Unlocking the Benefits of Sodium Nitrate in Organic Farming

GROWERS HAVE MANY OPTIONS OF NITROGEN INPUTS. Synthetic forms are ubiquitous, from anhydrous ammonia to urea to ammonium sulfate and ammonium nitrate. Yet organic growers — and those trying to reduce their synthetic inputs in order to maintain better soil health — have to seek out other options. Historically these have included manures and leguminous cover crops, as well as recent additions to the market such as feather meal, bone meal, fish meal and alfalfa or soy meal. These products are all naturally produced — many even on-farm — and do a good job providing long-term nitrogen to crops and improving soil health.

The drawback of most natural forms of nitrogen, though, is that they don't provide immediate availability of nitrogen to the plant. It takes time for soil bacteria to convert the nitrogen in the above-listed organic inputs into a form that the plant can use. Sodium nitrate is an all-natural form of nitrogen that is perfect for growers who need to provide a quick burst of energy to their crops at specific points in the growing cycle. In this article we'll discuss how sodium nitrate is produced, how it works, what growers have been able to accomplish with it — both in terms of yields and profits — and how sodium nitrate is certified according to USDA guidelines.

What Is Sodium Nitrate?

All forms of nitrogen fertilizer of course include the nitrogen atom — they just have it in different molecular forms. Ammonium, for example, is NH_4^+ (one nitrogen atom with four hydrogen atoms, and an overall positive charge); nitrate is NO_3^- (one nitrogen atom with three oxygen atoms, and an overall negative charge); amino acids include a large number of compounds with more complicated molecules.

The nitrate form of nitrogen — which is what ($NaNO_3$) is composed of — is useful to growers because it is more easily taken up by plants than other forms. All plants need nitrogen, either in the ammonium or nitrate form. For this to occur naturally, though, nitrogen i

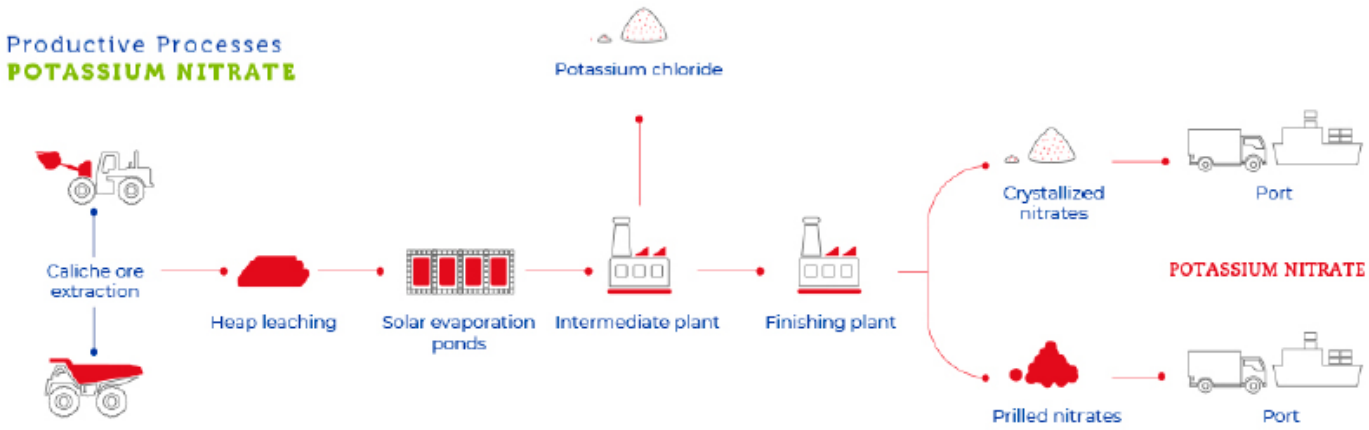
— which makes up approximately 78 percent of the earth's atmosphere) must be converted by

bacteria in the soil into ammonium, which different bacteria then oxidize into nitrite (NO_2^-) and then into nitrate (NO_3). However, nitrate forms of nitrogen are readily available for plant uptake.

Prior to the early 1800s, farmers got the nitrogen their crops needed via traditional techniques: compost, manure, and cover crops. These are still viable inputs and practices that should be maintained by successful organic growers. But an application of nitrate nitrogen, because it is soluble and immediately available to plants, can give crops an immediate nutritional boost — far more than a side dressing of manure or compost ever could.

