ALPINE®

Maximizing Fertilizer Efficiency

since 1973

2026-2027

Agronomy Guide

PRODUCTION & DISTRIBUTION
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PRODUCTION & DISTRIBUTION
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ALPINE® LIQUID PLANT FOOD

ALPINE® PLANT FOOD

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About ALPINE®

Founded in 1973 with the goal to revolutionize farming practices in Canada, ALPINE began by only importing liquid starter fertilizers into Ontario from the US. However, it did not take long to realize that manufacturing its own product would be the key to success in Canada. By 1975, ALPINE developed its first flagship product, 6-24-6, known today as ALPINE G24.

In 1998, ALPINE Liquid Fertilizers was acquired by Na-Churs Plant Food and became part of the Nachurs Alpine Solutions® *(NAS)* family. Since 1946, NAS has been the leading manufacturer of liquid fertilizers in North America. Today, ALPINE Liquid Fertilizers is well positioned to serve the agricultural marketplace in Canada. Locally manufactured products and global operational experience make our company among the most efficient producers of premium quality products.

With over 50 years in business, our goal remains the same: To provide seed-safe, high quality and precision-placed liquid fertilizer. All while being the innovator in the industry by providing the latest technologies to *Maximize Fertilizer Efficiency.*

ALPINE is excited for the next 50 years!

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ALPINE® GENERAL RECOMMENDATIONS

In-Furrow Applications

ALPINE liquid fertilizer placed on or near the seed at planting time is designed to stimulate early root growth, emergence and strengthen plant health. Recommended rates of ALPINE fertilizer are included in the PRS presented in this guide. Consult with your authorized ALPINE Retailer or ALPINE District Sales Manager for specific fertility recommendations.

Benefits with In-Furrow Applications

In furrow placement of micronutrients along with other crop enhancement products are greatly facilitated through the ALPINE application system. With the ever-increasing development of plant growth supplements, many can be added to the starter application, increasing efficiency and accuracy. The addition of an ALPINE Injection kit is often required to ensure product compatibilities and efficacy is maintained. All tank mixes should be tested for physical and performance compatibility before use. Consult with your ALPINE Retailer or ALPINE District Sales Manager before using such mixes.

Foliar Application

Foliar feeding is one of the most efficient methods of supplying nutrients during critical plant growth stages, while amplifying root activity. ALPINE foliar fertilizers provide a balance of N including slow-release, P in the orthophosphate form that plants require, and our Bio-K as potassium acetate. ALPINE EDTA chelated micronutrients are designed to enhance nutrient uptake, assisting plants in overcoming deficiencies while Maximizing Fertilizer Efficiency.

ALPINE foliar products are manufactured with the highest quality raw materials on the market today and includes available, chelated micronutrients to maximize foliar absorption. ALPINE foliar fertility can also be safely and conveniently mixed with most crop protection to help maximize yield potential (please follow proper mixing instructions).

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For more specific foliar guidelines, consult with your authorized ALPINE Dealer or ALPINE District Sales Manager for fertility recommendations.

MIXING INSTRUCTIONS

ALPINE liquid fertilizers can mix with many crop production products. Some non-100% EDTA chelates may not be compatible.

- In a small container prior to full scale mixing, proportionally mix all the components to confirm compatibility.
- Thorough mixing of all blends is important.
- Temperature and storage time can influence the degree of success.
- Mix only the amount that will be immediately used.
- Long-term storage is not suggested.

MIXING PROCEDURE

- Add ½ of total water to spray tank
- Start recirculation in the tank
- Add micronutrients and or any other flowable material
- Add any soluble powder first pre-mixing with water
- Add the recommended amount of ALPINE liquid fertilizer
- Add remaining water volume and continue recirculation prior to spraying

GENERAL PRODUCT STORAGE RECOMMENDATIONS

• WHITE PRODUCTS: Storage in poly, fiberglass, stainless, or lined/coated steel tanks to prevent product discoloration. Storage in flat bottom tanks is recommended during winter months. Bubble, recirculate, and/or agitate material before usage in all instances. Material stored in cone bottom tanks (although not recommended) will require longer recirculation after winter to regain product consistency.

• GREEN PRODUCTS: Storage in flat bottom tanks is recommended during winter months. Bubble, recirculate, and/ or agitate material before usage in all instances. Material stored in cone bottom tanks (although not recommended) will require longer recirculation after winter to regain product consistency.

THE FOLLOWING CONDITIONS MUST BE OBSERVED IN ORDER TO APPLY ALPINE LIQUID FERTILIZER FOR FOLIAR APPLICATIONS. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE PLANTS.

- **DO** use ALPINE fertilizers under conditions of optimum plant growth including highest humidity, moderate temperature and adequate soil moisture.
- **DO** add, as a minimum, equal amounts of water. Do use sufficient water to provide thorough coverage.
- **DO** consult with your local ALPINE District Sales Manager to determine pesticides which are compatible with ALPINE fertilizer.
- **DO** add wettable or soluble powders, emulsifiables or flowables to water in the mix and wet, dissolve or disperse before adding ALPINE fertilizer.
- **DO** consult your local ALPINE District Sales Manager for rate and application instructions.
- **DO** use a small jar or container prior to full scale mixing to proportionally mix all the components to confirm compatibility.
- **DO NOT** use when the crop is under stress from pests, heat or inadequate soil moisture.
- **DO NOT** apply by aircraft if surface wind is greater than five miles per hour to assure adequate crop coverage and droplet disposition.
- **DO NOT** spray to run off. Do not spray to visible droplet coalescence. Do not allow concentrated spray mist to run off fruit or leaves.
- **DO NOT** apply during the heat of the day.
- **DO NOT mix** with calcium containing products unless the calcium is fully EDTA chelated.
- **DO NOT** mix fertilizers with hard water. Mixing with hard water may cause clogging of lines due to the combining of calcium, magnesium and iron in the water with phosphate in the fertilizer.

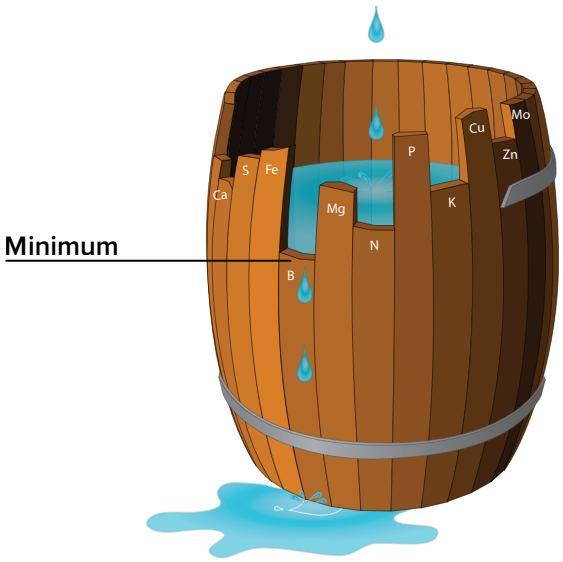
Maximizing Fertilizer Efficiency

Growers continue to strive for the optimization of input costs with the end goal being an increase in profitability through a higher return on the annual dollars spent to grow each crop. The cost of their fertility program is often at the top of the list when it comes to annual input expenses for almost all crops they grow. It is one cost line item that growers have the most direct control of on a per acres basis. When compared to other input costs such as pesticide, seed, or fuel cost, fertilizer tends to have the greatest impact on overall profitability.

To appropriately develop a productive fertilizer program, growers must have the ability to understand and relate environmental conditions, some basic principles of soil chemistry, plant growth, nutrient interactions, and differences of various fertilizer sources. Throughout this handbook, the key attributes that make ALPINE sources of plant nutrition exceptional at increasing fertility efficiencies and profitability to growers will be validated.

Liebig's Law

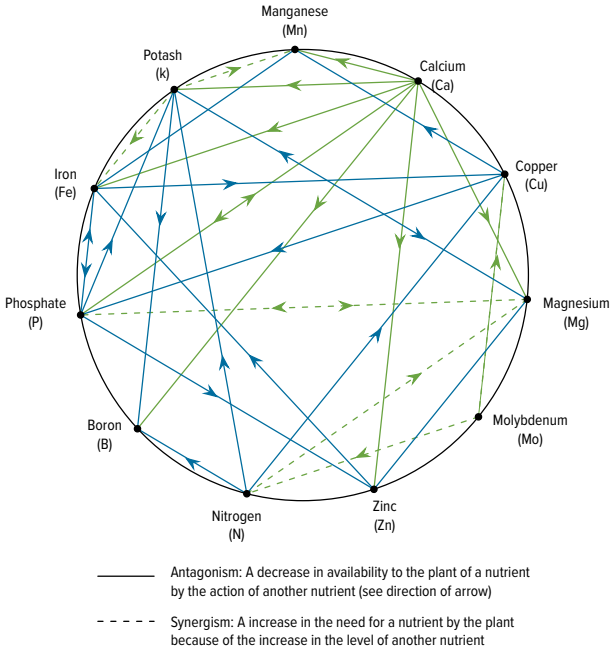
Justus von Liebig was a noted German chemist who in the late 1800s was widely acknowledged as the father of fertilizer and popularized the theory of the minimum developed by Carl Sprengel in the early 1800s. Liebig was able to prove the scientific concept that total crop growth is limited by the scarcest nutrient available rather than the total amount of nutrients available to the plant. Hence, nutrients must be supplied in the balance as loading up on one or more key nutrients will not produce a desirable outcome and thereby make that nutrient application less efficient.



https://commons.wikimedia.org/wiki/File:Minimum-Tonne.svg

Mulder's Chart

Much of what we know today about nutrient interactions was published by D. Mulder in *Les elements mineurs en culture fruitière* in 1953. He was able to show which nutrients interacted with others, either synergistically or antagonistically. Again, this leads to the need for a balanced approach to crop nutrition where we examine the soil levels and applied levels to ensure that an imbalance does not develop which will influences our yield targets. Knowing these interactions will aid greatly in developing fertility programs to maximize the efficiency of each pound of nutrient applied.



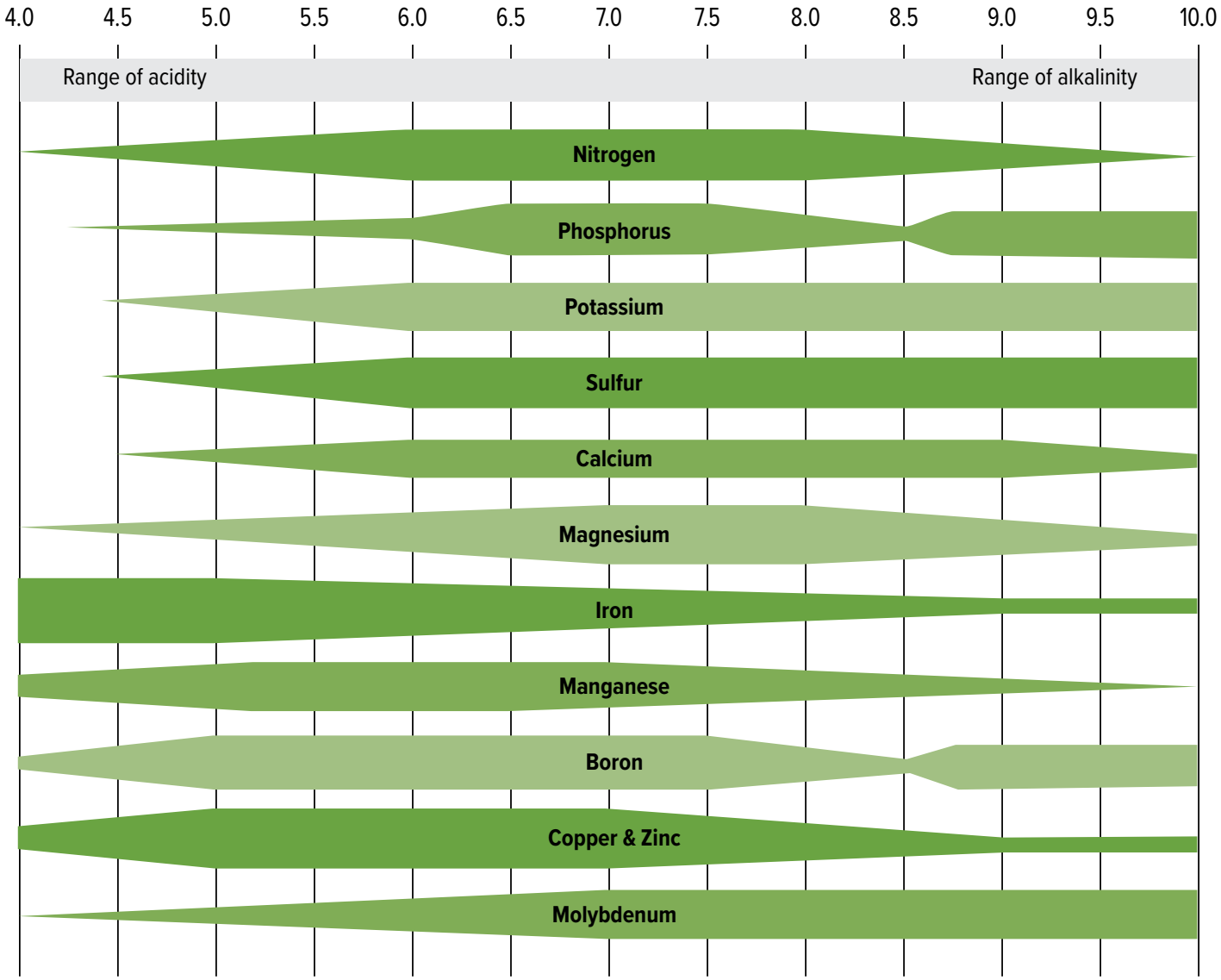
Soil pH and Nutrient Availability

As much as the first two core concepts aid in developing programs the relationship between soil pH and its effect on availability of nutrients is another key concept to consider. Although altering soil pH requires more effort to change to reach optimal availability rates of various nutrients, knowing the relationship can help growers chose nutrient materials or placement locations that are optimal for their soil conditions.

"For example, P-containing fertilizer can be applied in or close to the seed-row at planting to facilitate early season uptake of phosphate ions by crop roots before allowing it to react with soil cations that dominate under acidic or alkaline soil pH conditions."

https://nutrientstewardship.org/implementation/soil-ph-and-the-availability-of-plant-nutrients/

Soil pH and Nutrient Availability



Source: Illinois Agronomy Handbook

Fertility Planning

Soil and Tissue Sampling

The soil test should be done annually so that changes in base fertility levels can be monitored and incorporated into the yearly fertility program. Previous crop yield and rainfall play an important factor in determining the nutrient level found in soils. Monitoring the pH level that comes with standard soil testing is also important as cropping system changes can also have an effect on soil pH. Continuous cropping, direct seeding operations are showing a faster rate of pH decline than past traditional cropping practices. In areas of increased rainfall many growers are experiencing higher pH levels due to the seepage of alkaline salts. This can have a major influence on fertility products chosen. To make efficient use of fertility dollars knowing base levels are crucial.

Tissue sampling is another way to assess the program and may uncover deficiency levels that were not addressed by the soil application of nutrients. This may have come about by missing one of the core principles of fertilizer programing as previously discussed or may be a result of the lack of availability of certain nutrients during key growth stage nutrient demands.

