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Raise Healthy Calves

Joe W. Rust

Spring is usually a time when we see more problems with calf health and mortality than any other time of the year. This may be due to sudden changes in the weather or just because there are more calves born at this time. Nevertheless, now is a good time to consider some management tips to insure a good healthy crop of calves.

Heifer calves saved for herd replacements are the foundation of the future herd. Dairy bull calves and beef calves are a profit potential that can be lost if the calf does not survive. A good calf raising program begins with good genetics and involves proper management of nutrition, health and housing. These factors are very critical when the calf is at a young age. It is estimated that 10 to 20 percent of dairy calves die before they reach one year of age. This certainly can be improved upon. Perhaps 0 to 5 percent should be our goal. We can follow a few basic principles to insure a good crop of herd replacements that should be better genetically than their dams.

Start with the selection of the sire of the calf. We know that we should use sires that are proven for superior milk production. We can also use information that is available on most A.I. sires to select matings for easy calving. This is especially important when breeding heifers.

Management of the cow at calving time is critical to delivering a live healthy calf. Have the cow in a clean dry place. A pen or small pasture is best. Anything is better than a muddy lot. Be prepared to give assistance if needed during calving. Clear any mucous from the calf's nose and make sure it is breathing. Perhaps the most important step toward keeping the calf healthy is to make sure the calf receives an ample amount of colostrum soon after birth. Colostrum contains antibodies needed to provide immunity to any diseases or infection it might encounter during the first few weeks of its life. The calf has the ability to absorb the antibodies through the intestinal wall immediately after birth, but they gradually lose this ability by 24 hours of age. A newborn calf should receive two quarts of colostrum by the time it is four hours old. Four to five quarts is recommended during the first 12 hours after birth. Feeding the colostrum by a clean nipple bottle will insure the proper amount. Use an esophageal tube feeder if the calf refuses to suckle.

There are several products on the market recently that provide additional immunoglobulins to the calf. These products are usually derived from cheese whey or colostrum. These products cannot replace colostrum completely, but can be useful as an added treatment or supplement in some cases. Fresh colostrum can be frozen and thawed slowly if needed later on.

During early life pneumonia and scours are the greatest threat to the health of the calf. A clean, dry and well ventilated pen for the calf is the best protection against infectious organisms making the calf sick. Sanitation and good nutrition are also important. Whole milk and fresh or sour colostrum provide the best quality feed for calves. Feed a high quality milk replacer as a substitute if whole milk or colostrum is not available. A good milk replacer should contain twenty percent protein and twenty percent fat. Good milk replacers contain milk products such as skim milk or whey as their source of protein. Beware of large amounts of non-milk ingredients and replacers that contain more than 0.5 percent fiber. Starting calves on a dry starter early will allow weaning from liquid feed by 4 to 6 weeks of age or even earlier. If the calf will eat 1.0 to 1.5 pounds of a good quality starter containing 16 to 18 percent protein it can be weaned without difficulty.

Young calves do require attention, especially the first few weeks. If signs of sickness are shown, it is *important to begin* treatment early. Prevention by good management practices are the first line of defense against sickness and disease, but the timely use of antibiotics are sometimes necessary. Antibiotic treatment for scours should be accompanied with electrolyte solutions to prevent dehydration.

Results of the North Central Experiment Station Vegetable Variety Trials were published in THE MIDWESTERN VEGETABLE VARIETY TRIAL REPORT. This report also summarizes vegetable trials from Michigan State University, Purdue University (Indiana), Ohio State University, University of Illinois and the University of Kentucky. The cost of this publicaiton is $7.00 (including postage). If you need assistance in your vegetable variety selection for this season, this publication will be of great benefit to you. Contact the Experiment Station for your copy.