With the explorations of the early nineteenth century came the discovery of a pure nitrate source that growers could use to boost crops. This source was guano — the excrement of seabirds that had been deposited for thousands of years on extremely arid islands off the coast of Chile. European merchants began to mine it in 1840, but in just a few decades the source was mostly depleted. Explorers turned inland and found deposits of nitrate-containing rock in Chile's Atacama Desert. They began exporting sodium nitrate around 1870. These deposits — called caliche, locatedin a band 30 kilometers wide by 700 kilometers long — were formed in ancient times via nitrogen fixation by microorganisms.

They are now in the form of a mineral conglomerate of salts. To extract these deposits and turn them into a useable form, the heap leaching process is used. The caliche ore is blasted from the earth's crust andpiled into massive heaps. Seawater is then used to dissolve and leach the soluble minerals, and that leachate solution is gathered in evaporation ponds.



Processes carried out fully or partially in: María Elena, Pedro de Valdivia and Nueva Victoria.

The nitrate precipitates are then crystallized, dried, and formed into prills, which contain approximately 97 percent $NaNO_3$. The prills are easily transportedaround the world. They can be broadcast, spread on the soil surface as a side dressing, or dissolved in water for spraying. When the Haber-Bosch process was discovered in the early 1900s, synthetic nitrogen suddenly became abundant. Sodium nitrate is one of the only forms of naturally occurring nitrate nitrogen on the market today and is approved for USDA organic operations.

How to Use Sodium Nitrate

Sodium nitrate provides a rapid boost to plant growth. It can be an important part of an overall nitrogen management strategy for many types of crops. Growers can get the greatest plant response by applying sodium nitrate when temperatures are low — when the soil is not able to provide available nitrogen to the plant because the soil biology is not as active. According to Doug Holbrook of SQM Specialty Plant Nutrition, a producer of sodium nitrate, “When your ground temperatures are cold and wet, any nitrogen is tied up and not available. It’s important to get that plant, before V4, to take up all the nitrogen it can. That shot of nitrate nitrogen will give it that boost and take it through those cold, wet temperatures.”

TABLE 1

	N required	20% of N required	Amount of 15-0-2 Sodium Nitrate
Field Crops			
Corn	120-180	24-36	150-225
Cotton	50-75	10-15	60-100
Oats, barley, spelt	60-80	12-16	75-100
Pasture grass	100-120	20-24	120-150
Peanuts	80-120	16-20	100-130
Wheat (spring & winter)	80-100	16-20	100-130
Fruits and Vegetables			
Almond	200-300	40-60	250-375
Apple	100-150	20-30	125-188
Baby greens, spinach	80-120	16-20	100-130
Blueberry	80-100	16-20	100-130
Carrots	100-150	20-30	125-188
Celery	180-200	36-40	225-250
Citrus	100-200	20-40	125-250
Cole crops	150-175	24-35	150-218
Cucurbits	100-150	20-30	125-188
Green beans	60-80	12-16	75-100
Lettuce	100-150	20-30	125-188
Onions, leeks, garlic	100-150	20-30	125-188
Peach	100-150	20-30	125-188
Potatoes	180-200	36-40	225-250
Sweet corn	120-180	24-36	150-225
Tomatoes, melons, peppers	120-180	24-36	150-225

It is most efficient to apply sodium nitrate at the right rates and right timings. Since it is not subject to volatilization — as are ammonia and urea — sodium nitrate can be applied directly to the surface without risk of loss. For vegetables, the ideal application is every 10 to 14 days, in either a liquid or dry form. Field crops benefit from a 2 x 2 application — placing fertilizer, either liquid or dry, two inches below and two inches to the side of the seed at seeding — and then a foliar feeding or side dressing later on. For corn, growers should apply sodium nit

plant is at the four- to seven- leaf stage or as a layby application. As part of the agreement with the USDA National Organic Standards Board (USDA NOSB) it is recommended that sodium nitrate make up no more than 20 percent of the total applied nitrogen to a crop.

Table 1 above provides suggested application rates in pounds per acre, by different crop types. In addition to vegetables and row crops, sodium nitrate can be extremely helpful when applied to pasture. It can be applied either in the dry form or dissolved as a liquid. When put on dry, try to broadcast it evenly in the evening, without animals in the pasture. Livestock will be attracted to the sodium component of the prills, but the prills dissolve very quickly if there is any amount of moisture in the air. By morning, the animals can be let into the pasture (keep them out longer if the broadcasting wasn't very even).