Plant Tissue Sufficiency Levels (PPM)

	Alfalfa	Canola	Cereals	Corn –tasseling	Lentils	Pea	Potato	Soybean
N	3.0–4.5	2.7–3.2	4.0–5.0	2.8–3.5	3.5–5.0	4.5–6.0	4.0–60	4.0–5.5
P	0.25–0.45	0.34–0.4	0.24–0.36	0.25–0.4	0.25–0.5	0.3–0.6	0.3–0.7	0.25–0.5
K	2.5–3.8	2.58–3.2	2.0–3.0	1.8–3.0	1.8–4.0	1.8–2.5	3.5–6.5	1.75–3.0
S	0.25–0.35	0.49–0.55	0.2–0.3	0.2–0.5	0.2–0.5	0.2–0.6	0.25–0.5	0.25–0.6
B	25.0–80.0	15.0–20.0	6.0–10.0	6.0–20.0	25.0–70.0	15.0–45.0	25.0–60.0	25.0–60.0
Ca	1.0–2.5	1.19–1.40	0.28–0.42	0.3–0.7	0.5–1.5	1.1–1.8	0.7–2.0	0.5–2.0
Cu	8.0–20.0	4.0–12.0	6.0–10.0	6.0–10.0	6.0–40.0	10.0–30.0	10.0–25.0	8.0–20.0
Fe	50.0–250.0	100.0–200.0	36.0–54.0	50.0–250.0	30.0–300.0	50.0–150.0	100.0–200.0	50.0–150.0
Mg	0.3–0.8	0.4–0.5	0.2–0.3	0.2–0.5	0.3–0.4	0.35–0.8	0.5–1.1	0.25–0.6
Mn	30.0–100.0	60.0–110.0	32.0–48.0	30.0–100.0	40.0–150.0	40.0–70.0	60.0–200.0	35.0–100.0
Mo	1.0–2.5	0.5–1.0	0.3–0.3	0.1–0.3	>1.0	0.4–1.0	0.1–1.5	1.0–5.0
Zn	25.0–70.0	25.0–45.0	22.0–34.0	25.0–50.0	20.0–50.0	40.0–80.0	30.0–70.0	25.0–50.0

Nutrient Requirements

Fertility plans in their simplest form are based on the number of pounds of nutrients required by the plant to produce a bushel of grain less the amount available to the plant from the soil bank. Determining the actual amount of fertility to apply is determined by using the core concepts to arrive at a level required to meet the yields goals. This simple goal is a mix of scientific interpretations as much as it is a work of art. Having an experienced fertility advisor will go a long way in optimizing the efficiencies of products applied and the grower achieving yield targets. ALPINE representatives have decades of company experience to draw upon as well as their own experience and training to help growers determine maximum fertility efficiency programs.

Field Crop Nutrient Uptake and Removal in Ontario

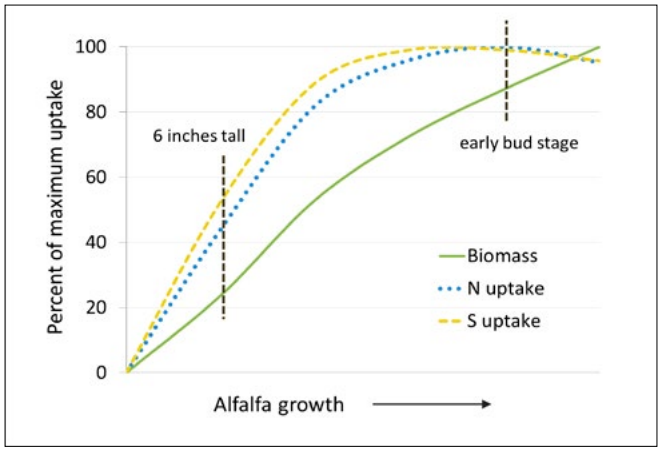
	Yield		N	P_2O_5	K_2O	Ca	Mg	S
Crop	**bus/ac**		**lb/ac**					
Grain corn	180	uptake	208–287	89–131	160–292	31–59	22–36	16–19
		removal	116–179	66–79	47–53	1	16	12–13
Soybean	50	uptake	230–290	40–50	120–220	25–30	20–25	17
		removal	187–200	40–44	69–70	9–11	7–9	5
Winter Wheat	90	uptake	168–186	61–67	113–182	15	20–28	18–23
		removal	103–113	49–56	31–34	2	14	7
Canola	45	uptake	135–144	59–75	107–120			27–28
		removal	90–100	50–60	25–30	9–12	12–15	15
Potato	330 cwt/ac	uptake	160–170	50–55	220–330	xx	30	15
		removal	63	12	108–125	2.5	5	5.6
Forages	**Tons/ac Dry Matter**							
Corn Silage	8		173–239	74–109	133–243	26–49	18–30	13–16
Legume Haylage	5		266–367	53–79	224–354	113–177	19–36	19–20
Grass Haylage	4		129–219	39–62	163–27	49–90	10–21	

Ontario Ministry of Agriculture, Soil Fertility Handbook, Publication #611, 2006

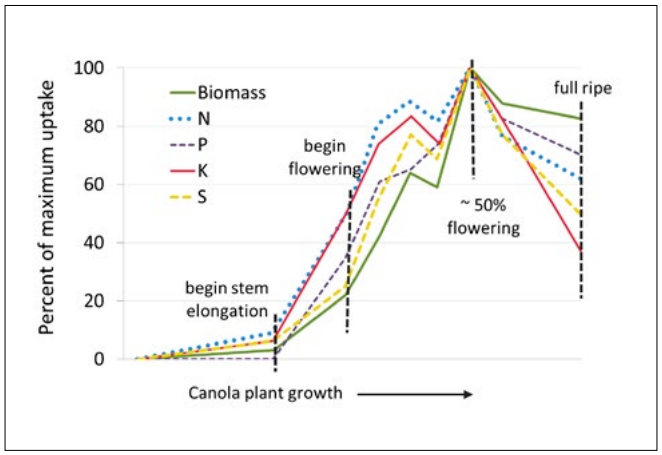
Nutrient Uptake Timing

Plants uptake of various nutrients are determined by the growth stage of the plant. The uptake of nutrients is predetermined by the development stage of the plant and any imbalances at any stage will affect the final yield. Again, this is where interpretation of plant needs and nutrient availability need to be looked at closely. Many times, we may look at our soil bank numbers and applied numbers and feel that all is in balance and yet yields fall short. One overlooked factor is often is there enough nutrient in a plant available form ready to supply the plant needs at a specific growth stage. Are supplied nutrients still available to the plant or have they been immobilized in the soil or lost due to leaching. This often an opportune time for the application of foliar applied fertilizer to ensure available plant nutrients at critical crop growth stages. The efficiencies of foliar applied products are discussed in detail on page 37.

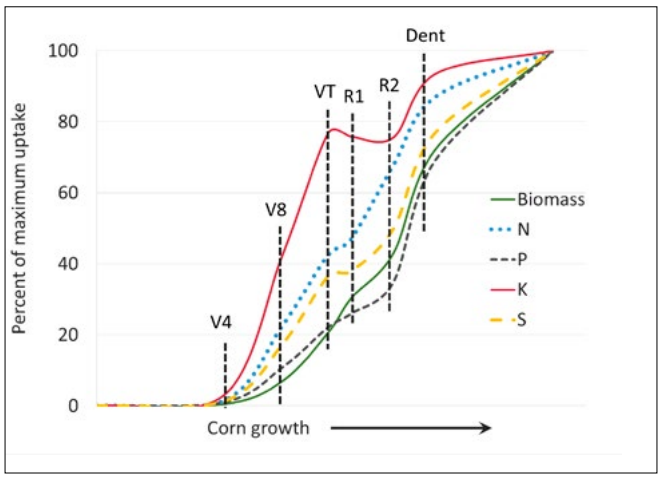
Alfalfa



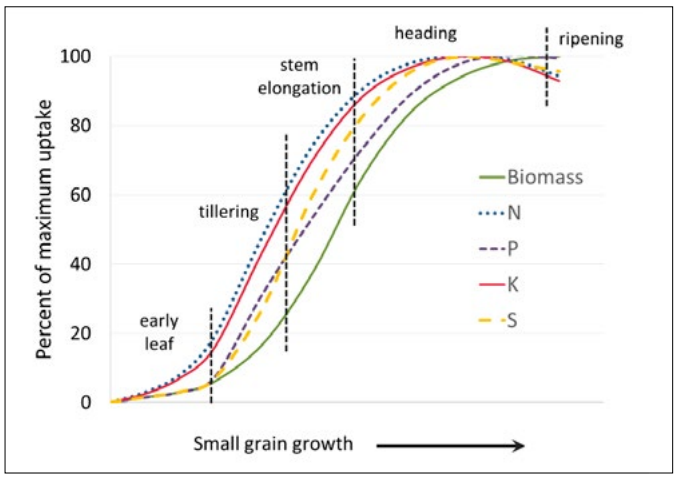
Canola



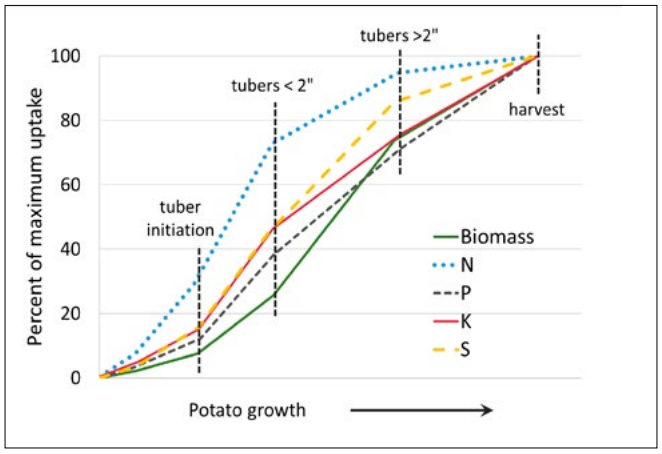
Corn



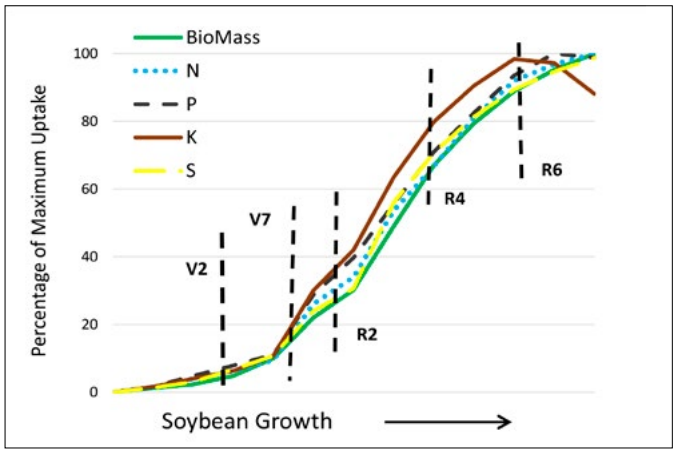
Cereals



Potato



Soybean



4 nutrient stewardship PARTNER

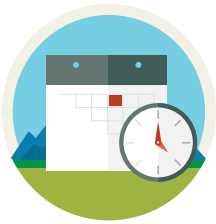
A Concept Of The International Plant Nutrient Institute (IPNI)

RIGHT SOURCE

Matches fertilizer type to crop needs.

RIGHT RATE

Matches amount of fertilizer to crop needs.



RIGHT TIME

Makes nutrients available when crops need them.

RIGHT PLACE

Keeps nutrients where crops can use them.

RIGHT SOURCE

Right Source: Matches Fertilizer Types To Crop Needs

The core scientific principles that define right source for a specific set of conditions are the following: *Consider rate, time and place of application.*

Supply nutrients in plant-available forms.
The nutrient applied is plant-available, or is in a form that converts timely into a plant-available form in the soil.

Suit soil physical and chemical properties.
Examples include avoiding nitrate application to flooded soils, surface applications of urea on high pH soils, etc.

Recognize synergisms among nutrient elements and sources.
Examples include the P-zinc interaction, N increasing P availability, fertilizer complementing manure, etc.

Recognize blend compatibility.
Certain combinations of sources attract moisture when mixed, limiting uniformity of application of the blended material; granule size should be similar to avoid product segregation, etc.

Recognize benefits and sensitivities to associated elements.
Most nutrients have an accompanying ion that may be beneficial, neutral or detrimental to the crop. For example, the chloride (Cl-) accompanying K in muriate of potash is beneficial to corn, but can be detrimental to the quality of tobacco and some fruits. Some sources of P fertilizer may contain plant-available Ca and S, and small amounts of Mg and micro-nutrients.

Control effects of non-nutritive elements.
For example, natural deposits of some phosphate rock contain non-nutritive trace elements. The level of addition of these elements should be kept within acceptable thresholds.

RIGHT RATE

Right Rate: Matches Amount Of Fertilizer To Crop Needs

The core scientific principles that define right rate for a specific set of conditions are the following: *Consider rate, time and place of application.*

Assess plant nutrient demand.
Yield is directly related to the quantity of nutrients taken up by the crop until maturity. The selection of a meaningful yield target attainable with optimal crop and nutrient management and its variability within fields and season to season thus provides important guidance on the estimation of total crop nutrient demand.

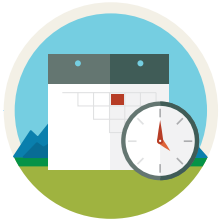
Use adequate methods to assess soil nutrient supply.
Practices used may include soil and plant analysis, response experiments, omission plots, etc.

Assess all available nutrient sources.
For most farms, this assessment includes quantity and plant availability of nutrients in manure, composts, bio-solids, crop residues, atmospheric deposition and irrigation water, as well as commercial fertilizers.

Predict fertilizer use efficiency. Fertilizer
Some loss is unavoidable, so to meet plant demand, the amount must be considered.

Consider soil resource impacts.
If the output of nutrients from a cropping system exceeds inputs, soil fertility declines in the long term.

Consider rate-specific economics.
For nutrients unlikely to be retained in the soil, the most economic rate of application is where the last unit of nutrient applied is equal in value to the increase in crop yield it generates (law of diminishing returns). For nutrients retained in the soil, their value to future crops should be considered. Assess probabilities of predicting economically optimum rates and the effect on net returns arising from error in prediction.



RIGHT TIME

Right Time: Makes Nutrients Available When Crops Need Them

The core scientific principles that define right time for a specific set of conditions are the following:
Consider source, rate and place of application.

Assess timing of plant uptake.
Nutrients should be applied to match the seasonal crop nutrient demand, which depends on planting date, plant growth characteristics, sensitivity to deficiencies at particular growth stages, etc.

Assess dynamics of soil nutrient supply.
Mineralization of soil organic matter supplies a large quantity of some nutrients, but if the crop's uptake need precedes its release, deficiencies may limit productivity.

Recognize dynamics of soil nutrient loss.
For example, in temperate regions, leaching losses tend to be more frequent in the spring and fall.

Evaluate logistics of field operations.
For example, multiple applications of nutrients may or may not combine with those of crop protection products. Nutrient applications should not delay time-sensitive operations such as planting.

RIGHT PLACE

Right Place: Keeps Nutrients Where Crops Can Use Them

Right place means positioning needed nutrient supplies strategically so that a plant has access to them. Proper placement allows a plant to develop properly and realize its potential yield, given the environmental conditions in which it grows.

Right place is, in practice, continually evolving. A host of factors can affect proper fertilizer placement, including but not limited to, the following:

Plant genetics	Plant spacing
Placement technologies	Crop rotation or inter-cropping
Tillage practices	Weather variability

Consequently, there is much yet to learn about what constitutes the "right" in right place and how well it can be predicted when management decisions need to be made.

The core scientific principles that define right place for a specific nutrient application are the following:
Consider rate, time and place of application.

Consider where plant roots are growing
Nutrients need to be placed where they can be taken up by growing roots when needed.

