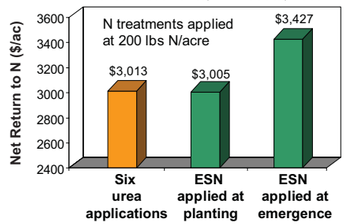
Figures 2a. and 2b. show study results from Central Minnesota. In this study, one-time applications of ESN produced yields similar to or better than the standard practice of spoon-feeding N in multiple applications of urea.

Figure 2a. **Potato Yield Response to N Source Treatments, Minnesota, 2005**



Source: Rosen, Univ. of Minnesota

Figure 2b. **Potato Net Return Response to N Source Treatments, Minnesota, 2005**

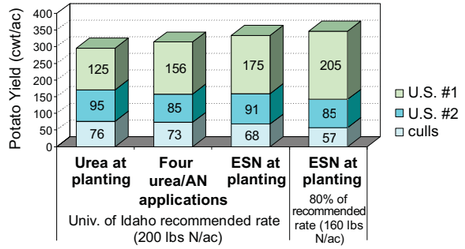


Source: Rosen, Univ. of Minnesota

Figures 2a. and 2b. Irrigated potato yield (a) and net return (b) in response to urea and ESN. Urea treatment consisted of 100 lbs N/acre and 20 lbs N/acre broadcast and incorporated at emergence and hilling, respectively, and four post-hilling applications at 20 lbs N/acre each as 50% urea and 50% ammonium nitrate. Post-hilling applications were broadcast and incorporated with overhead irrigation. ESN treatments were applied as a starter at planting or broadcast and incorporated at emergence. All plots received 40 lbs N/acre as 18-46-0 at planting. Net return was calculated from the standard grower contract, local N prices, and application charges. Site is an irrigated sandy loam soil in Central Minnesota. ***Source: C. Rosen, Univ. of Minnesota, 2005.***

Field research and grower experience have shown that ESN produces larger, more uniform potatoes with fewer culls than conventional N management practices. Figure 3. shows an increase in total yield and #1s and a decrease in culls in a University of Idaho study.

Figure 3. **Potato Yield and Grades in Response to N Source Treatments, Idaho, 2005**



Source: B. Hopkins, Univ. of Idaho, 2005

Figure 3. Potato response to N source treatments. "At planting" treatments were broadcast and incorporated at planting. Multiple urea/AN treatments consisted of 66 lbs N/acre as urea at planting plus 133 lbs N/acre split into three equal applications of ammonium nitrate broadcast and incorporated with irrigation on Jul. 20, Aug. 2, and Aug. 9. Site is irrigated sandy loam in Southeastern Idaho.

Source: B. Hopkins, Univ. of Idaho, 2005.

Nitrogen and Potato Production

N management in potato production presents numerous challenges. Most potatoes are grown on sandy soils under irrigation or in humid regions where rainfall is supplemented by irrigation. In addition to delaying tuber initiation, excess N early in the season is prone to greater losses because of limited plant uptake and greater potential for excess precipitation. ESN is a tool that can help overcome these losses if used properly. ESN increases N-use efficiency by protecting most of the N from loss until the period of rapid crop uptake.

Interactions of weather, timing of N demand, and potential for N loss should be considered in determining the most appropriate ESN application. The following recommendations are the result of field-testing in key potato-producing areas. Actual results may vary depending on weather and soil conditions.

a single application. The protective coating benefits the environment by reducing the exposure of fertilizer N to leaching, volatilization, and denitrification losses. The result is improved environmental stewardship and increased production efficiency.

Field Testing ESN's Value For Potatoes

ESN has proven an effective N-management tool for potatoes in a variety of environments. ESN's continuous feeding produces greater yields of high quality potatoes than conventional N management programs.

Other Considerations For Using ESN Use On Potatoes

- Crop N status, such as petiole nitrate levels, should be monitored as recommended to determine if additional in-season N applications are needed.
- ESN can be used in conjunction with conventional N fertigation programs. Apply a large portion of recommended N (70-90%) as ESN at emergence or planting, monitor petiole status, and apply N with fertigation as needed. Labor requirements for fertigation are reduced from conventional programs, while maintaining flexibility to adjust for changing weather and yield potential.
- Applying ESN later than recommended increases risk of insufficient N supply in early growth stages.