Dry applications can consist of up to 150 pounds per acre in a single application. Green-up will begin within 10 days, and nitrogen will continue to be released for over 30 days. Dissolving sodium nitrate and spraying it onto pasture is also a great option. Twenty gallons per acre is a typical spray volume, but if applying more than this, be sure to mix in a carbon source in order to avoid burning — one pound carbon (liquid fish, molasses, etc.) per two gallons of water is a good rule of thumb. Repeat the spraying at two- to three-week intervals. This type of application will produce a green-up within three days and can enhance the pasture for up to 10 weeks.

ppm N	50.	75	100	200
E.C. (mS/cm)	0.5	0.7	0.9	1.7
injector ratio	ounces/gal			
15 (hozon)	0.67	1.00	1.34	2.68
50	2.22	3.33	4.44	8.90
100	4.44	6.70	8.90	17.80
128	5.70	8.55	11.40	22.80
200	8.90	13.35	17.80	35.60

TABLE 2

Sodium nitrate can also be beneficial for seedlings and for greenhouse vegetables. Seedlings can be fed 50 to 150 ppm N once per week, depending on the growth stage. For vegetables and cut flowers, feed 100 to 200 ppm N with constant liquid feeding, or 200 to 400 ppm N for pulse feeding every 7-10 days. Table 2 above shows the amount of 15-0-2 that can be added for continuous liquid feed programs. The electrical conductivity (E.C.) values in the chart are approximate; use E.C. levels to verify the appropriate feeding level from the injector, adjusting for the E.C. of the irrigation water.

Proven Field Benefits of Sodium Nitrate

A number of studies have demonstrated the efficacy of Allganic® Nitrogen Plus — a leading brand of sodium nitrate — across a variety of crop types. Here are just a few examples.

Organic Corn

A three-year field trial of organic corn was conducted in cooperation with Iowa State University to evaluate the use of sodium nitrate to provide 20 percent of the corn's nitrogen requirement. The control for this study consisted of 5,800 gallons/acre of liquid swine manure in the first season, followed by three tons/acre of chicken manure the next two seasons. The sodiu

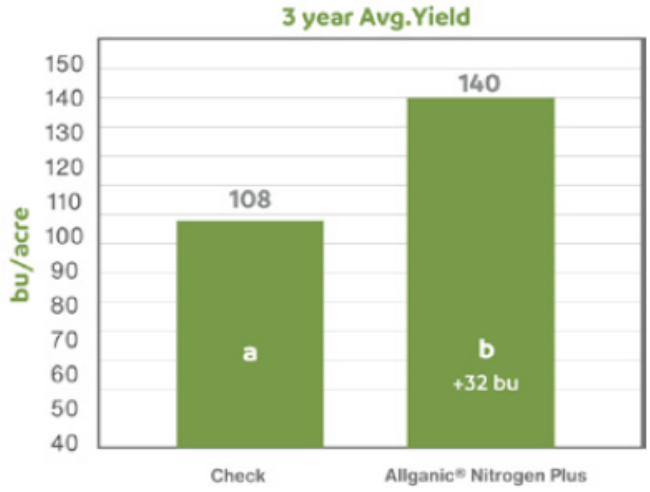
received the same amount of manure as the control in the first year, followed by a dry, banded, sidedress application of 225 pounds of Allganic® Nitrogen Plus (15-0-2) to supply 20 percent of the corn's nitrogen demand (36 pounds N/acre), for a yield target of 160-180 bushels/acre.

The application was timed for 30-40 days after planting (when the corn was knee high). The three-year average yield for the plot treated with sodium nitrate was 140 bushels/acre — 32 bushels higher than the test plot (108 bushels). This amounts to a significant increase in gross income for the grower. See graph A below.

