Boodley/61

carnations grown from a single

f Peak Production

hio[b]	Colorado[c]
une	July
une	July-Aug.
ly	August
ly	Aug.-Sept.
ugust	September
ptember	October
ovember	November
nuary	Jan.-Feb.
pril	March-April
ne	April-May
ne	May-June
ne	June

eturn Crops 1951-52, New York State

Colorado Flower Growers Ass'n Bul.

rnations. Colorado Flower Growers

arnation Crop Control. Ohio Agricul-

Carnation Timing. Colorado Flower

CHAPTER 6 FERTILIZATION (Carnations)

JAMES BOODLEY

Proper fertilization is one of the extremely important cultural practices that must be followed to produce a maximum number of high-quality flowers. Good fertilization practices begin before the crop is planted, and are continued throughout the producing period. Since carnations exhibit symptoms of mineral deficiencies slower than other crops, by the time the symptom is apparent, much damage is done to the plant. Severe deficiences may result in irreversible conditions so that the crop never recovers.

The ability of the grower to correctly diagnose troubles resulting from mineral deficiencies is to be desired. The knowledge of fertilization and watering practices and the response of carnations to specific nutrient deficiencies coupled with monthly soil tests and frequent observations of the crop will enable the grower to become fairly proficient in his diagnosis of the problem. Messing (6) has provided the most comprehensive presentation of some mineral deficiencies of carnations.

Nitrogen Deficiency

A deficiency of nitrogen is noticed very quickly by the reduction in the rate of growth of the plants. This is followed by a loss of color in the plant beginning with the older leaves first and soon extending throughout the entire plant. Weak growth coupled with a failure of the internodes to elongate also develops. The older leaves turn yellow followed by a death of the leaves that begins at the tip and progresses toward the base across the whole width of the leaf. During the winter months slow reutilization of nitrogen results in slow death of the older leaves. During periods of active growth the older foliage dies very rapidly. Nitrogen starved plants produce small, but normal appearing flowers. A lack of side shoots is another indication of nitrogen deficiency.

A most distinctive symptom of nitrogen deficiency has been described as "curly tip." The tip of the young leaves fails to separate and continuing growth results in a characteristic curve of the stem tip (Figure 6.1.). Varieties that normally have long and relatively fleshy leaves are specially prone to "curly tip." A similar symptom may also be expressed by plants that may have an adequate supply of nitrogen but are growing under conditions of low light intensity and cool temperatures.

Phosphorus Deficiency

The lack of phosphorus is not easily identified by any characteristic symptoms. Young plants become stunted and produce thin growth similar to nitrogen deficient plants. The difference between these two deficiencies is easily distinguished. Phosphorus starved plants produce foliage that is very dark green in color whereas nitrogen deficient plants have pale green foliage. Slow but continuous growth may take place and normal though small flowers may be produced on phosphorus deficient plants. An abundant supply of phosphorus should be available to young plants for maximum production.

BOODLEY '61

1961.
from Carnations - A manual of the culture, insects & diseases and economics of carnations. Dept of Flor. Cornell Univ.