The Essential Elements

Russ Mathison

With spring just around the corner, many who read the North Central Quarterly think increasingly about spring planting. The plantings will span a wide spectrum of plant types from annuals to perennials, and the plantings are made for an equally wide variety of reasons, ranging from hobby gardening and ornamental plantings to providing food or an economic livelihood for the planter. All of these diverse plant types, for whatever purpose they are grown, have in common the need for light, mechanical support, heat, air, water and nutrients. The soil on which these plants are grown is responsible for supplying, either wholly or in part, all of these except light. This article will discuss plant nutrients; namely, which of the over 100 known elements are considered plant nutrients, in what forms they are taken up by plants, the relative amounts of each needed, and finally how the root actually contacts the nutrient and absorbs it.

There are sixteen elements essential for plant growth. Essential means the plant cannot complete its life cycle in the absence of the element. The element cannot be substituted for, and it must be directly involved in the nutrition of the plant. Three of the sixteen essential elements, or nutrients, are provided primarily by air and water. These are carbon (C), hydrogen (H) and oxygen (O). The remaining thirteen essential nutrients are provided via the soil, and are divided into two groups, macronutrients and micronutrients, based on the relative amounts of each required by plants. Macronutrients are needed in relatively large quantities. Nitrogen (N), phosphorous (P), and potassium (K) are required in the largest amounts, usually making up 1 percent or more of the plant's dry weight, hence they are called primary macronutrients. Calcium (Ca), magnesium (Mg) and sulfur (S) each comprise less than 1 percent of the plant's total dry matter and are termed secondary macronutrients. The remaining seven essential nutrients are called micronutrients, or trace elements, because they are needed in much smaller quantities. They are measured as parts per million (ppm) of a plant's total dry matter. The micronutrients are iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), boron (B), molybdenum (Mo), and chlorine (Cl).

Plant nutrients exist in the soil as charged particles. That is, they have either a positive or negative electrical charge. Those nutrients readily available to plants are located in one of two places. Those with a positive charge, called cations, are usually attached via this charge to minute soil structures called colloids. Because of this electrical "attraction" to soil particles, most cations are non-leaching, which means they are less likely to be washed down through the soil by normal rainfall. Following is a list of essential nutrients usually found as cations and the form in which they exist in the soil and are taken up by plants.

Element	Chemical symbol	Usable form
Nitrogen	N	$NH4^+$ (ammonium)
Potassium	K	K^+
Calcium	Ca	Ca^{++}
Magnesium	Mg	Mg^{++}
Iron	Fe	Fe^{++}
Manganese	Mn	Mn^{++}
Copper	Cu	Cu^{++}
Zinc	Zn	Zn^{++}
Cobalt	Co	Co^{++}

Those essential nutrients with a negative charge are called anions and are usually found in the soil solution. Thus, they are more easily washed down through the soil out of the root zone by the process of leaching and should be somehow replenished regularly. Anions differ from cations not only in the polarity of their charge, but also in the form they exist in the soil. Anions are almost always bound to one or more oxygen molecules. Following is a list of essential anions and the form in which they exist in the soil and are taken up by plants.

Element	Chemical symbol	Usable form
Nitrogen	N	$NO3^-$ - nitrate
Phosphorous	P	$PO4^-$ - phosphate
Boron	B	$BO3^{\equiv}$ - borate
Sulfur	S	$SO4^-$ - sulfate
Molybdenum	Mo	$MoO4^{\equiv}$ - molybdate
Chlorine	Cl	Cl^-

Plant roots must come into close physical proximity to these essential soil-borne nutrients in order for the nutrients to be absorbed. This physical contact between roots and nutrients takes place via three mechanisms: (1) root interception, (2) mass flow, and (3) diffusion. Root interception means the root, during elongation, moves into direct contact with nutrients. Of the three mechanisms, root interception is probably the least important because root volume is frequently less than 1 percent of soil volume in the plow layer for most annual crops. In the mechanism of mass flow, nutrients in the soil solution move to roots in the convective flow of water through the soil caused by the absorbtion of water by the plant roots and subsequent transpiration. The amount of nutrients supplied to roots by mass flow depends on water use by the plant and the concentration of nutrients in the soil solution. In most cases, mass flow can meet the crop nutrient demands for all except the primary macronutrients (N, P and K). The third mechanism of nutrient supply, diffusion, usually begins when root interception and mass flow do not meet the plant's nutrient needs. Diffusion is defined as the movement of particles from areas where they are more highly concentrated to areas where they are less concentrated. When roots absorb nutrients, this creates an area of low nutrient concentration immediately surrounding the root. Nutrients not near the root, via diffusion, move into this area of low concentration. This process continues until nutrient requirements are met and plants cease uptake.