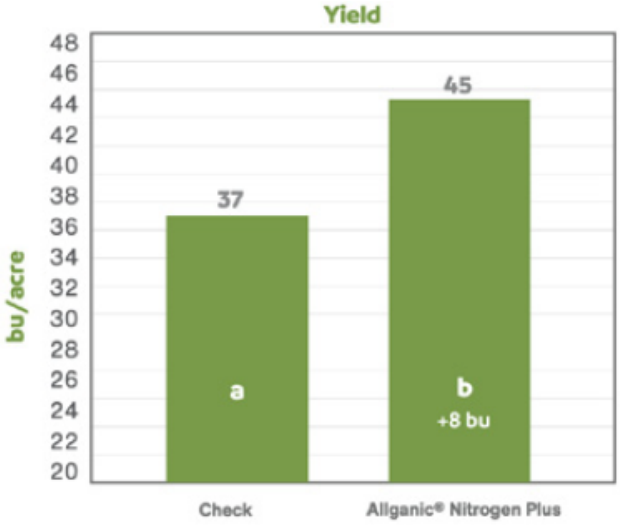
Organic wheat

A field trial on organic hard red winter wheat was conducted in Jefferson, Iowa, in cooperation with Iowa State University to evaluate the use of Allganic® Nitrogen Plus to provide 20 percent of the wheat's nitrogen requirement. The wheat was drilled in early October at 120 pounds/acre on a prior soybean field. The control plot was not given any additional nitrogen. The test plot consisted of a top-dress application of Allganic® Nitrogen Plus (15-0-2) at 160 pounds/acre (25.6 pounds N/acre) — 20 percent of the crop's nitrogen demand — in the middle of May. The results were conclusive: the plots with sodium nitrate averaged 45 bushels, compared to 37 for the control. Just as importantly, the protein content was also higher: 11.4 percent compared to 10.5.

See graph B below.