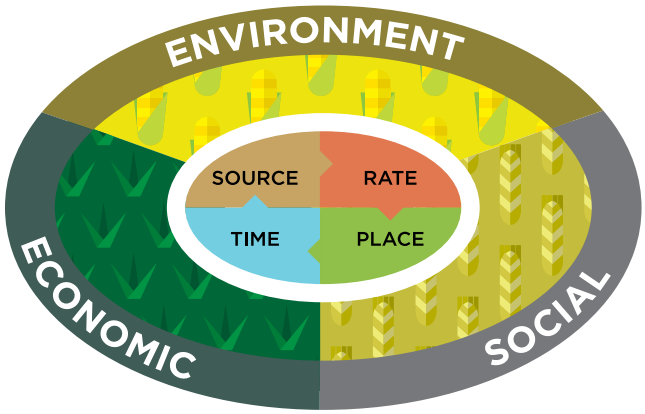
Consider soil chemical reactions
Concentrating soil-retained nutrients like P in bands or smaller soil volumes can improve availability.

Suit the goals of the tillage system
Subsurface placement techniques that maintain crop residue cover on the soil can help conserve nutrients and water.

Manage spatial variability
Assess soil differences within and among fields in crop productivity, soil nutrient supply capacity, and vulnerability to nutrient loss.

According to The Nutrient Stewardship Initiative:

"Agriculture is being challenged to maintain profitable farm economics, while meeting the increased product demands of a growing population and responding to increased scrutiny of land and resource management. Agricultural sustainability means addressing economic, environmental and social goals. 4R nutrient stewardship is an innovative approach to fertilizer best management practices (BMPs) to help achieve agricultural sustainability. The 4Rs imply that there are four aspects to every fertilizer application and it provides an effective framework to assess whether a given crop has access to the necessary nutrients. The four aspects of fertilizer management are interconnected, and none of the four can be right when any one of them is wrong."

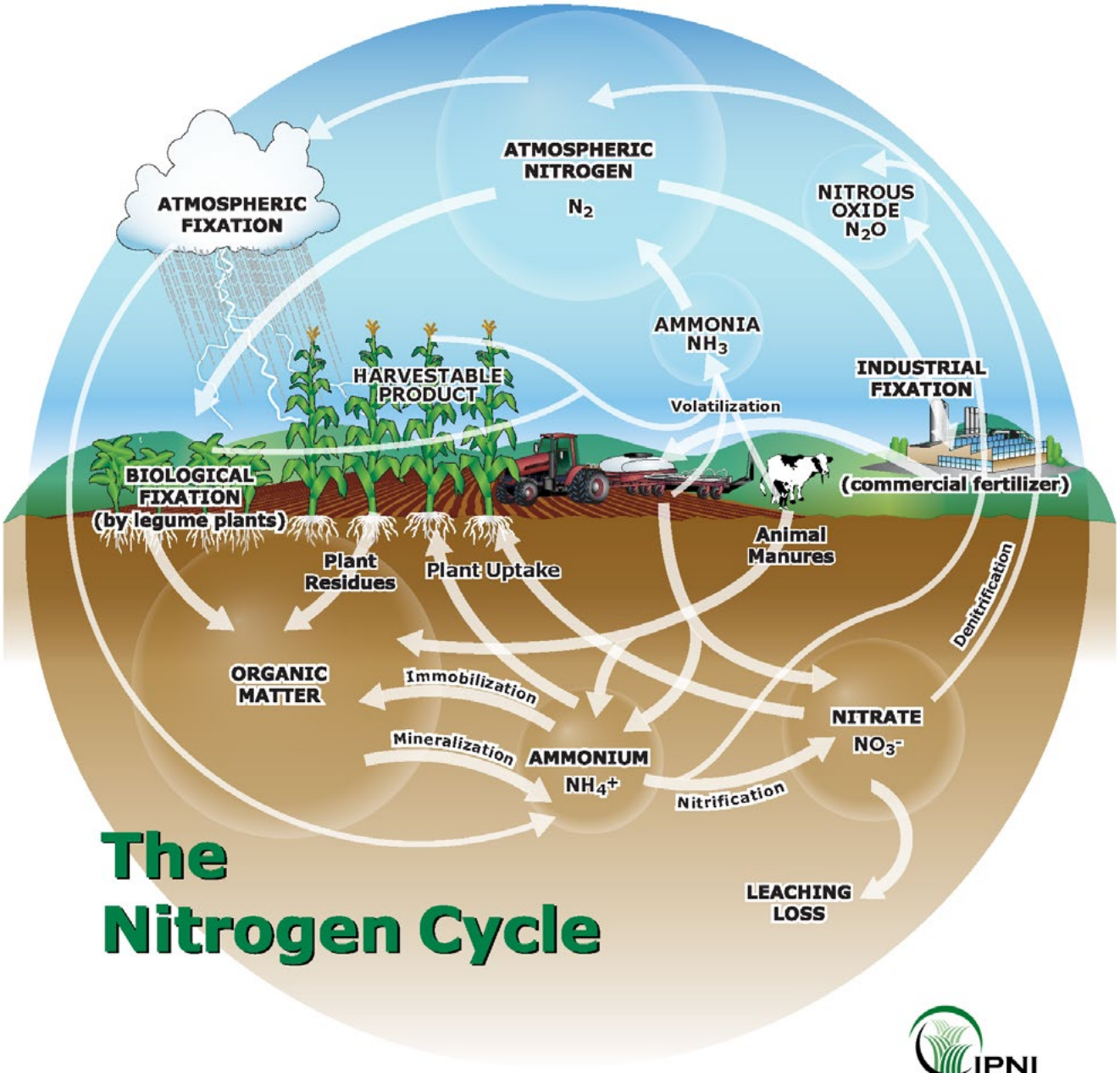


Maximizing Nitrogen Efficiency

Nitrogen is a key macro-nutrient required by the plant and is largely seen as the plant growth driver due to the functions it has in plant and effect on yield.

Role of Nitrogen in plant:

1. Formation of DNA and RNA
2. Production of chlorophyll
3. Production of proteins



IPNI International Plant Nutrition Institute

Nitrogen is also the key nutrient in which there is no appreciable accumulation in the soil bank. Plants must obtain nitrogen in one of the three plant available forms: **Nitrate-N** (NO_3-N), **Ammonium-N** (NH_4-N), and **Urea** ($CO[NH_2]_2$). This can come from:

1. Nitrogen reserves in the organic matter pool which is stored in large molecules that need to be converted to plant available forms
2. Atmospheric nitrogen that is accessed by plants able to fix nitrogen through a bacteria symbiotic relationship (predominately legume crops)
3. Application of a commercial fertilizer

Once these available forms of nitrogen are plant available, they become subject to losses caused by:

- **Leaching**– Excess soil moisture
- **Volatilization**– loss to atmosphere due to conversion to gas
- **Denitrification**– loss to atmosphere from water saturated warm soils
- **Immobilization–** tied up by bacteria and soil microorganisms
- **Erosion**– physical loss of soil by wind or water

In order to reduce these losses growers have instituted several cultural practices to limit losses and increase the efficiency of applied fertilizer. There are several products in the marketplace that have been developed to control the loss of nitrogen.

- Urease inhibitors to control volatilization
- Nitrification inhibitors to reduce leaching and denitrification losses
- Controlled release products to slowly release nitrogen

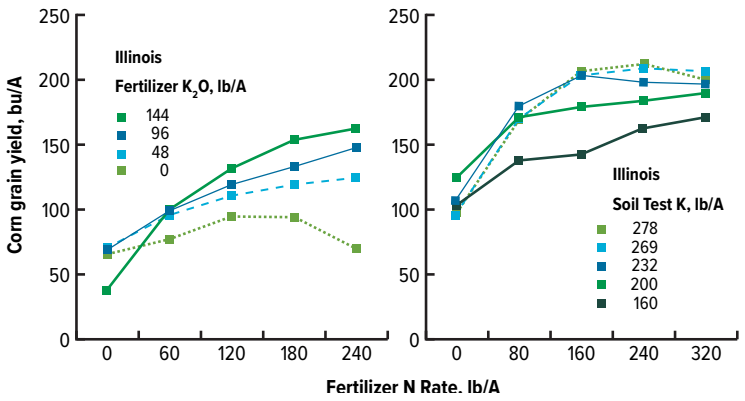
Managing nitrogen losses is a key consideration in creating a fertility program and will often determine the source, timing, place and rate of application - in other words utilizing the principles of 4R Nutrient Stewardship to develop the best plan for the grower based on a particular set of environmental conditions, economic and social factors. Many of these programs involve the use of products that will deliver nitrogen at various plant growth stages.

"In most cases, nitrogen fertilizer is the costliest major nutrient in any fertilizer program. By placing all the nitrogen requirements at seeding, a producer must rely on adequate rainfall during the growing season so the crop can efficiently utilize the nitrogen. Split application is the process of matching nitrogen supply for a pre-established target yield and a given level of soil moisture, and then supplying the remaining nitrogen as moisture conditions improves."

"Split applications of nitrogen give producers greater flexibility in their fertilizer program. This practice minimizes the risk of placing all the nitrogen at the time of seeding. By providing nitrogen to meet the changing demands of a growing crop, producers can potentially increase nitrogen use efficiency. Split application reduces the exposure of nitrogen in saturated soils where the potential for losses such as leaching and denitrification are increased. It also reduces the amount of product a producer must handle during the busy seeding period. Finally, proper timing and placement of nitrogen may help reduce nitrous oxide emissions, a very potent greenhouse gas."

– Soil Facts, Nitrogen-Split Application, SK Soil Conservation Assoc.

Another method to increase the nitrogen use efficiency is to keep the other nutrients such a potassium in balance with the nitrogen rate applied. Addition of K has been shown to increase the absorption of NH_4+ and of $N0_3$- ions into the plant.



Source:Better Crops/Vol 82 (1998, No. 3)

"In the field, better N uptake and utilization with adequate K mean improved N use and higher yields. Crops respond to higher K levels when N is sufficient, and greater yield response to N fertilizer occurs when K is sufficient. Corn studies in Illinois and Ohio provide examples of this economically and environmentally important interaction."

Better Crops/Vol 82 (1998, No. 3)

See page 17 to learn how ALPINE K19-S can make UAN applications more efficient.

Maximizing Phosphorus Efficiency

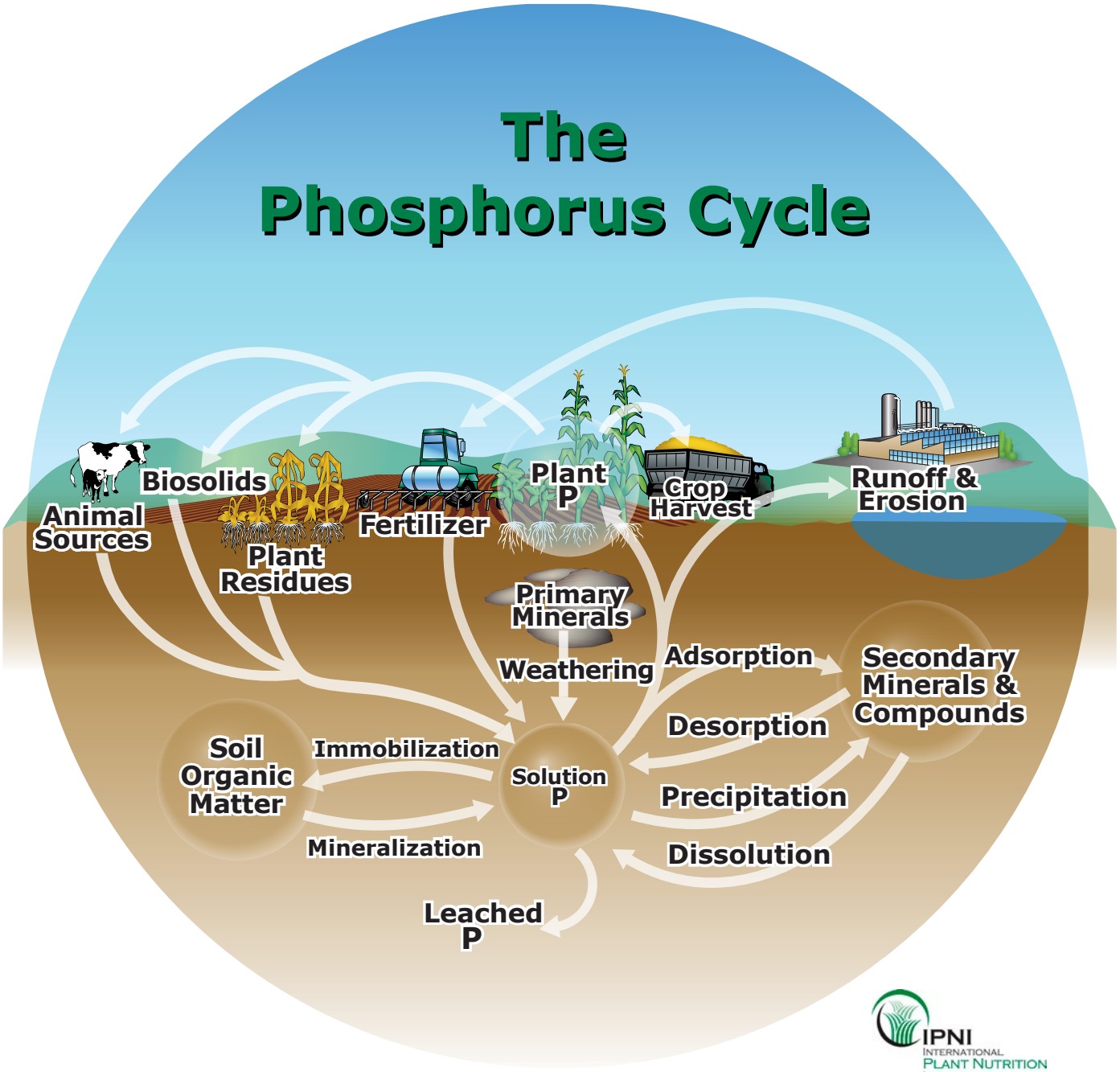
Phosphate is the second key macro-nutrient which plays a vital part in plant growth and development.

Role of Phosphorus in plant:

1. Essential for early root growth and formation
2. Improves water and nutrient absorption by the plant
3. Encourages development of flower blooms and seed development
4. Improves plant strength and abiotic stress tolerance
5. Cell division and DNA, RNA formation
6. Photosynthesis

"A starter fertilizer is most beneficial when the crop is planted into cold, wet soils regardless of the total fertility status of the soil."

–Agronomy Facts 51, Penn State



Phosphate is the second-highest nutrient required by most crops in terms of removal rates from the soil. Unlike nitrogen, there is a considerable bank of soil phosphate in most soil however the majority is not available to the plant. The process of dissolution, mineralization, and desorption releases some phosphate to the plant's available pool of P in the soil solution for plant growth each year. There are also offsetting processes of precipitation, immobilization, and adsorption which tie up phosphate and make it unavailable to the plant. The influence of pH has a great impact on these reactions with the plant availability of phosphorus being greatest between a pH 6–7.5. The plant available ions of H_2P0_4 and HPO_4^2 (orthophosphate) are also immobile in the soil, able to move only 1/8 inch in the soil profile.

In order to gain the most efficient use of applied phosphate to the soil, the use of seed placed starter phosphate has become standard practice in developing efficiency fertility programs. The starter nutrition is a key component of any balanced nutrition program. Starters provide the emerging seedlings with essential nutrients which are accessible near the young roots just as the sugars and starches are being depleted from the germinated seed. By enhancing early rapid seedling development by use of seed-placed starter, yield can be positively impacted. Early robust seedlings can also better resist insect and disease attacks as well as compete more effectively with early weed pressures.