Once nutrients are in contact with the root they must somehow be absorbed into the root interior. It was once thought that "carrier molecules" produced in the plant accomplished this task by moving back and forth through root cell walls, but this theory has recently been shown inaccurate. Nutrients are now believed to enter roots through pores, or "nutrient channels" in root cell walls. The pores are specific for the type of nutrient allowed to enter, with the specificity determined by the size of the opening itself and the polarity of electrical charge surrounding the opening.

Hopefully this discussion of the essential macro and micronutrients, the mechanisms which bring them into contact with roots and the methods of entry into roots will increase our appreciation of the phenonomen of plant growth. The information presented here was straightforward and uncomplicated, but the system of nutrient supply as it actually operates in the soil ecosystem is quite complex, constantly in a state of change, and greatly influenced by factors such as soil pH, rainfall and the soil parent material.

Forestry Technician Alumni Program Proposed

The Itasca Community College Alumni Association is searching for interest in the development of a forestry technician alumni organization. Forestry technician alumni from the University of Minnesota North Central School and Experiment Station program and the Itasca program are encouraged to contact the alumni association. The Forestry Technician Program, initiated in 1958 at the North Central School graduated its first class in 1959. The program has been under the auspices of ICC since 1979. If you attended either forestry technician program and are interested in developing or supporting an alumni group please contact the ICC Alumni Association at 1851 169 E., Grand Rapids, MN 55744, 218-327-4205 or Harley Hanson at 218-327-4449.

Pruning Blueberries in Minnesota

David K. Wildung

Pruning blueberries is perhaps one of the least understood cultural practices in their management. Experience with most fruit crops tells us that pruning is beneficial, therefore it should benefit blueberries as well. Such has not always been shown to be the case. The subtle benefits of blueberry pruning may not be as easily seen as other cultural practices such as amending the soil pH or winter protecting plants; but over time the effects of pruning should show themselves in better light penetration, more vigorous new vegetative growth, greater fruit productivity and increases in fruit size. The objective of this article is to provide you with a better understanding of what to do when pruning Minnesota cultivars.

First, why should you prune blueberry plants? Let's review some of the reasons.