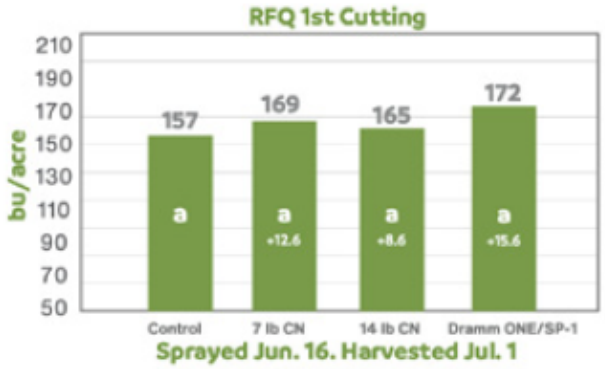


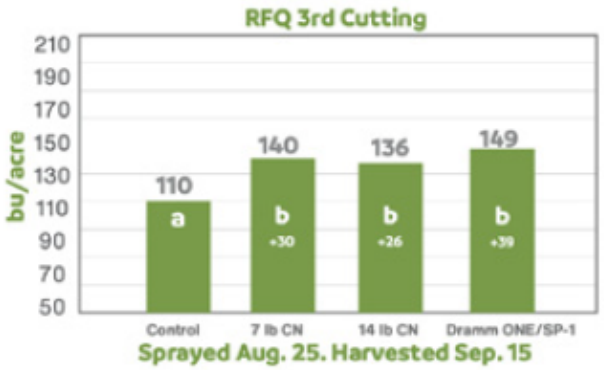
GRAPH A - CORN YIELD

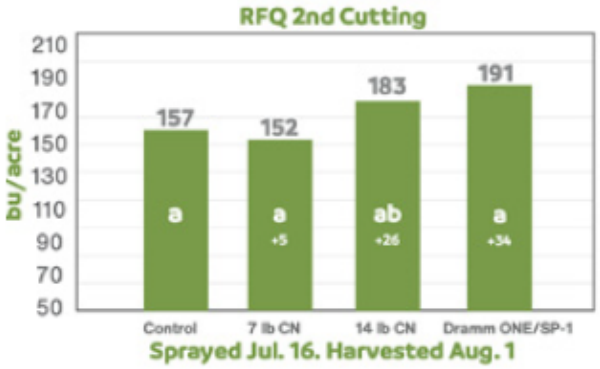


GRAPH B - WHEAT YIELD

GRAPH C - PASTURE YIELD







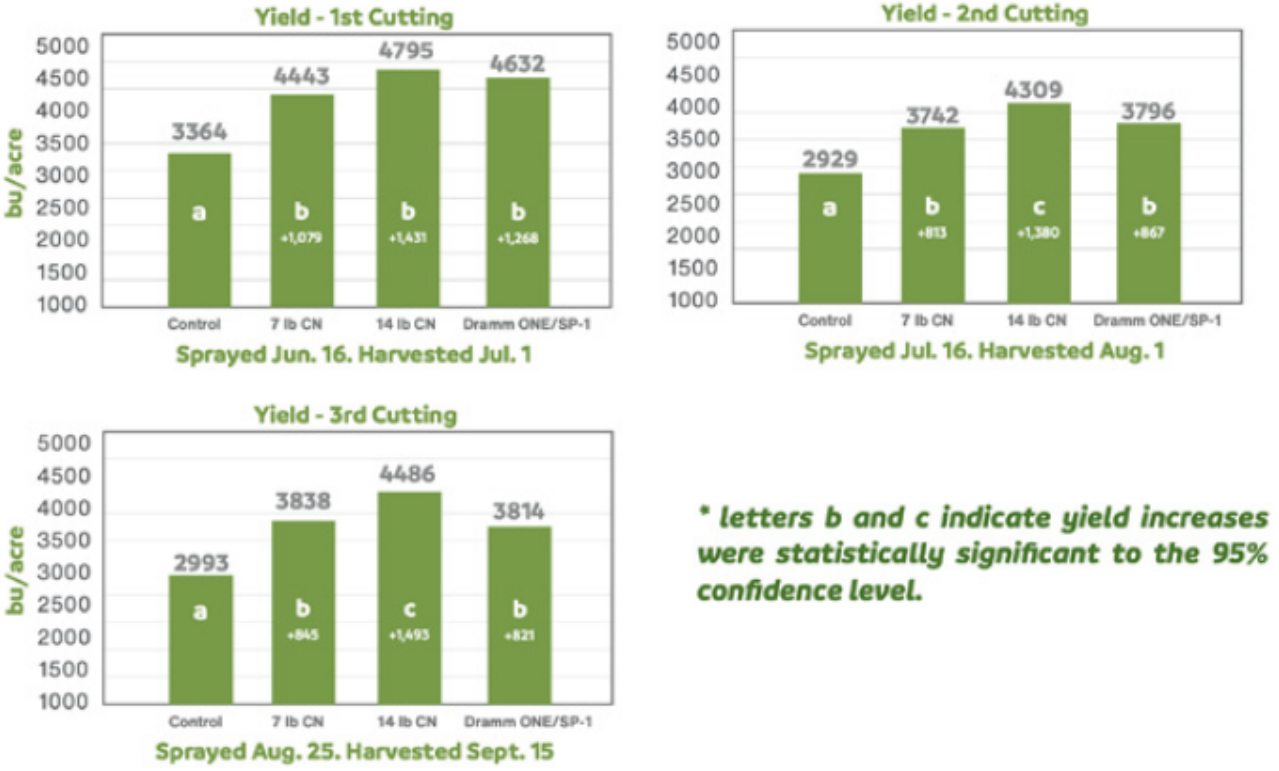
*Letter b indicates RFQ increases were statistically significant to the 95% confidence level.

Organic pasture

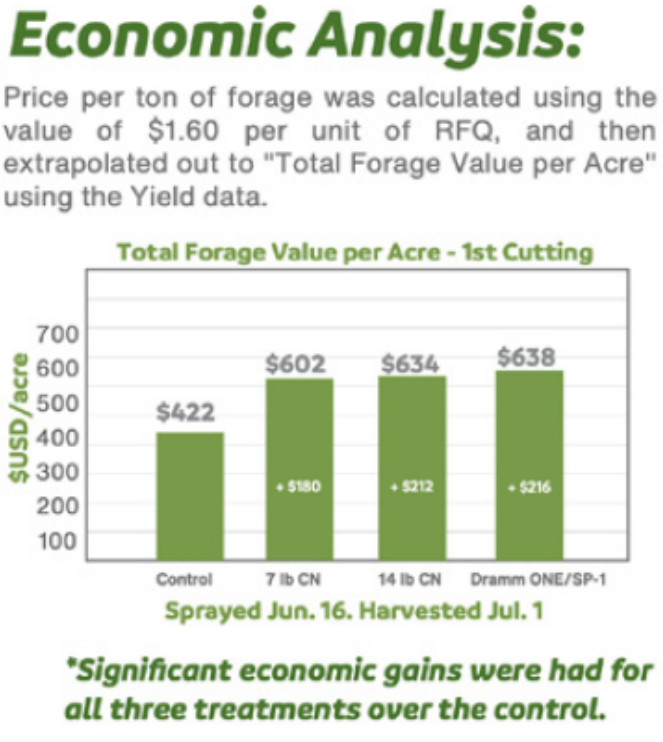
Sodium nitrate can be a great help on organic pastures. A study conducted on four fields in Minnesota discovered benefits in yield, forage quality and financial value when sodium nitrate was applied. The test plots had each been seeded in May with either Italian ryegrass or a perennial ryegrass/alfalfa mix. One field was left untreated as a control, and the other three