Starter nutrition is especially beneficial when soils are cold and wet. Under these conditions, early root growth is reduced along with a reduction in nutrient mobility and nutrient mineralization. These conditions are present across Canada in most years, especially as the increasing farm size has resulted in more acres being seeded earlier into colder, wetter soils. The adopted practice of conservation tillage has also contributed to seeding more acres into cooler soils due to the inherent surface straw mulch which accompanies this practice.

In starter nutrition, phosphorous is the key nutrient since it is practically non-mobile in the soil and is known to promote vigorous root growth. A small amount of nitrogen in the starter has two benefits to the seedling as it provides early nitrogen to the plant without causing seedling injury and it enhances the uptake of the phosphorous. The addition of potash in the starter also has a positive effect in phosphorous uptake. If the soil tests call for micro-nutrients, then placing them with the starter nutrition is an efficient manner to place them close to the seed for maximum benefit.

"Early season limitations in P availability can result in restrictions in crop growth, from which the plant will not recover, even when P supply is increased to adequate levels."

–Grant ET AL. Canadian Journal Plant Science, 2001

Synergistic effect of nitrogen and potassium on the uptake of phosphorous:

Treatment	% P Absorbed
P alone	12.1
N + P	20.3
P + K	13.1
N + P + K	22.3

–Dr. John Strauss,Director of Agronomy Services, Tulsa, Oklahoma

Traditional liquid phosphate fertilizers are 70% polyphosphate which must convert into the orthophosphate form in the soil solution by combining with soil moisture before the plant can uptake the nutrient. Similarly, dry forms of phosphate fertilizer which are already in the orthophosphate form must convert into a solution in the soil before the plant can uptake the nutrient. The conversion rates of both of these processes are dependent on soil moisture conditions and soil temperature.

Plant requirement of phosphate is crucial in the early stages of plant growth. Numerous studies have shown that a lack of phosphate early in plant growth will negatively affect the yield and maximum yield cannot be achieved even if phosphate availability or additional supply is available to the plant at later growth stages.

Work by the University of Guelph has shown that the phosphate supply from seed placed starter fertilizers will provide the required amount of phosphate to the plant at this critical stage in plant development. The plant is unable to source enough phosphate from the soil at this stage even in soils which test high for available phosphate.

The recent analysis of corn research trials done in Ontario from

Conversion of Polyphosphate to Orthophosphate		
Soil pH	Days After Application	% Remaining
4	100	50
7.2	30	50

Source: Sutton and Larson, Soil Science 97

"In the soil, polyphosphate converts to orthophosphate by hydrolysis (adding on water). The time required for hydrolysis to occur varies with soil conditions. In some cases, 50% of the polyphosphate hydrolizes to orthophosphate within two weeks. Under cool, dry conditions, hydrolysis may take longer."

– MSUE Agricultural Extension Bulletin N-P-K FERTILIZERS. M.L. Vitosh, Extension Specialist, Crop & Soil Science. 2005.

1967 to 2010 to the effectiveness of phosphate fertilizer showed that a profitable response to seed placed phosphate would occur as often in fields testing 25 ppm as it would in fields testing 10 ppm. The review also concluded that on soils with soil test P levels over 15 ppm that:

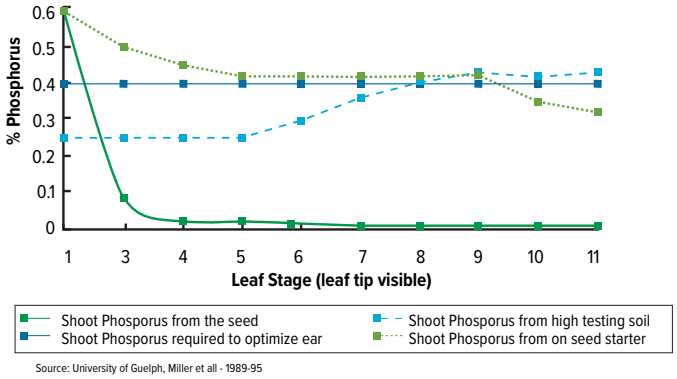
1. 18 lbs/ac of P_2O_5 applied to current crop provided maximum economic benefit
2. Maximum P efficiency was when the fertilizer was banded or seed placed
3. Broadcasting P to crop removal rates to maintain soil test levels had very little economic benefit

The research review also showed seed placed or banded starter fertilizers that contained K lead to more consistent higher corn yields on soils testing less than 90 ppm of potassium.

Starter nutrition can be described as the catalyst to achieve the genetic yield potential of the plant. To increase the probability of the emerging seedlings roots making contact with this catalyst one can control its placement with properly equipped planters. By placing the starter nutrition as close to the seed as possible the efficiency in P uptake by the plant is maximized.

While the starter fertilizer is an efficient method to maximize phosphorus efficiency it may not always provide all the phosphate necessary to obtain the yield goals desired by todays farm managers or the genetic yield potential of many of today's new crop varieties. In order to accomplish this the use of relay phosphate may be required to increase plant availability.

Phosphorus Concentration in the Corn Shoot



Source: University of Guelph, Miller et all - 1989-95

"A higher starter rate won't compensate for fertilizer being farther from seed. The closer the starter is to the seed, the better the response is."

–Ken Ferrie, Farm Journal Agronomist

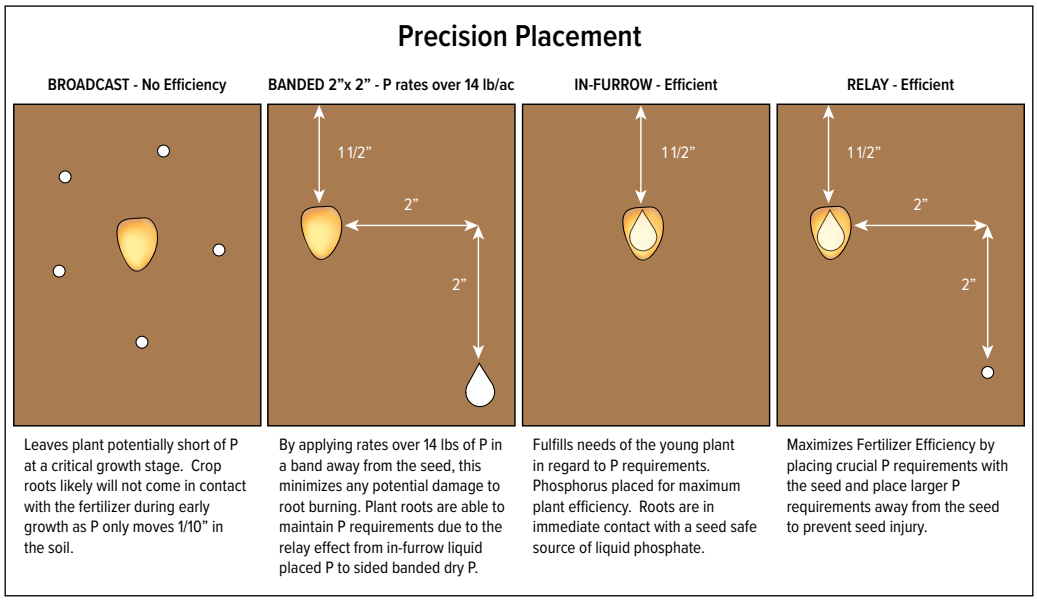
"The final grain yield is influenced by the tissue Phosphorus concentration prior to the 6-leaf stage, regardless of the P supply at later stages."

–University of Guelph, Miller ET AL. 1988

"The Farm Journal Test Plots in corn, have shown, on average, a 7 to 10 bushel per acre response to starter placed 2" to the side and 2" down from the surface (2x2) and a 3 to 5 bushel per acre response to in-furrow application. Using dual placement, also called the relay effect, yield has increased 15 to 20 bushel per acre. 'It's like the fertilizer positions are handing off a baton. The roots find the nutrients as they need them.'"

- Farm Journal Field Agronomist, Ken Ferrie

Precision Placement



Leaves plant potentially short of P at a critical growth stage. Crop roots likely will not come in contact with the fertilizer during early growth as P only moves 1/10" in the soil.

By applying rates over 14 lbs of P in a band away from the seed, this minimizes any potential damage to root burning. Plant roots are able to maintain P requirements due to the relay effect from in-furrow liquid placed P to sided banded dry P.

Fulfills needs of the young plant in regard to P requirements. Phosphorus placed for maximum plant efficiency. Roots are in immediate contact with a seed safe source of liquid phosphate.

Maximizes Fertilizer Efficiency by placing crucial P requirements with the seed and place larger P requirements away from the seed to prevent seed injury.

Maximizes Nutrient efficiency by placing crucial P requirements with the seed and places larger P requirements away from the seed to prevent seed injury.

ALPINE® Premium Liquid Starters

ALPINE starter fertilizers are high quality, liquid solutions that provide growers with an excellent opportunity to increase productivity, profit and nutrient efficiency.

ALPINE liquid starters have a neutral pH, are low in impurities and are non corrosive. ALPINE starters enable the product to be placed directly with the seed at planting time. Placement with the seed enables the phosphorous to be taken up at the earliest stages of growth. This is the stage at which young crops require a majority of their phosphorous. ALPINE starter fertilizers are readily available and give the plant a great start even under cold soil conditions. ALPINE starters contain 80 or 100% orthophosphate – the plant available form of phosphate. ALPINE starters result in increased plant health and crop yield.

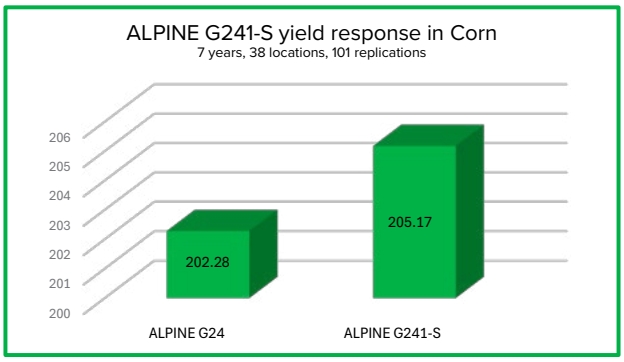
Quality of Product

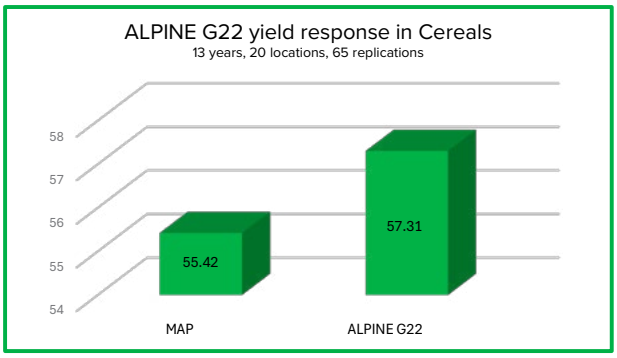
Quality of raw materials must always be considered. One problem with the fertilizer industry, as a whole, is the NPK analysis is the only thing that needs to be guaranteed. The level of impurities and the raw materials used to make the product are never considered. There are what is known as "Spent Acids" that make their way into the fertilizer industry from the bright dipping car part industry. These are very cheap raw materials but can cause problems with germinating seeds due to the high levels of impurities like aluminum. Dry phosphorous can even have as much as 10,000 ppm of Aluminum while ALPINE starter fertilizers will run closer to 1500 ppm. Aluminum, at high levels, can be toxic to root growth – not a good idea for a seed-placed starter. ALPINE starter fertilizers use high quality raw materials to ensure the highest availability of crop nutrients and seed safety. The production process is monitored to ensure a high level of orthophosphate in the final product. Not all manufacturers can say the same.

True Solution Liquid Fertilizer

A true solution liquid fertilizer has the following characteristics:

- Will not settle out
- High solubility
- Each drop has the exact same ratio or percentage of nutrients
- Greater flexibility in mixing with other products





4Rs verification	
Right Source	Plant available orthophosphate and Bio-K ALPINE G241-S 80% ortho ALPINE G22+ K19-S 70% ortho
Right Rate	High efficiency fertility with an efficient use rate to initiate a quick start
Right Place	In-furrow seed placed plant nutrients, enhancing germination and root growth
Right Time	Early availability when planting in cold, wet soils

Application Rate

When applying phosphorous, ALPINE® considers the concentration per foot of row in determining the proper application rate. Phosphorous is the starter part of your program and concentration per foot of row needs to be considered to obtain maximum phosphate use efficiency. ALPINE Agronomists also recommend that the first fourteen pounds per acre of phosphate, to most nutrition programs, to an ALPINE starter liquid fertilizer seed placed product.

In-Furrow Recommendations

Row Width:	Max L/ac:
CORN- GRAIN:	
30″	15–20
CORN- SEED/SWEET:	
30″	11–16
WHEAT, BARLEY, RYE, AND OATS:	
6–8″	22–30
SOYBEANS/EDIBLE BEANS:	
28–30″	8
19–21″	12
4–16″	15
6–8″	20

*On light, sandy soils with organic matter of less than 2%, reduce rate by 2 litres per acre.

**Do not apply any combination of potash and urea blend preplant broadcast on this type of ground in combination with seed placed starters.

***Micronutrients: may be applied in combination with ALPINE G241-S® to a maximum of 2 litres per acre total micro-nutrient.

ALPINE liquid fertilizer placed on or near the seed at planting time can stimulate early root growth and strengthen young plants. Consult with your authorized ALPINE Dealer or ALPINE District Sales Manager or ALPINE retailer for specific fertility recommendations.

Additives To In Furrow Applications

In furrow placement of other crop enhancement products is greatly facilitated once the ALPINE application kit for the application of ALPINE starter products is installed on the planting implement. Crop protection products, biologicals, or plant growth supplements can often be added to the starter product for a very efficient and accurate method in applying these other products. All tank mixes should be tested for physical and performance compatibility before use. Consult with your ALPINE retailer or ALPINE District Sales Manager before using such mixes. The addition of an ALPINE Injection kit to the ALPINE application kit is often required to ensure product compatibilities.

Low Use Rate

The low use rates of ALPINE starters mean fewer fill ups, resulting in increased productivity. Growers gain efficiencies in product handling and storage, reducing overall workload and more acres planted in a day. These use rates also provide growers with an economical, environmentally friendly program that will fit well into a Nutrient Management Plan.

Easy To Add Micro-nutrients

ALPINE starter liquid fertilizers' unique blends of orthophosphate and polyphosphates allows for rapid uptake of phosphorous, as well as flexibility when adding **ALPINE MicroBolt®** micro-nutrients to your starter program. The precision placement of nutrients that is obtained with ALPINE's application equipment takes the inconsistency out of other micro-nutrient application methods. Micronutrients added through the ALPINE system gives even distribution of that micro-nutrient over every foot of every row.

Application Equipment

To use ALPINE liquid starter nutrition, your planting equipment may need modifications for in-furrow or precision placement. Precision-placed nutrition requires proper equipment for accurate application to achieve maximum nutrition efficiency. The experienced ALPINE sales team will guide you through the set up process and can supply all the necessary parts and tanks required from our in house inventory located in New Hamburg, Ontario.

Product Storage Tank Recommendations:

ALPINE G22

Storage in flat bottom tanks is recommended during winter months. Bubble, recirculate, and/or agitate material before usage in all instances. Material stored in cone bottom tanks (although not recommended) will require longer recirculation after winter to regain product consistency. Not recommended for storage in mild steel tanks.

ALPINE G241-S

Storage in flat bottom tanks is recommended during winter months. Bubble, recirculate, and/or agitate material before usage in all instances. Material stored in cone bottom tanks (although not recommended) will require longer recirculation after winter to regain product consistency. Not recommended for storage in mild steel tanks.