1. TO INCREASE FRUITING. Probably the most important reason for pruning is to obtain a balance between fruit production and production of new wood for future crops. The objective should be to constantly remove the oldest least productive canes and to encourage new cane development. The model plant would end up with new canes replacing old canes with most of the canes being of an intermediate productive stage. While this concept is fairly easy to visualize, the details of it are more difficult to predict. If too much pruning is done individual fruit size will increase but total production usually is reduced. If no pruning is done excessive growing points usually develop followed by reduced new growth for future fruiting leading to less production and smaller individual fruit.
2. TO ALLOW FOR BETTER LIGHT PENETRATION AND AIR CIRCULATION. Thinning out old canes from the center of the plant will open it up to get more light to all parts of the plant leading to better fruit development. Removing the old thick canes will also improve air circulaiton which should reduce disease incidence and allow better spray penetration if needed especially for stem cankers.
3. TO REMOVE WEAK, WINTER INJURED OR DISEASED BRANCHES. Unfortunately winter damage is a fact of life in Minnesota blueberry production. Depending upon the severity of the damage much of the top growth may have to be removed. This type of pruning should be done in the spring when the injury is easiest to see. Usually the bark color is a good indicator of damage — healthy tissue appearing reddish brown; damaged tissue dark brown or black. Cuts should be made to healthy laterals (as indicated by both bark color and internal wood color). In this type of pruning, normal pruning procedures (thinning out type cuts) may have to be discarded to maintain the plant in a healthy condition. Canker disease development is often associated with weak winter damaged canes. Weak and damaged canes should be removed in the spring and shoots with actively developing cankers removed during the growing season. Should summer pruning be necessary the cuts should be made several inches below the visible injury and the infected tissue should be removed from the field and destroyed. Pruning shears can also be disinfected between cuts.
4. TO REMOVE LOW GROWING OR CROSSING CANES. Low growing branches usually are not productive and crossing branches can often lead to mechanical damage from rubbing. This type of maintenance pruning should be done with other dormant pruning.
5. TO REJUVENATE OLD PLANTS. While our Minnesota blueberry plantings are relatively young, old blueberry plantings have been rejuvenated by cutting all of the top growth to the ground. Our studies on old blueberry plants have indicated that Minnesota blueberry plants will produce as well as unpruned plants by the third year after cutting the plants to the ground (see table). Highbush plants grown in Michigan have been totally restored to full production in two years by this drastic practice. Commercial lowbush plantings are also usually managed in this way by burning or mowing all top growth every two or three seasons. Ideally if good annual pruning is practiced drastic rejuvenation pruning should not be necessary. Unfortunately, winter injury in Minnesota occasionally rejuvenates our planting in this manner. It is nice to know that the established plants will in time recover following cutting to the ground.
6. TO DECREASE THE AMOUNT OF FRUIT BUDS. Occasionally we have seen 'Northblue' plants that tend to set almost all fruit buds and very few leaf buds. Winter protection studies at our station have indicated that 'Northblue' may overset fruit causing a reduction in fruit size and delaying fruit maturity. Typically when this occurs the flower buds open before the leaf buds or else there are few if any leaf buds on the new shoots. Heavy fruit bud development will not occur on every plant or even on every cane of an individual plant. If it does occur the affected canes should be tip pruned to remove the excess flower buds. This type of pruning should be done in the late spring when the fruit buds are swelling. The amount of tip cutting done depends on the individual cane but the goal is to achieve balance between leaf buds and fruit buds for maximum fruit development.

While pruning can be done at any time during the dormant season, spring is the most desirable time because winter injured wood can be seen and removed most easily. Pruning tools would consist of a looping shears for larger cuts over ½ inch and a good pruning shears for most cuts. Cuts should be made close and smooth to promote healing. Stubs should not be left that can crowd the crown of the plant or become a potential source for disease infection. New canes will develop from cut stubs but new shoots developing from the root system may be stronger and more productive. Normally soft succulent fast growing shoots should also be removed because they usually are not productive and are susceptible to disease and winter injury. If pruning time is limited, as it often is in the spring, it is probably better to prune all plants slightly than to prune a few plants thoroughly and the rest not at all. Annual pruning is the best.

The positive effects of pruning may not be evident over a one or two-year period

Yield of Minnesota blueberry seedlings pruned in 1987 to different levels of pruning.

Pruning Severity*	Yield (Lbs/Plant) 1987	1988	1989	3 Year Average
0%	0.41	2.51	6.39	3.10
20%	0.30	2.08	6.50	2.96
40%	0.26	1.85	5.99	2.70
60%	0.26	1.91	6.68	2.95
80%	0.16	1.55	6.94	2.88
100%	0.01	0.63	6.58	2.41
Hedge	0.05	1.59	7.94	3.19
LSD 5%	0.14	0.66	NS	NS

*This planting was established in Staples, MN in 1974. In 1987, a one time pruning removing 0, 20, 40, 60, 80, or 100% of stems over ¼ inch was completed. In addition a hedge treatment cut off all growth above 12 inches.

continued on back page

Quarterly Report

Robert F. Nyvall, Superintendent

As this is written spring is getting here, surely but so slowly.

We are pleased to announce that Dr. Gene Allen has been appointed Vice President of the Institute of Agriculture, Forestry and Home Economics. Dr. Allen has been Interim Vice President for over a year. We look forward to working with Dr. Allen and wish him much success as he leads the Institute in the future.