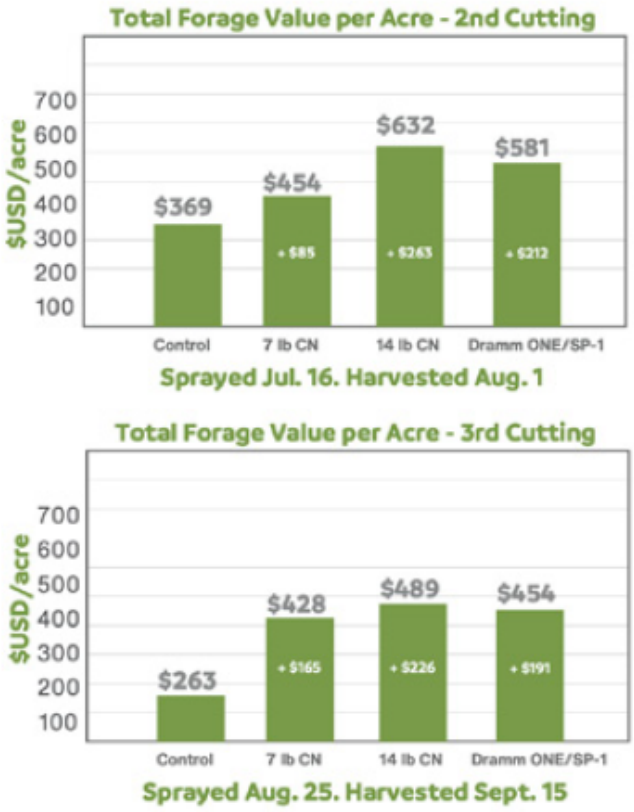
with 15 gallons/acre of 15-0-2 approximately two to three weeks before cuttings, in mid-June, mid-July and late August. The treated fields yielded significantly better than the control; see graph C above. The treated plots also rated better in terms of relative forage quality; see graph D below.

GRAPH D - PASTURE QUALITY



**** letters b and c indicate yield increases were statistically significant to the 95% confidence level.***





Financial Benefits of Sodium Nitrate

Finally — but not insignificantly — sodium nitrate is among the most cost-effective nitrogen options for the organic grower. In the above pasture study, sodium nitrate resulted in an increased financial return for the grower, see graphs above. In a study conducted by Beck's Hybrids in Atlanta, Indiana, Allganic® Nitrogen Plus was applied to organic corn for three years and compared to similar fields of organic corn that were fertilized with animal manure. The sodium nitrate was put on at 50 pounds, 2 x 2 x 2, at planting and then 100 pounds at the V4 stage of growth.

The plots fertilized with sodium nitrate outperformed the manured plots by 12.5 percent in terms of yield over the three years. More importantly, the return on investment of the sodium nitrate application was $27.89 per acre. When well-managed, sodium nitrate can not only produce higher yields; it can help growers make more profit.

Organic Certification of Sodium Nitrate

Sodium nitrate was listed as a permissible fertilizer by the USDA National Organic Program in the 1990s, with the caveat that it only be used to provide 20 percent or less of a crop's total applied nitrogen. This stipulation is in line with the recommendation of top producers of sodium nitrate since the product is meant to provide a boost of energy to the plant at specific points of development. In 2012, its status on the USDA NOP National List, and thus the 20 percent annotation, expired, meaning that sodium nitrate was an allowed substance under USDA organic rules without a specific restriction amount — although growers do need to continue to comply with the soil-fertility-building practices established by their regulators.

No further formal rulings have come forth from the NOP since 2012, and in 2022 the National Organic Standards Board (NOSB) voted to recommend NOP to put sodium nitrate back on the National List, with the 20 percent annotation, in order to bring clarity back to the rules. An official ruling from NOP is still awaited. Growers should be aware that current Canadian organic regulations do not permit the use of sodium nitrate.

Therefore, crops grown for export to Canada as USDA certified organic should not be given sodium nitrate. Finally, all products that are on the USDA National List come up for recertification every five years. Certified-organic growers who benefit from using sodium nitrate and who would like to continue to have it as a tool should be sure to tell their certifiers and product distributors.

Conclusion

Sodium nitrate is an extremely beneficial product for the organic grower. Like any agricultural amendment, it needs to be used responsibly, following the “4R’s” of fertilizer application: in the right place, in the right form, in the right amount and at the right stage of crop development. Crop quality is king, and by maximizing growth at key points of development, sodium nitrate helps growers to produce crops of outstanding quality — and to make more profit while doing so.