For all starter products:
DO NOT STORE OR TRANSPORT ANY PRODUCT IN ALUMINUM, OR GALVANIZED STEEL TANKS

The In-Furrow Starter Advantage

1. Seed-placed liquid orthophosphate
   - No conversion or dissolving required
   - Immediately available in cold soils
   - Increased root mass

2. NPK analysis with micronutrients
   - Proven enhanced P uptake with a complete NPK starter
   - Micronutrients available at germination
   - Complete starter nutrition

3. Convenient low rate
   - Planting efficiency increased
   - Less storage and handling
   - Plant more acres per day

4. Quality product
   - Low impurity levels
   - Noncorrosive

5. Higher returns
   - Consistent yield responses over 45 years and counting
   - More efficient nutrient utilization per dollar

Liquid advantages

...As stated in Bertrand/Holloway Research-Australia

1. The differences between the efficiency of fluid vs granular fertilizers were significant - especially in clay soils.

2. Fluid fertilizers increased by 42% the amount of available “P” in the soil compared to granular applications.

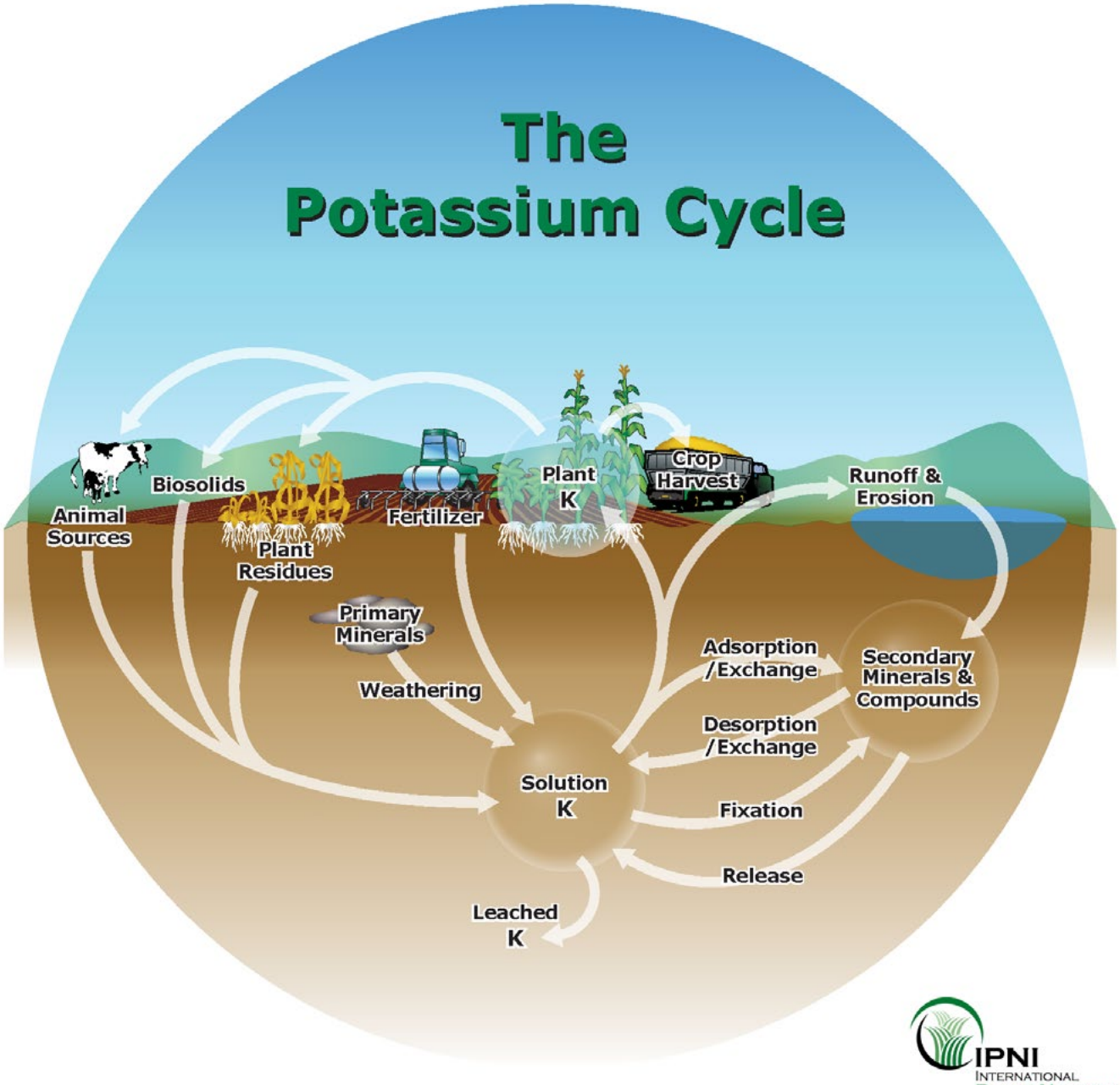
3. Fluids are at least 20% more efficient than granular

Maximizing Potassium Efficiency

The third of the big three macronutrients has been gaining more attention in crop plans of late. Higher yielding crops combined with inadequate availability at key growth stages is resulting in more K in nutrient plans.

Role of Potassium in plant

1. Formation and translocation of starches, sugars, and fats
2. Protein formation
3. Aids in enzyme actions
4. Helps cells maintain their internal pressure
5. Maintains balance of salts and water in cells
6. Improves seed quality
7. Increases root growth and resistance to disease and drought



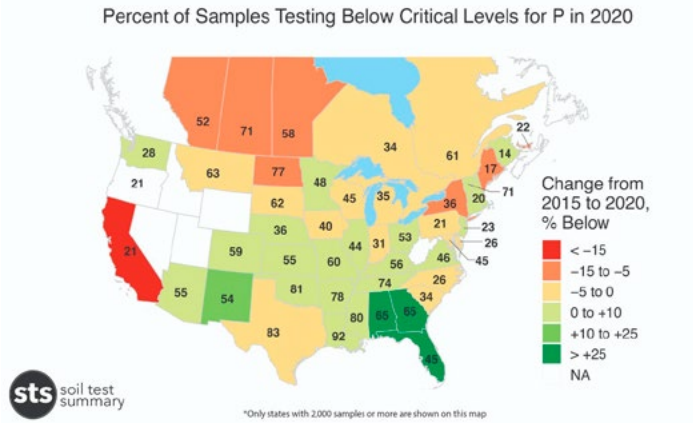
IPNI International Plant Nutrition Institute

Similar to phosphorus much of the potassium in the soil is not plant available, undergoes absorption/desorption, fixation/release and mineralization, and has limited mobility in the soil. Potassium is also affected by soil pH and is less available to the plant in acidic soils. Potassium is also similar to phosphorus in that uptake of K is restricted to the plants in cold soil conditions, requiring a soil temperature of 15–27 degree Celsius to be plant available.

Potassium occurs only in the ionic form in the soil and is not found in the soil organic matter. Research has also shown that reduced tillage systems reduces plant available potassium. It is thought that restricted root growth combined with restricted distribution of roots are affecting K uptake.

Potassium interacts with all nutrients used by the plant which makes planning of fertility plans more complicated with potassium. First is the interaction with nitrogen which has been discussed on page 14. Next is the reaction with P which is noted before on page 19. K can increase the uptake of zinc provided there is sufficient sulphur. The K/Mg and K/Ca ratios are important factors to consider as well as the addition of any of these three nutrients generally causes a reduction in availability of the other two nutrients.

Canadian soil tests show the need for more K



The Fretilizer Institute, 2024, soiltest.tfi.org

The trend in Canada is showing that there are more soil samples testing at or below critical levels. This is the point at which additional K is required in the crop nutrition program to maximize plant health and yields. The 2020 chart shows that the majority of provinces tested are requiring attention to K.

The ALPINE® Bio-K® Story

bio-K® Patented Potassium Technology

THE PROBLEM

An alarming trend of declining potassium levels and lack of availability at key demand times.

THE RESULT

With the combination of higher yields, newer genetics, production practices, reduced tillage, and decreasing potassium levels in your soil, farmers are jeopardizing plant structure, plant health and stress tolerance which negatively affects yield potential, decreases harvest efficiency and profitability.

THE SOLUTION

bio-K® POWERED BY

ALPINE innovative potassium technology Bio-K will address these costly issues. ALPINE Bio-K is a proven technology that is more efficient and readily taken up by the plant better than any other potassium source in the market today.

Farmer Benefits

- Multiple application methods
- Non-corrosive to equipment
- Mixability with crop protection products
- Product flexibility

Crop Benefits

- Seed safe
- Improves nutrient use efficiency
- Improves plant health and stress
- Highest K solubility
- Reduces water loss and wilting
- Increases photosynthesis
- Balanced plant nutrition

What is ALPINE bio-K®?

ALPINE Bio-K® products are uniquely formulated to maximize the uptake of potassium as well as increase nutrient use efficiency. The organic based carrier in ALPINE Bio-K® is a natural plant metabolite, recognized as a preferred food source for soil mycorrhizae. It is essential to the production of many plant compounds such as fatty acids, auxins and amino acids. ALPINE Bio-K® also maintains cation-anion cell balance, enhancing rapid absorption by plant roots and leaves.

bio-K® PRODUCTS

- ALPINE G241-S®
- ALPINE K19-S®
- ALPINE K20-S®
- ALPINE K24®
- ALPINE F18 Max®

ALPINE Bio-K® technology is designed with the most available source of potassium for plant uptake and plant use efficiency. Some of the benefits with incorporating ALPINE Bio-K® into your crop plan include:

- *Increase microbial activity in the seed zone to enhance germination.*
- *Amplify the early uptake of potassium to enhance water use efficiency.*
- *Early potassium uptake is key for both phosphorous and nitrogen use efficiency.*
- *Support cell wall integrity, structure and strength.*
- *Increase turgor pressure which in turn will increase root tips.*
- *Increased root tips anchor roots allowing for greater soil penetration.*
- *Greater soil penetration enhances drought tolerance through water use efficiency and nutrient uptake.*

ALPINE Bio-K® has a point of deliquescence of 23% RH and is the most effective source for soil and foliar applied K. When including ALPINE Bio-K®, you will have a synergistic effect both in-furrow as well as when blended as a foliar with your crop protection.

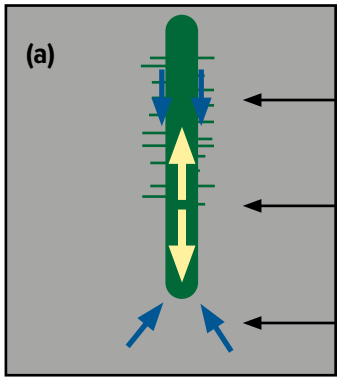
For more information on ALPINE products, please visit alpinepfl.com

Pounds of soil applied nutrients replaced by one pound of foliar applied nutrient		
NUTRIENT	FOLIAR	SOIL
N	1	4
P	1	20
K	1	6
S	1	5-7
B	1	30
Cu	1	12
Mn	1	30
Mg	1	75
Zn	1	12

Plant benefits in two manners by the foliar application of nutrients:

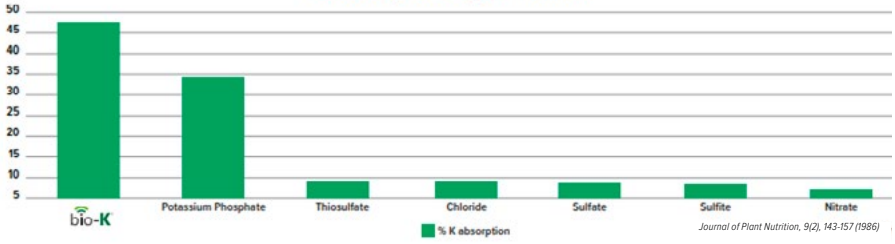
1. *By the rapid influx into the plant of the foliar applied nutrients*
2. *By the increased uptake of the base applied nutrients*

Root elongation in hard and drying soils



Schematic diagram illustrating (a) forces exerted by a penetrating root tip on the soil (Bengough, G et al., 2010).

Foliar absorption of Potassium after 48 hours From Organic and Inorganic K carriers
% K absorption, Soybean leaves



Journal of Plant Nutrition, 9(2), 143-157 (1986)

Superior Solubility

Solubility of potassium products	
ALPINE Bio-K	286.6
ALPINE K-Thio	165.0
ALPINE Double OK	112.6
Potassium sulfite (K-Row 23)	107.0
Potassium chloride (KCl)	34.3

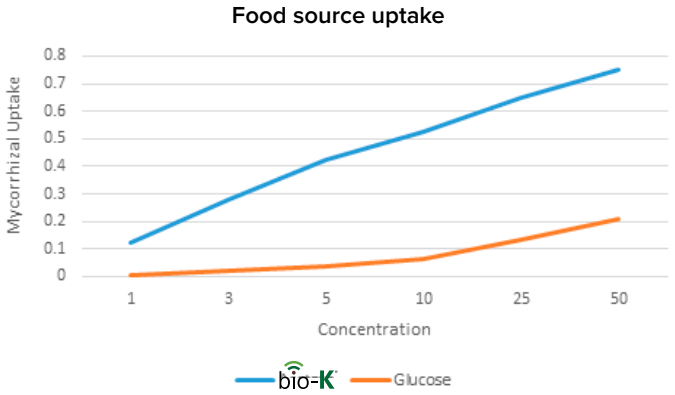
Journal of Plant Nutrition, 9(2), 143-157 (1986)

The photo shows the amount of potassium that can dissolve in 2.5 oz of water. Clearly the potassium source has a huge impact on solubility and ultimately plant availability.

ALPINE has been developing a product line in which Bio-K plays an integral part in the efficient performance of potassium and the other nutrients within the product. This is often referred to as the "hitchhiker effect." Because the plant uptake of the fused source of potassium with the acetate increases plant uptake, other nutrients that are in the formulation with Bio-K are also drawn more efficiently into the plant.

In Furrow

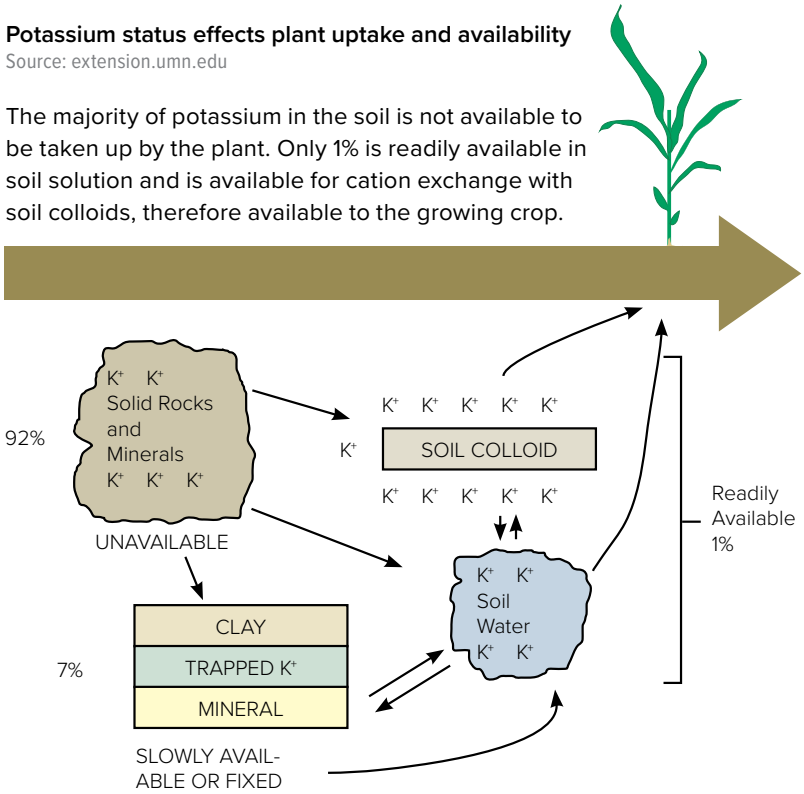
Bio-K in furrow products are an excellent way to place K at the right place and right time most beneficial for plant utilization. Like Phosphorus, Potassium has limited movement in the soil and only 2% is accessible at any given time in the plant available pool. Fortunately, most plants have a symbiotic relationship with mycorrhizal fungi that is instrumental in plant nutrient uptake. This is where ALPINE starters - powered by Bio-K, can influence the amount of K that can be taken up by the plant. The organic based carrier in Bio-K is the preferred food source for these fungi. In essence the preferential desire for acetate K sources results in the mycorrhizal fungi providing more K to the root hairs.