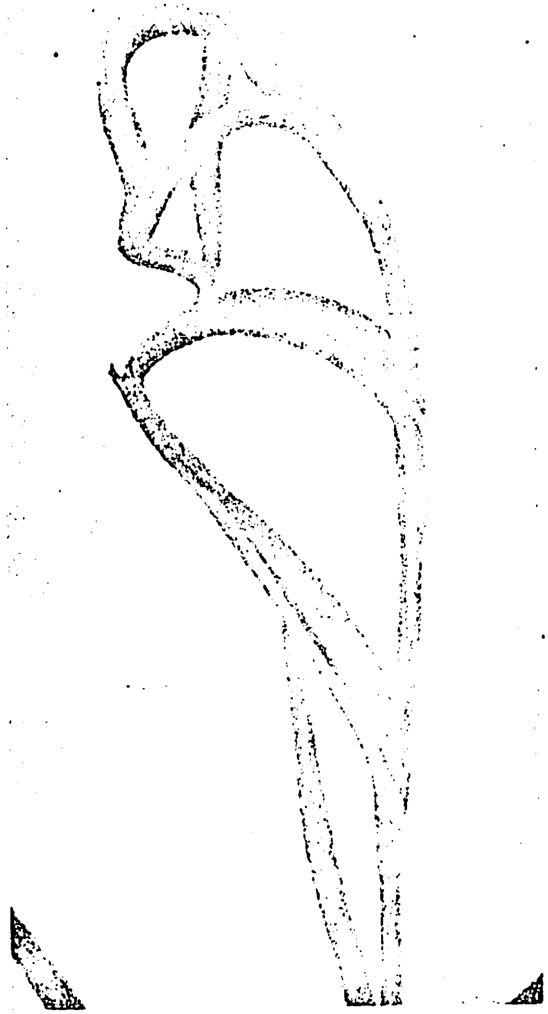

Figure 6.1 "Curly tip" of carnations. Generally caused by a deficiency of nitrogen.

Potassium Deficiency

A slight reduction in the rate of growth and thinner shoots may be the first sign of potassium deficiency. Characteristic symptoms, however, soon appear on the middle leaves. The tips of the leaves show a slight loss of color and the part extending from the tip down to a third or half of the total length becomes suddenly covered with light colored, necrotic, sunken spots, irregular in shape and size. From then on symptoms develop very quickly with the oldest leaves dying rapidly.

On mature plants a potassium deficiency usually is noted by weak new stems with short internodes and the leaf blades are narrow and long. This is due to the reutilization of potassium from the dying parts of the plants.

Flowers that form after the first symptoms of deficiency are noted are generally of poor quality. If the deficiency is not corrected premature death of the calyx occurs with a dying or necrosis appearing first on the upper margin of the calyx.

Calcium Deficiency

The first and very characteristic symptom of calcium deficiency is tip burn on the young leaves. A definite construction of the leaf occurs at a certain distance from the tip. Later on the whole tip may become narrow and bend upward at right angles to the rest of the leaf blade. The growing points of individual shoots die. Side shoots may become very prolific and be light green in color and thin. These shoots soon develop similar symptoms to those on the main shoots.

In mature plants the growth and production of flowers may be severely affected. The stamens are often larger than in non-deficient flowers. The flowers show a marked tendency toward sleepiness.

The last symptom is death of the root tips and a gall-like overgrowth of the crown of the plant, similar to club-root of cabbage.

Sulfur Deficiency

An increase in the stiffness in stems and leaves is the earliest symptom of sulfur deficiency. The later growth is slowed and the plants become stunted. A chlorosis of the tops may appear followed by the whole plant becoming bright grassy green in color. The most severe loss of color frequently occurs on the actual nodes and on the basal parts of the young leaves. A very characteristic symptom is the extremely slow development of flower buds. Six weeks may elapse between the time the first color appears and maturity of the bloom. Sulfur deficient carnations of William Sim variety will have lighter red flower color than those that have an adequate supply of the element.

Curly tip similar to that for nitrogen deficiency may also be encountered on sulfur deficient plants. However, the young leaves are stiffer and tightly rolled and the condition is not as wide-spread as in the case of nitrogen deficiency.

A cessation of elongation of the internodes and irregular discolored patches on young leaves will also occur at later stages of a sulfur deficiency. At this stage blooms frequently die without reaching maturity.

Magnesium Deficiency

A sudden and severe interveinal chlorosis of the middle leaves is characteristic of this deficiency. It rapidly spreads and soon most of the foliage becomes virtually yellow with only the veins remaining light green. Stem tips become weak, growth is arrested and the older leaves die very rapidly.

At a later stage of this deficiency a very characteristic symptom that consists of a narrow regular necrotic band develops across the leaf blade close to its base. As a result the leaf collapses. This effect may spread quickly and in a short time most of the foliage in the middle of the plant may be affected.

On mature plants a magnesium deficiency will result in the death of many of the shoots followed by new growth of auxiliary shoots on the lower parts of the plant. This new growth may be similar to that of potassium deficient plants; internodes are short and the leaves long and narrow. However, the leaves remain light green in color.

Flowers that are produced are generally of poor quality and the flower stems weak.

The affects of acute potassium and magnesium deficiency may become somewhat similar in the later stages of growth including early death of the calyx as described under potassium deficiency.