We were saddened that Frank Kosbau, friend of the Station and a leader in agriculture, was killed in a tractor accident in February. Frank is survived by his wife Deloris and daughter Dee Ann Clubb both of Aitkin, two sisters and three brothers. A memorial plant breeding research fund has been established to raise funds for wild rice research at the Station. For information on this tax deductible contribution contact me at the station or Thomas Godward, Rt 3, Aitkin, MN 56431, the chairman of the Franklin D. Kosbau Memorial Plant Breeding Research committee.

Dr. Frank Kaufert, Dean Emeritus of the College of Natural Resources, passed away in February after a lengthy illness. He was 84. Dean Kaufert was a frequent visitor to North Central during the forestry technician training programs in the 1960s and 1970s.

Ray Graupmann, who has worked as an animal attendant at the Station since 1974 has retired. We'll miss Ray. He always has a smile and a good word. Now he'll be able to devote more time to fishing (his favorite pastime). We wish both Ray and Shirley all the best in the future.

The Station continues to grow. We will be advertising shortly for a plant geneticist silviculturist to work on the aspen/larch project. This position will have primary responsibility to develop new germplasm for improved aspen and larch. Hopefully we'll have a person by January 1.

Pruning *continued from page 3*

so you need to evaluate pruning over the life of the planting. Temporary yield reductions following a drastic pruning treatment might be made up by increased yield three to five years after being done. Likewise annual pruning removing 10 to 20 percent of the canes may show no great yield advantage until the plants get very old and are compared to similar unpruned plants.

In summary how should you prune the Minnesota cultivars?

1. There is no ideal blueberry pruning system. Positive pruning responses usually are difficult to see immediately. The long term response is desired.
2. New plants should be cut back to remove flower buds during their first season. Weak shoots should also be removed. Every effort should be made to get the plants well established. At this time, fruit development is secondary to strong plant development. It may be necessary to remove flower buds during the second season if the plants are not well established.
3. Young plants established from three to five years should be able to produce some fruit. Pruning should be done to remove weak, winter damaged or diseased canes. Development of strong fruiting canes is desirable. Ideally two to three strong canes should be selected each season.
4. Pruning mature plants:
   A. Most cuts will be of a thinning out nature.
   B. Allow two or three strong fruiting canes to develop annually.
   C. Begin removing the oldest least productive canes in the fifth or sixth year.
   D. Remove weak, succulent, crossing, low growing, winter damaged and diseased canes as needed.
   E. Tip pruning may be necessary when individual plants or branches have too many fruit buds in relation to leaf buds.
   F. Strive to obtain a balance between fruit production and vigorous new growth.
   G. Avoid developing a dense center crown. Strive for good light penetration and good air movement throughout the plant canopy.
   H. Early spring pruning is best to assess winter damage.
   I. Light annual pruning is most desirable to maximize blueberry fruit production.
5. Old unpruned plants can be renovated by drastic pruning of 80 to 100 percent of their above ground canes. It appears that such heavily pruned plants will recover by the third or fourth season following such a treatment.

NCSA Alumni News

Tom Carpenter

A sign of spring arrived today, March 30; the snow is melting and it is 52 degrees outside. By the looks of things, there won't be much water standing around for long.

By now, all Alumni should have received the letter with the information of the North Central Research Fund. We have received some responses to the Fund and are hoping to receive more. Your support in any amount will be of value.

A personal comment — The University of Minnesota is having a program in St. Paul honoring employees with over twenty years of service on April 4. Three of NCSA alumni have been working for the North Central Experiment Station for the following years. Dan Carey 37 years, Gordy Bickford 34 years and I have been here 28 years. We have all been invited to attend the program.

Wishing you all good health until the next **Quarterly**. If you have any news or comments, please contact me at the Station.

COMING EVENTS

Visitors Day	Thursday, July 19
Horticulture Night	Wednesday, August 29

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