New Phytologist (2008) doi: 10.1111/j.1469-8137.2008.02590.x

Potassium status effects plant uptake and availability
Source: extension.umn.edu

The majority of potassium in the soil is not available to be taken up by the plant. Only 1% is readily available in soil solution and is available for cation exchange with soil colloids, therefore available to the growing crop.



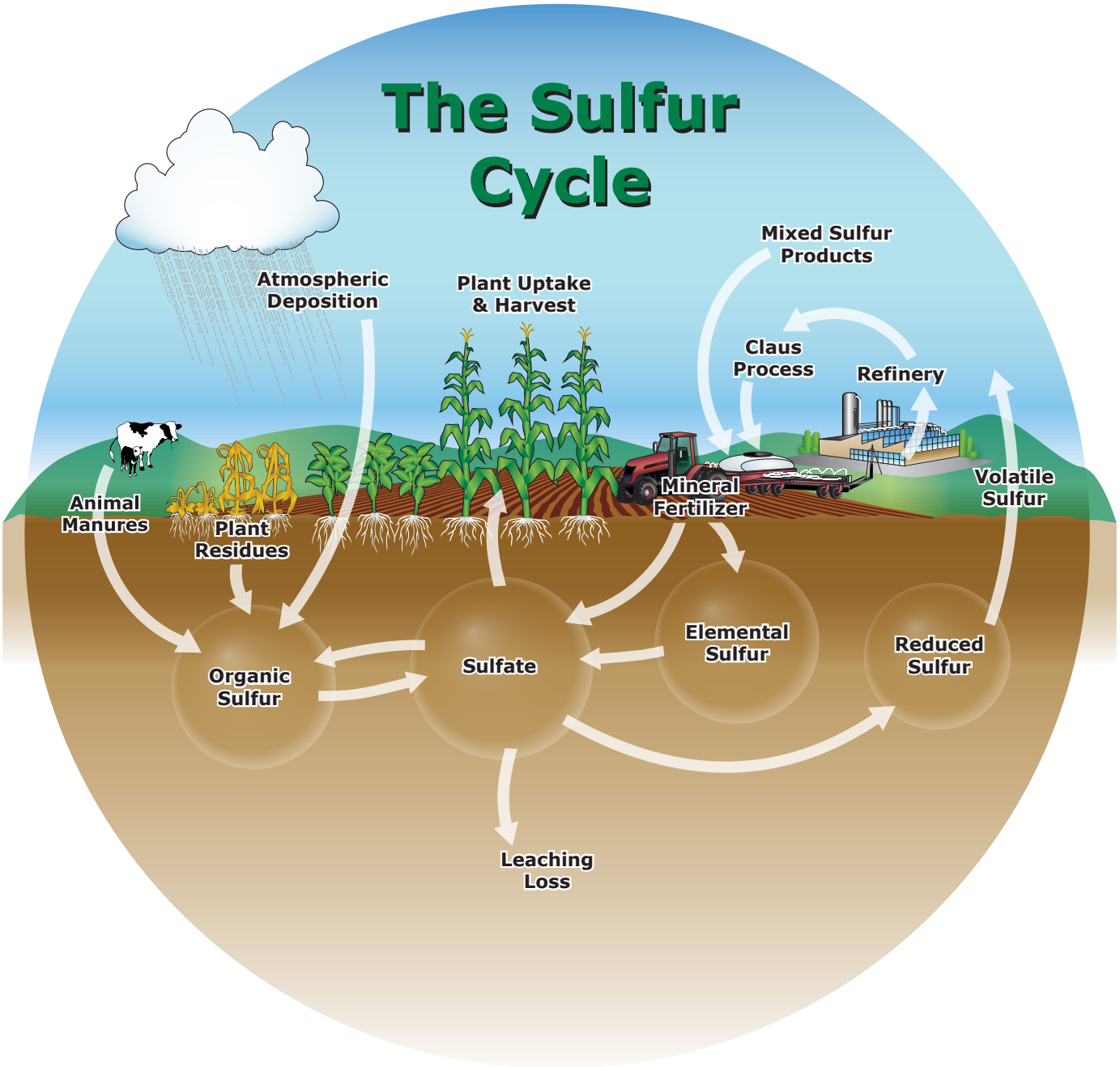
Acetate-carbon fuels microbial growth, which leads to greater biomass carbon production and improved soil health. Soil health and microbial populations promote increased root growth. More roots leads to greater nutrient and water retention, increased plant growth, less soil erosion, and improved soil porosity.

Maximizing Sulphur Efficiency

Sulphur is the fourth macro-nutrient required by plants and is tied very much to the efficiency of nitrogen utilization.

Role of Sulphur

1. Structural component of proteins, peptides and enzymes
2. Used in the formation of chlorophyll
3. Used in the process to convert inorganic n to protein
4. Involved in the nitrogen fixing process of legumes
5. Responsible for odour and flavor characteristics of many plant



Sulphur is found primarily in the organic matter content of the soil and must convert to the sulphate SO_4^{2-} ion before it becomes plant available. Soil applied forms of Sulphur fertilizer must also convert to the sulphate form which requires the activity of soil microbes and soil conditions that are warm and moist. Once in the plant available form sulphate can be lost by leaching. Heavily water saturated soils will also restrict sulphur availability since it produces an anerobic condition in which soil microbes cannot breakdown the applied fertilizer source of sulphur or any from the organic matter bank.

Sulphur reacts with other nutrients in the soil and largely has synergistic effects. Since Nitrogen and Sulphur are tied directly to protein formation their ratio within the plants are key in both nutrients efficiency rate. Soil testing can give base line levels and indicators of soil Sulphur deficiencies but it will be the plant tissue test which will be crucial in determining the need for additional sulphur.

Crop	N:S ratio
Alfalfa	9:1
Canola	6:1
Cereals	10:1
Corn	8:1
Lentil	14:1
Pea	18:1
Potato	8:1
Soybean	18:1

While soil applied sulphur either in sulphate or elemental forms can be used to correct deficiencies spotted in the field and confirmed by tissue sampling, time delays in the nutrient reaching the plant at proper growth stages could become problematic. Foliar applied sources of sulphur can be applied when conditions warrant, to provide the plant available sulphur in a timing manner according to its growth requirements. Foliar efficiency rating for sulphur is found on page 37. Again, planning for a balanced nutritional plan is still key to ensure adequate sulphur in the soil when the crop goes in the ground. Foliars can then supplement nutritional requirements if environmental factors limit the uptake of sulphur.

One of the added side benefits of a foliar sulphur application is its documented role in plant disease control. The fungicidal effect of foliar applied sulphur has been used in various cropping systems since the early 19th century.

Refer to pages 30, 32 and 33 to see how ALPINE G241-S, ALPINE K20-S or ALPINE K19-S, or could fit into your nutritional planning for sulphur.

Maximizing Foliar Fertilizer Efficiency

The application of foliar nutrition has been in use for many years in high-value specialized crops. As Canadian growers are looking to maximize net returns and nutrient efficiencies, the application of foliar nutrition is making its way into many of the progressive grower's crop nutrition programs. Growers are seeing the positive effect this strategy has on increasing crop yields, nutrient efficiencies, and reducing the risk of weather fluctuations on their nutrition program.

The effectiveness of foliar-applied nutrition was first reported by Michigan State University in the early 1950s. The U.S. Atomic Energy Department provided the University with a grant and radioisotopes of all nutrients for them to study the rates of absorption and movement within the plant. These early studies concluded that foliar-applied nutrients were 8–10 times more effective in supplying the required nutrients than soil-applied nutrients.

Other work has established the equivalency of foliar-applied nutrients to soil-applied nutrition. This type of work confirms what growers are seeing in their fields when foliar nutrition is used with a base fertilizer program.

The advantages of using foliar applied nutrition with a base fertility program are:

- Correct nutrient deficiencies as determined from soil or tissue tests
- Strengthen damaged crops
- Speed growth
- Stimulate root uptake
- Provide nutrient efficiency

Foliar nutrition results are highest when the plant is showing high growth activity, going from the vegetative to the reproductive stage, and when deficiencies are present or when the crop has been damaged. To achieve the best results, the foliar product should contain nitrogen, to act as an electrolyte to carry the other nutrients and phosphorous, to move the nutrients within the plant.

The foliar nutrients enter the plant through the leaf stomata and hydrophilic pores in the leaf cuticle. The nutrients are only absorbed while in solution on the leaf surface. For this reason, applications are best made in mornings and evenings, when heavy dew is on the leaf surface, high humidity, and temperatures below 20°C.

"One of the touted benefits of foliar fertilization is the increased uptake of nutrients from the soil."

–George Kuepper, NCAT Agriculture Specialist, Foliar Fertilization, 2003

The beneficial effect of a foliar application is an increase in chlorophyll synthesis which can often result in leaves turning a darker green. The increase in photosynthetic activity will stimulate extra root growth; in turn, the root hairs excrete excess sugar which stimulates microbial colonies. These bacterial colonies provide auxins and other root stimulating compounds. With the increase in cellular activity, gas exchange increases the uptake of water. As the roots take up more water they also bring in more of the nutrients from the soil solution. The foliar application stimulates the entire "pumping system" in the plant to increase the uptake of the base applied nutrition.

Pounds of soil applied nutrients replaced by one pound of foliar applied nutrient		
NUTRIENT	FOLIAR	SOIL
N	1	4
P	1	20
K	1	6
S	1	5–7
B	1	30
Cu	1	12
Mn	1	30
Mg	1	75
Zn	1	12

The plant benefits in two manners by the foliar application of nutrients:

1. By the rapid influx into the plant of the foliar applied nutrients
2. By the increased uptake of the base applied nutrients

This planned approach utilizing staged foliar applications delivers the highest efficiency of nutrients and in turn, creates the highest return on the investment on the grower's crop nutrition program.

Rate Of Foliar Absorption	
Nutrient	**TIME FOR 50% Absorption**
Nitrogen (As Urea)	1/2 - 2 hours
Phosphorus	5 - 10 days
Potassium	10 - 24 hours
Calcium	10 - 94 hours
Magnesium	10 - 24 hours
Sulfur	5 - 10 days

Source: Michigan State University

ALPINE Foliar Recommendations

Favorable spray conditions:

- Time: afternoon or evening when temperature has dropped 3 degrees from peak
- Temperature: 18–29°C
- Humidity: greater than 70%
- Wind speed: less than 8 km/5 mph

Maximum rate of any combination of nutritional products without pesticide is 10 litres and with pesticide 5 litres. 10 gals per acre minimum water volume when using pesticide and nutrition together.

ALPINE foliar fertilizers are best used as a supplement to a good nutrition program. Consult your ALPINE District Sales Manager or ALPINE Retailer for a specific rate according to crop condition and nutrition program.

Mixing instructions

ALPINE foliar fertilizers can mix with many crop production products including glyphosate.

- In a small container prior to full scale mixing, proportionally mix all the components to confirm compatibility
- Thorough mixing of all blends is important
- Temperature and storage time can influence the degree of success
- Mix only the amount that will be immediately used
- Long-term storage is not suggested

ALPINE FOLIAR FERTILIZERS tank mixing procedures

- Add ½ of total water to spray tank
- Start recirculation in the tank
- Add micro-nutrients and/or any other flowable material
- Add any soluble powder, first pre-mixing with water
- Add the recommended amount of ALPINE foliar fertilizers
- Add remaining water volume and continue recirculation prior to spraying

THE FOLLOWING CONDITIONS MUST BE OBSERVED IN ORDER TO APPLY ALPINE LIQUID FERTILIZER FOR FOLIAR APPLICATIONS. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE PLANTS:

- DO USE ALPINE fertilizers under conditions of optimum plant growth including highest humidity, moderate temperature and adequate soil moisture.
- DO add, as a minimum, equal amounts of water. Do use sufficient water to provide thorough coverage.
- DO consult with your local ALPINE distributor to determine pesticides which are compatible with ALPINE fertilizer.
- DO add wettable or soluble powders, emulsifiables or flowables to water in the mix and wet, dissolve or disperse before adding ALPINE fertilizer.
- DO consult your local ALPINE DSM for rate and application instructions.
- DO USE a small jar or container prior to full scale mixing to proportionally mix all the components to confirm compatibility.
- DO NOT use when the crop is under stress from pests, heat or inadequate soil moisture.
- DO NOT apply by aircraft if surface wind is greater than five miles per hour to assure adequate crop coverage and droplet disposition.
- DO NOT spray to run off. Do not spray to visible droplet coalescence. Do not allow concentrated spray mist to run off fruit or leaves.
- DO NOT apply during the heat of the day.
- DO NOT mix with calcium containing products unless the calcium is fully EDTA chelated.
- DO NOT mix fertilizers with hard water. Mixing with hard water may cause clogging of lines due to the combining of calcium, magnesium and iron in the water with phosphate in the fertilizer.

Maximizing Micronutrient Efficiency

Micronutrients play an essential role in all plant growth and are only segregated from the macronutrients because of their low use rate. Plant availability of micronutrients is affected by many of the same parameters as macronutrients. Although calcium and magnesium are actually secondary nutrients, they are often grouped in with the micronutrients based on their low use rates required when supplementing plant nutritional requirements. Three major factors are affecting the efficient use of micro-nutrients

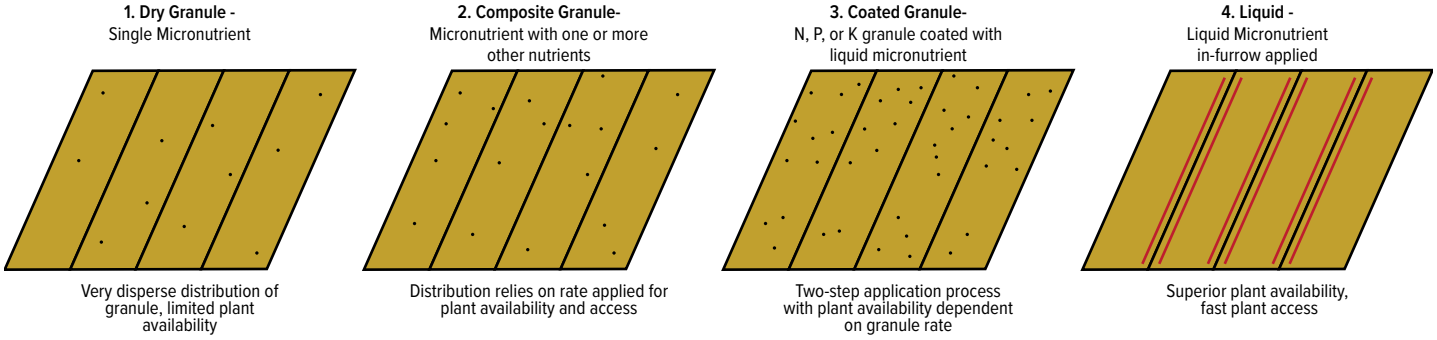
1. The ability of a plant to access nutrients that are applied in minute quantities
2. Preventing nutrient tie-up with soil particles in soil applications
3. Penetration of waxy leaf cuticle in foliar applications

One of the major ways to ensure plants can access the micronutrient and prevent immobilization with other ions is to **chelate** the mineral micronutrient with an organic molecule.