Boron Deficiency

The first symptom of boron deficiency is a shortening and thickening of the leaves coupled with a purple discoloration and death of the leaf tips. This may be followed by the death of the growing point of each shoot. When this occurs, a witch's broom or bushey type growth occurs due to many side shoots developing below the killed terminal bud. The new side shoots that develop frequently stick and are curled. also splitting the leaf at its base and growing through the split. Frequently a band around the calyx may appear but this is not always true. If the deficiency occurs in the more mature plants opening buds show a decrease in the number of petals and there may be severe distortion of the petals.

There have been reports that boron deficiency results in an increase in the number of splits that may occur in carnations.

A shortening of the internodes is also an indication of boron deficiency.

On soils that are limed heavily or have a high calcium content a normally sufficient supply of boron may become limiting to growth. This occurs as a result of a suppression of uptake of the boron due to the high calcium levels in the soils.

Frequently the supply of boron in a soil may be sub-marginal and the deficiency symptoms appear during the summer and during the early fall. As light intensity is reduced and conditions for growth are not as favorable the plants seem to grow out of the condition.

Manganese, Iron and Zinc Deficiences

The requirements of carnations for these micro nutrients are relatively low and frequently supplied in the irrigation water and fillers that are used in fertilizers. There are generally no visual symptoms of deficiency of these elements. There have been some reports that although a deficiency of iron fails to induce any visual symptoms it has resulted in a reduced number of blooms being produced.

MINERAL ELEMENTS NEEDED FOR GROWTH

Nitrogen

Nitrogen is one of the most important elements used as a building material in the plant. It promotes rapid vegetative growth and is important in the formation of proteins. Nitrogen also forms an integral part of the chlorophyll molecule thus giving the plant its healthy green color. The symptoms of nitrogen deficiency have been described. Excesses of nitrogen cause soft, succulent growth that may result in reduced flowering.

Nitrogen is most often supplied to plants in either the nitrate or ammonium forms. Although the plant can utilize either of these forms of nitrogen the nitrate form is absorbed in the greater amounts. Ammonium forms are transformed to the nitrate forms by soil microbiological and chemical activity.

The availability of nitrogen to the plants is dependent on several factors. Nitrates are most readily available to plants when the soil pH is in a range 6.0 to 7.0. At other than this pH range nitrate availability is reduced due to a suppression in uptake by other elements and a reduction in the solubility of the nitrogen carrying materials.

Soil moisture influences the availability of nitrogen. A soil maintained in a dry condition does not provide enough moisture for the soil solution to make the nitrogen available. An excessively wet soil will result in a reduction in oxygen content and an increase in carbon dioxide content of the soil. This

shortening and thickening of
id death of the leaf tips. This
oint of each shoot. When this
curs due to many side shoots
new side shoots that develop
· leaf at its base and growing
calyx may appear but this is
more mature plants opening
d there may be severe distor-

ncy results in an increase in
s.

lication of boron deficiency.

h calcium content a normally
to growth. This occurs as a
ue to the high calcium levels

nay be sub-marginal and the
and during the early fall. As
wth are not as favorable the

nicro nutrients are relatively
ter and fillers that are used
ptoms of deficiency of these
lthough a deficiency of iron
ted in a reduced number of

FOR GROWTH

nts used as a building mate-
owth and is important in the
integral part of the chloro-
reen color. The symptoms of
s of nitrogen cause soft, suc-
g.

either the nitrate or ammo-
r of these forms of nitrogen
ants. Ammonium forms are
logical and chemical activity.
lependent on several factors.
n the soil pH is in a range
vailability is reduced due to
reduction in the solubility of

nitrogen. A soil maintained
sture for the soil solution to
oil will result in a reduction
ide content of the soil. This

will reduce absorption directly by adversely affecting the plant and also indirectly by reducing the activity of the nitrofying bacteria to convert ammonium forms to nitrate forms.

A cold soil temperature affects the absorption of nitrogen through its influence on the activity of the soil nitrobacteria. The use of only ammonium forms of nitrogen during the cold winter months may result in nitrogen starvation because of the slow down of conversion of ammonium to nitrate forms by the soil nitrobacteria.

Holley (3, 4) has found that the use of nitrate forms of nitrogen such as ammonium, sodium, or calcium resulted in the best growth of carnation plants. The nitrate levels that should be maintained are 25-100 ppm in the extracting solution as determined by the Spurway Soil Testing procedure.

Nitrate forms of nitrogen are readily leached from the soil. Because of this it is necessary to make frequent applications of nitrogen fertilizers to growing crops.

Recent research work at Massachusetts (2) on carnations showed, under the conditions of their studies, that best results were obtained when nitrogen and potassium were each at concentrations of 200 ppm in the irrigation water applied to the soil.

Phosphorus

Although the requirements of the plant for phosphorus are much lower than for nitrogen and potassium it is still classed as a major plant nutrient element. Phosphorus is extremely important in the plant in the respiratory and photosynthetic processes. An adequate supply of phosphorus early in the life of the plant is important in laying down the primordia for the reproductive parts of the plants. It is also thought to stimulate root growth.

Phosphorus, when applied to most soils, is retained against removal, and sometimes this retention is so great that it may render the element unavailable to growing plants. In most soils phosphorus availability is at a maximum in a pH range of 5.5 to 7.0; decreasing as the pH drops below 5.5 or above 7.0. At a low pH the hydrous oxides of iron, aluminum, titanium and manganese retain phosphorus so that it is unavailable to the plants. Above pH 7.0 the ions of calcium and magnesium as well as the presence of carbonates of these metals in the soil tend to precipitate the available phosphorus in the soil so that it is less available for plant growth. For this reason superphosphate and ground limestone should never be mixed together when added to the soil. The superphosphate should be added first and thoroughly mixed into the soil. Limestone can then be added and mixed in thoroughly. The additional mixing of the soil when the limestone is added will further distribute the phosphorus throughout the soil mass. Since phosphorus does not leach or move readily in the soil solution, uniform distribution will increase the chances for the foraging root system of the plant to come into contact with the phosphorus particles in the soil.

The phosphorus requirements for carnations grown in a loam type soil can be met by an annual application of five pounds of 20 per cent superphosphate to 100 square feet of bench area or two and one-half pounds of treble superphosphate to the same area. If the soil is very sandy the amounts should be increased 50 per cent. A clay soil may need less than the above if the phosphorus remains available.

Potassium

The potassium requirements of carnations is equal to or second only to nitrogen. Although the specific function of potassium in the growth processes is not known, it is essential for growth, it is required in large amounts and cannot be replaced completely by any other element.

It is considered to be essential for the production and translocation of carbohydrates. It seems to be directly related to the nitrogen metabolism of the plant.

Young, actively growing plant tissues are usually much higher in potassium than older plant parts. The element is quite mobile and is readily transferred from older to younger regions of growth.

The plant absorbs potassium only in the form of the ion, K. Soil potassium exists in three forms; relatively unavailable, slowly available and readily available. Since the readily available form accounts for only one to two per cent of the total soil potassium, and there is a continual removal of potassium from the soil by leaching and crop removal, it is important that an adequate supply be available to the plants at all times.

There are four factors that are known to affect the conversion of potassium to less available forms. The type of colloid that exists in certain types of clay soils has a high potassium fixation capacity. Since most greenhouse soils are thoroughly modified this is of relatively little importance. Although the effects of temperature on potassium have not been thoroughly studied it is considered that fixation proceeds more rapidly at higher temperatures.

When soils that contain exchangeable potassium are alternately wet and dried a large portion of the exchangeable potassium is converted to the less available form.

The effect of pH on the fixation and release of soil potassium has been a controversial one, but there is evidence to show that soils with a high degree of base saturation lose less of their exchangeable potassium by leaching than do soils with a low degree of base saturation. Liming is the common means of increasing the base saturation of a soil, so the proper addition of lime to a soil with a low pH will decrease the loss of exchangeable potassium. Although the pH level will vary with different soils it is probable that this effect begins to take place very rapidly when the pH drops below 5.5.

Potassium is generally supplied as muriate of potash (KCl)—60%, K_2O; potassium sulfate (K_2SO_4)—18.7% K_2O; or potassium nitrate (KNO_3) —44%, K_2O, 13% Nitrogen. The normal rate of application for muriate of potash is ½ to ¾ pounds per 100 square feet of bench area.