Minerals that may be chelated are calcium, copper, iron, magnesium, manganese, and zinc. Minerals such as boron that cannot form a chelate which will release the boron back to the plant will be **complexed** with a molecule that has weaker bonds enabling plants to access the boron.

There are a variety of chelation molecules used in the fertilizer industry but one of the most useful is EDTA. This chelator has five ligands that can encapsulate the mineral nutrient more completely than other chelators. It is capable of holding onto the nutrient more completely than other chelators and still being able to effectively release it to the plant. EDTA is stable in the soil and resists microbial breakdown. EDTA is also stable in liquid phosphate fertilizers making it ideal for use with balanced foliar fertilizers. When chelated micronutrients are applied to the leaf surface in a foliar application the organic chelator can penetrate the waxy layer and release the micronutrient into the plant.

Micronutrient sources



Micronutrient Responses

Crop	Mn	B	Cu	Zn	Mo	Fe
Alfalfa	M	H	H	L	M	M
Barley	M	L	M	M	L	H
Canola	M	H	H	M	L	–
Corn	M	L	M	H	L	M
Dry Beans	H	L	L	H	M	H
Grass	M	L	L	L	L	H
Lentils	H	L	L	L	M	–
Oats	H	L	H	L	L	M
Peas	H	L	L	L	M	–
Potatoes	H	L	L	M	L	
Rye	L	L	L	L	L	–
Soybeans	H	L	M	M	M	M
Wheat	H	L	H	L	L	L

Legend H–High M–Medium L–Low

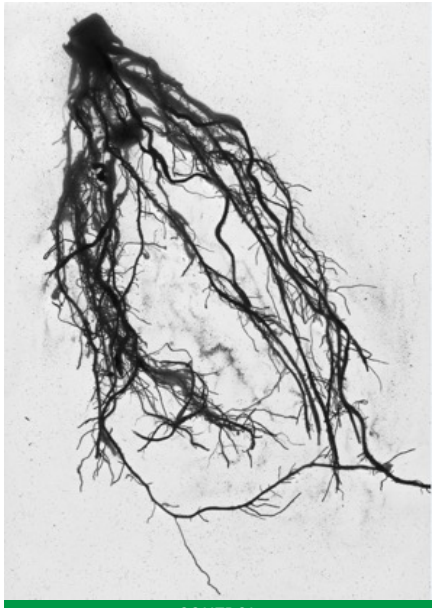
Type of Micronutrient	Chemical	Stability	The Facts
Chelated	EDTA DTPA EDDHA	Strong	Stable at high pH Stable with phosphates Crop safe
Sequestered	Phenolics Lignosulphonates	Moderate	Only for foliar application
Complexed	Amino Acids Citrates Glucoheptonates	Weak	Cheap but poor storability
Inorganic	Sulfates Nitrates Carbonates	None	Only for foliar application High rates required Risk of phytotoxicity

Maximizing Soil Health Efficiency

Key Benefits

- Enhanced Seed Germination
- Stimulation of root growth
- Keep P Available Longer
- Improve Water & Nutrient Uptake
- Increase Soil Aggregation
- Increase Microbial Activity in Soil
- Increase Benefits with PGR Products
- Reduce Burn From UAN Applications
- Increase Nitrogen Use Efficiency
- Increase Buffering Properties in Saline Soils
- Chelates Ions to Release Phosphorous

WITH ALPINE Soilmax



CONTROL

The increased root tips increase nutrient uptake.

Measurement	ALPINE Soilmax	Control
Root Length	796.7574 cm	568.4671 cm
Surface Area	154.2961 cm^2	129.3244 cm^2
Average Diameter	0.6164 mm	0.7241 mm
Root Volume	2.378 cm^3	2.341 cm^3
Root Tips	12413	8431
Root Forks	13398	8667

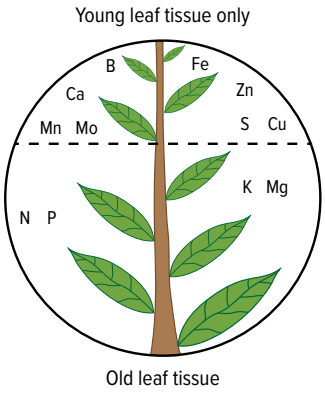
"Humic matter has been shown to increase the uptake of nitrogen by plants, and to increase soil nitrogen utilization efficiency. It can also enhance the uptake of potassium, calcium, magnesium and phosphorus."

– University of Florida, Gainesville (2005)

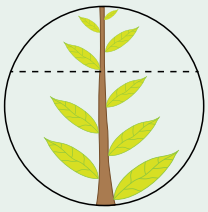
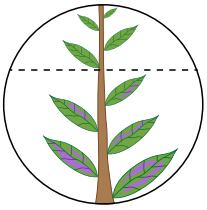
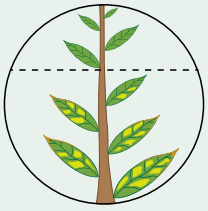
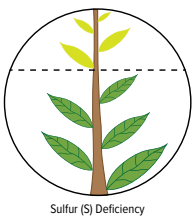
Locations Of Nutrient Deficiency Symptoms

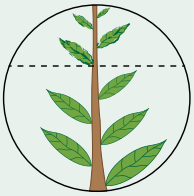
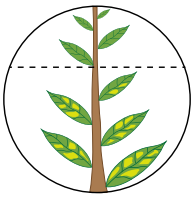
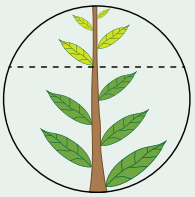
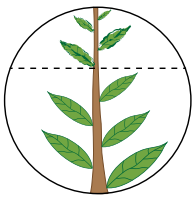
Source: International Plant Nutrition Institute (IPNI)

All 21 nutrients required by the plant, including macronutrients, micronutrients, and secondary nutrients, must be in balance in order for the plant to maintain it's utmost health to defend against unfavourable environmental conditions. A proper soil and tissue sampling program is key tool in managing plant nutrition.



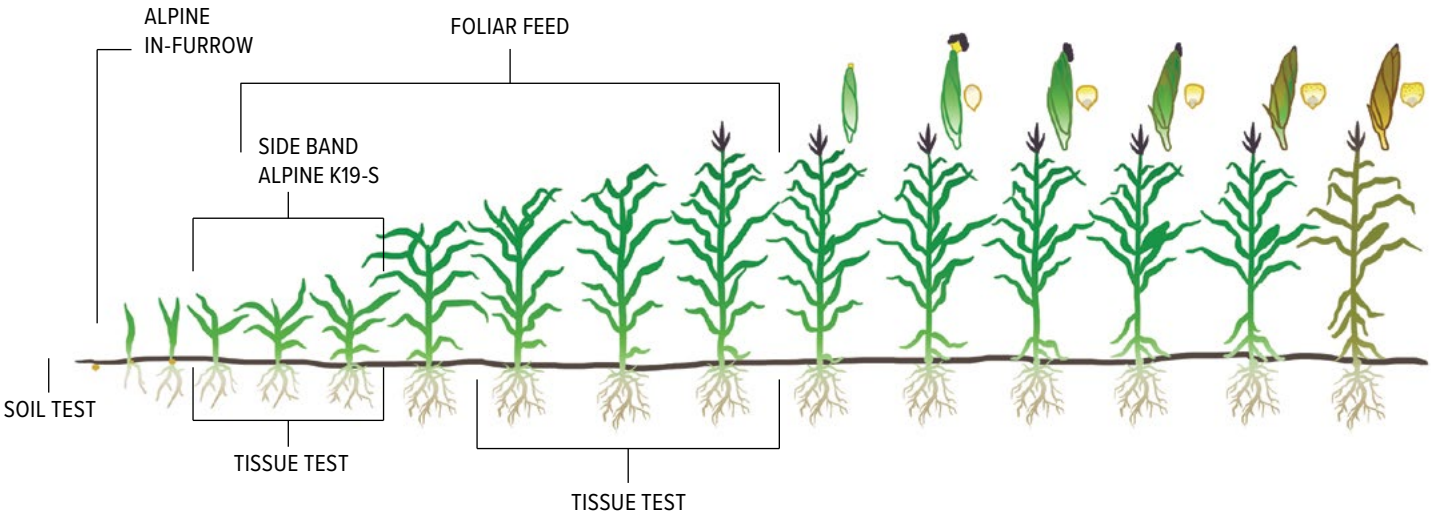
Macronutrients	SECONDARY NUTRIENTS	MICRONUTRIENTS	
Nitrogen	Calcium	Boron	Manganese
Phosphorus	Magnesium	Zinc	Copper
Potassium	Sulphur	Molybdenum	Iron

Nutrient	Function in the plant	Position on plant	Chlorosis?	Leaf margin necrosis?	Color and leaf shape	Diagram	ALPINE® Product
Nitrogen (N)	• Converts to amino acids, the building blocks for proteins • Produces necessary enzymes and structural parts of the plant • Becomes part of the stored proteins in the grain • Works with chlorophyll to utilize the sunlight as an energy source • Needed for rapid growth and full development	All leaves	Yes	No	Yellowing of leaves and leaf veins	 Nitrogen (N) Deficiency	ALPINE SRN® ALPINE CRN-B® ALPINE F18 Max™
Phosphorus (P)	• Needs to be available by the V6 growth stage for max yield potential • Needed for strong root development • Encourages early plant growth for longer growing seasons • Provides required energy for nutrient transport • Plays a vital role in photosynthesis • Essential in providing the genetics for all plant growth and development	Older leaves	No	No	Purplish patches	 Phosphorus (P) Deficiency	ALPINE G241-S® ALPINE HKW6® ALPINE F18 Max™
Potassium (K)	• Plays a vital role in photosynthesis • Regulates water use with stomatal activity • Keeps transportation systems functioning normally • Required for protein synthesis and starch synthesis • Enhances crop quality and improves disease resistance	Older leaves	Yes	Yes	Yellow patches	 Potassium (K) Deficiency	ALPINE HKW6® ALPINE K20-S® ALPINE TMR-F® ALPINE F18 Max™ ALPINE K19-S® ALPINE K24®
Sulphur (S)	• Mirrors phosphorus requirements in plants • Primary constituent of many amino acids • Aids in activation of enzymes and vitamins • Needed for chlorophyll formation • Used in nitrogen stabilization • Nodulation in legume crops	Young leaves	Yes	No	Yellow leaves	 Sulfur (S) Deficiency	ALPINE K19-S® ALPINE K20-S®

Nutrient	Function in the plant	Position on plant	Chlorosis?	Leaf margin necrosis?	Color and leaf shape	Diagram	ALPINE® Product
Calcium (Ca)	• Necessary for the proper functioning of growing points • Forms compounds which strengthen cell walls • Aids in cell division and elongation • Neutralizes organic acids • Regulates protein synthesis and slows the aging process	Young leaves	Yes	No	Deformed leaves	 Calcium (Ca) Deficiency	ALPINE MicroBolt Ca® ALPINE K20-S®
Magnesium (Mg)	• Only mineral component of the chlorophyll molecule • Aids in formation of sugars and starches • Plays important part in phosphorus translocation • Aids in proper functioning of plant enzymes	Older leaves	Yes	No	Yellow patches	 Magnesium (Mg) Deficiency	ALPINE MicroBolt Mg®
Manganese (Mn)	• Essential for chlorophyll production and photosynthesis • Aids in carbohydrate metabolism • Oxidation-reduction reactions • Enzyme activation • Combines with iron, copper, and zinc in hormone balance	Young leaves	Yes	No	Interveinal chlorosis	 Manganese (Mn) and Iron (Fe) Deficiency	ALPINE MicroBolt Mn® ALPINE MicroBolt Fe® ALPINE F18 Max™
Iron (Fe)	• Necessary for the formation of chlorophyll • Involved in oxidation process that releases energy from starches • Protein formation • Aids conversion of nitrate to ammonia in cells • Plant respiration	Young leaves	Yes	No	Interveinal chlorosis		
Boron (B)	• Required for cell division • Plays important part in calcium translocation • Protein synthesis and hormone formation • Carbohydrate metabolism • Pollen viability • Flower formation and fruit set	Young leaves	--	--	Deformed leaves	 Boron (B), Copper (Cu), Molybdenum (Mo), and Zinc (Zn) Deficiency	ALPINE MicroBolt B® ALPINE MicroBolt Cu® ALPINE MicroBolt Mo® ALPINE MicroBolt Zn® ALPINE F18 Max™
Copper (Cu)	• Required for chlorophyll production • Aids in photosynthesis and enzyme formation • Involved in oxidation-reduction reactions • Regulates water movement in cells • Needed for seed production	Young leaves	--	--	Deformed leaves		
Molybdenum (Mo)	• Co-factor in nitrate reductase enzyme • Essential for rhizobia in nitrogen fixation process • Aids in nitrate utilization • Involved in phosphate and iron metabolism	Young leaves	--	--	Deformed leaves		
Zinc (Zn)	• Necessary in chlorophyll formation • Involved in enzyme activation and production • Required in hormone (auxin) and nucleic acid synthesis • Aids in uptake and water use efficiency	Young leaves	--	--	Deformed leaves		

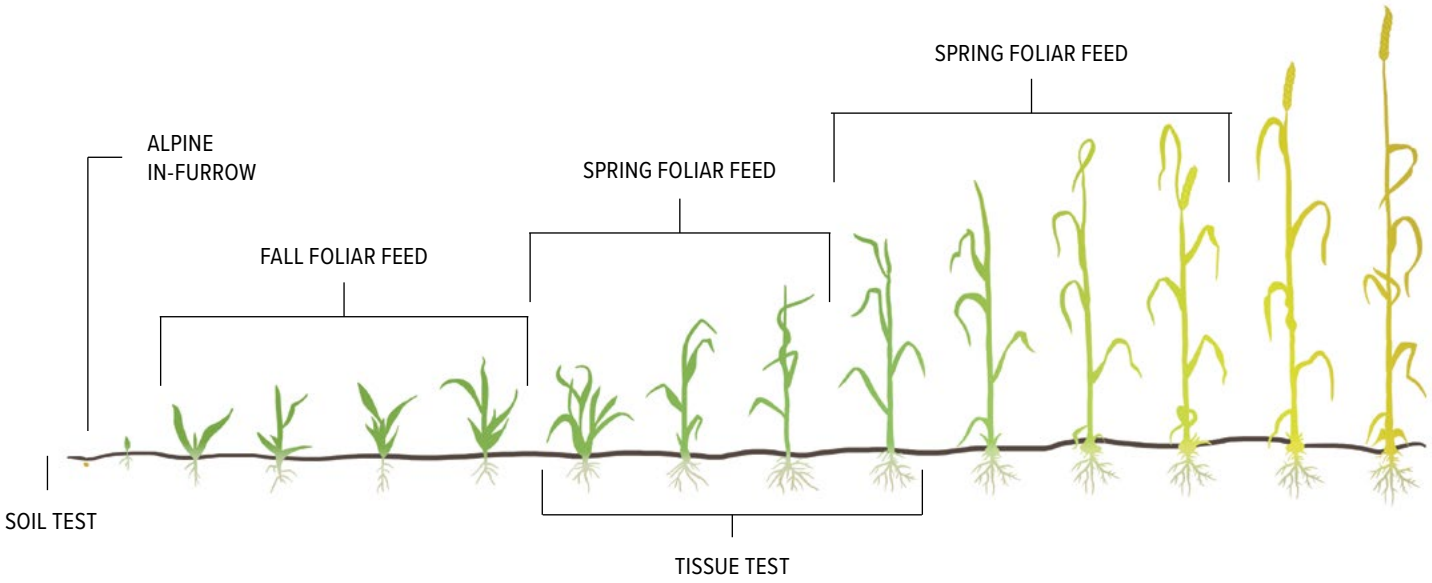
ALPINE® Products Crop Stage Application Charts

Corn



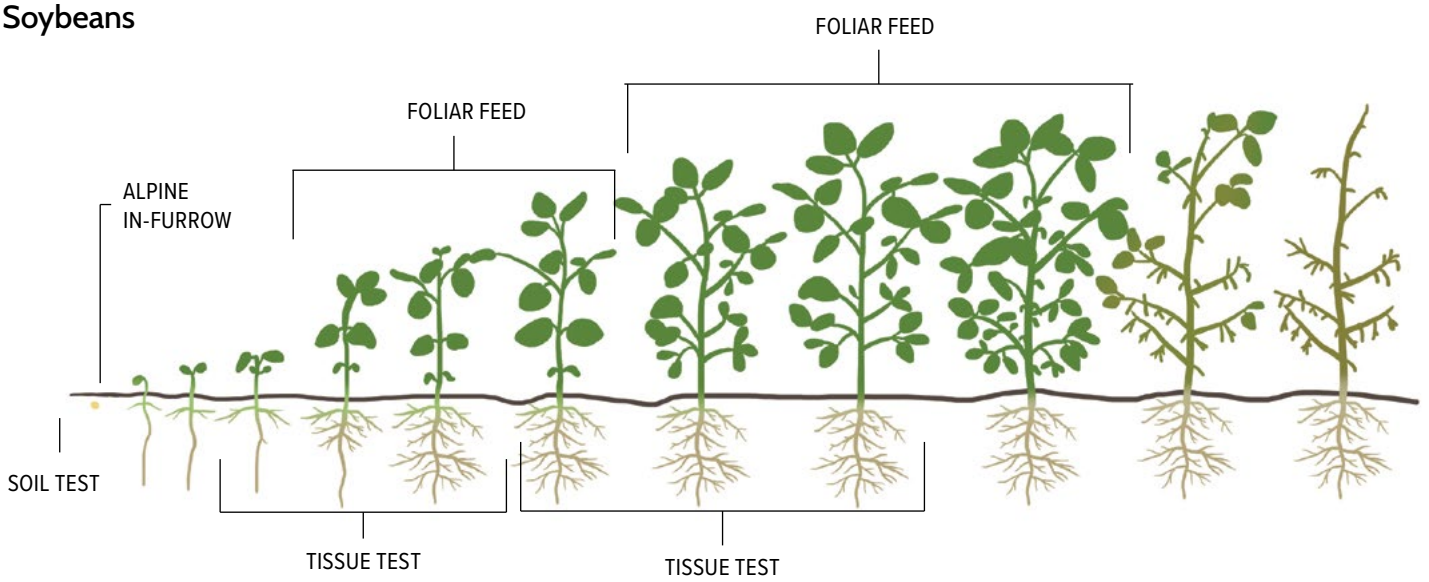
Stage	ALPINE SRN	ALPINE CRN-B	ALPINE F18 Max	ALPINE K20-S	ALPINE K24
2 leaf to VT	4–8 L	4–8 L	1–2 L	4–8 L	4–8 L

Cereals



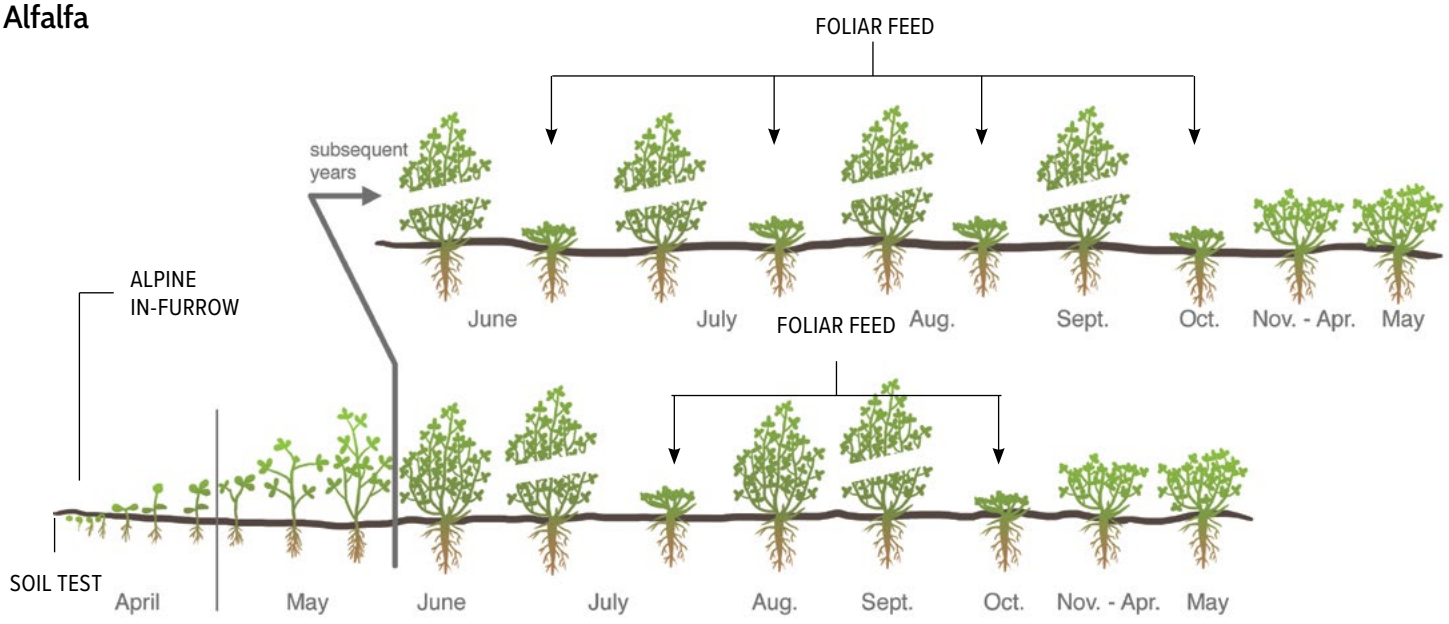
Stage	ALPINE SRN	ALPINE CRN-B	ALPINE F18 Max	ALPINE K20-S	ALPINE K24
3 leaf to anthesis	4–8 L	4–8 L	1–2 L	4–8 L	4–8 L

Soybeans



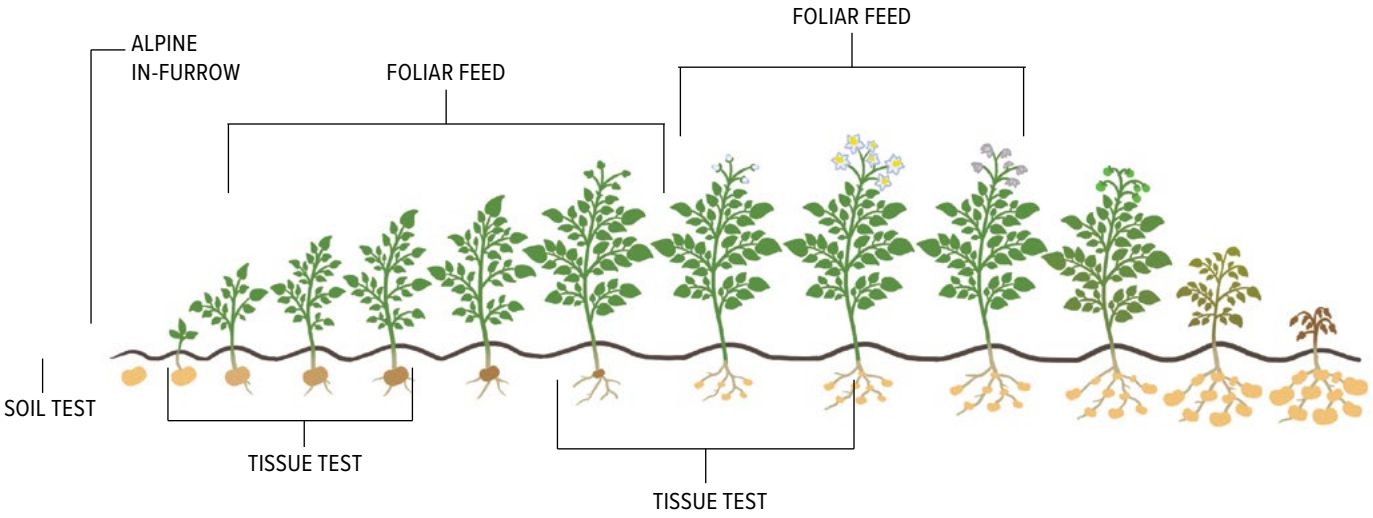
Stage	ALPINE SRN	ALPINE CRN-B	ALPINE F18 Max	ALPINE K20-S	ALPINE K24
V1 - R2	4–8 L	4–8 L	1–2 L	4–8 L	4–8 L

Alfalfa



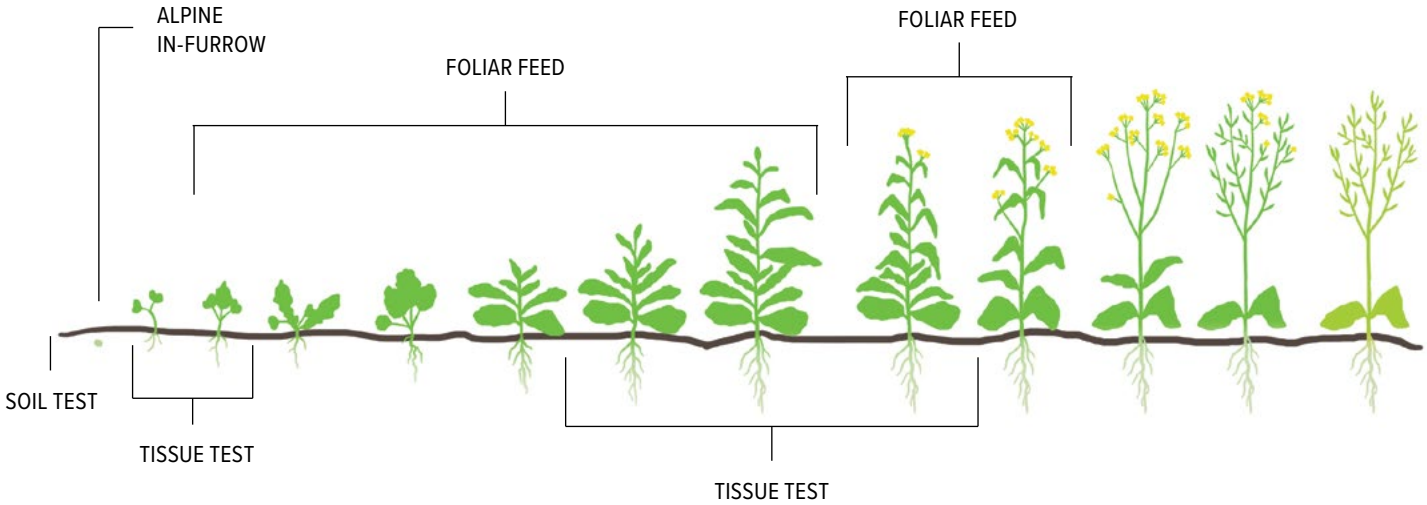
Stage	ALPINE F18 Max	ALPINE K20-S	ALPINE K24
Early growth in spring and after each cutting	1–2 L	4–8 L	4–8 L

Potatoes



Stage	ALPINE SRN	ALPINE CRN-B	ALPINE F18 Max	ALPINE K20-S	ALPINE K24
TUBER INITIATION	8 L	4–8 L	1 L	8 L	8 L

Canola



Stage	ALPINE CRN-B	ALPINE F18 Max	ALPINE SRN	ALPINE K20-S	ALPINE K24
2 leaf to bolting	4–8 L	1 L	4–8 L	2–10 L	2–8 L
Flowering	1–2 L	1 L	2–4 L	1–2 L	1–2 L

Notes

ALPINE®

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New Hamburg, ON N3A 3G8

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877.832.8815

SALES & MARKETING
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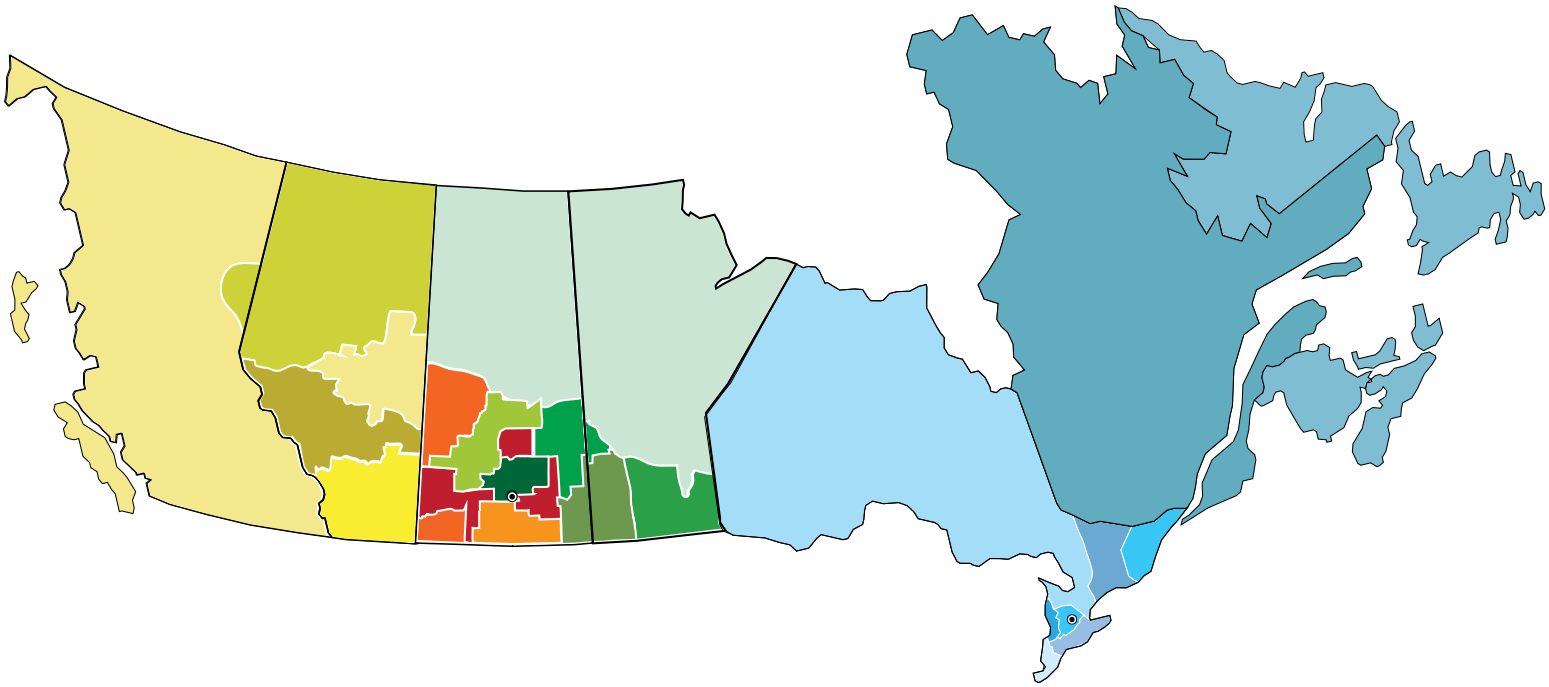
1356 Nafziger Rd.,
New Hamburg, ON N3A 3G8
800.265.2268

Canada Sales Map



To get in touch with your sales manager, scan the QR code

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