Holley (5) has suggested the use of 1¾ pounds of muriate of potash to 1000 gallons of water as a watering/fertilizing solution. This may be satisfactory for Colorado soils, but for New York soils it may be too little or too much depending on the soil used.

A potassium range of 25 to 50 parts per million as tested by the Spurway Test should prove adequate.

Potassium fertilization cannot substitute for poor light conditions during winter in improving the stem ~~length~~ strength of carnations.

Calcium and pH

The calcium content of the soil is closely associated with the degree of alkalinity or acidity, or pH of the soil. Occasionally the soil pH may be high but the calcium content may be low. A calcium content of 150-200 ppm Spurway is the optimum level to maintain. An annual application of five pounds of ground limestone to 100 square feet of growing area is adequate to maintain the desired levels. In a highly organic soil additional limestone may have

to be added becau-
a low organic matt
amounts of limesto
Since it is ea-
the soil should be
to 7.0 is recommen
close to 6.0 as pos
soil microbiologic
Calcium is al-
which is contained
49 to 51 per cent
phate contains 17

Sodium

Sodium is no
substitute some s
Sufficient sodium
the recommended

Magnesium

The magnesi
dolomitic limesto
tain sufficient ma
of a deficiency oc

Boron

The deficien
cultural practices
house operators
amendment has
trace elements.
have eliminated
materials in the
Where a de
mendation is to
of area. As an
entire growing s
are 6 to 8 inches
be made in Octo
may be made in
Do not add
can occur from
is made the soil
contained.

Trace Elemen

The additi
with caution.
tices followed
slightly deficie
materials a sin
The safest
lease the mate
the recommen

to be added because of the buffering capacity of such a soil. Lighter soils with a low organic matter content respond more quickly than heavier soils to equal amounts of limestone.

Since it is easier to change the pH of the soil before the crop is planted the soil should be tested well in advance of planting time. A pH range of 5.0 to 7.0 is recommended. Best results will be obtained if the pH is maintained as close to 6.0 as possible because of the effects on the availability of fertilizers, soil microbiological activity and other attendant factors.

Calcium is also available from the addition of 20 per cent superphosphate which is contained in the form of gypsum or calcium sulphate. Approximately 19 to 51 per cent of 20 per cent superphosphate is gypsum. Treble superphosphate contains 17 to 20 per cent calcium as the oxide form.

Sodium

Sodium is not particularly needed for plant growth. Carnation plants can substitute some sodium for potassium if potassium is on the deficient side. Sufficient sodium will be made available to plants if sodium nitrate is used at the recommended rates of application.

Magnesium

The magnesium requirements of carnations can be met with the use of dolomitic limestone as a soil amendment. Frequently local water supplies contain sufficient magnesium in the form of carbonates to offset any possibilities of a deficiency occurring.

Boron

The deficiency of boron in carnation soils has resulted through several cultural practices followed by growers. Steam sterilization has enabled greenhouse operators to reuse the same soil again and again. Peat moss as a soil amendment has been substituted for manure and thus eliminated a source of trace elements. Highly purified fertilizers developed for liquid application have eliminated the use of low analysis dry fertilizers which contain trace materials in the fillers added.

Where a deficiency of boron has been definitely established the recommendation is to use one ounce of Borax (household type) to 100 square feet of area. As an insurance measure the application can be spread over the entire growing season. Apply 1/3 ounce when shoots following the first pinch are 6 to 8 inches long (July-August). A second application of 1/3 ounce may be made in October-November after the first crop is cut. A third application may be made in February or March.

Do not add more than one ounce at any one application. Severe tip burn can occur from an over application of boron. If an over application of boron is made the soil can be leached with sodium to help remove the excess boron contained.

Trace Elements

The addition of trace element mixtures to carnation soils should be done with caution. If the soil has been used for years and liquid fertilization practices followed there is the possibility that some of the trace elements may be slightly deficient. Because the plants require only small amounts of these materials a single annual application is usually all that is needed.

The safest form of trace elements to use are the fritted types. These release the materials very slowly into the soil. As a safety measure use only half the recommended rates of application at one time. The other half can be applied in six months time. Probably the best time to make such applications is in March and September on a continuing crop.

If low analysis dry fertilizers are used in the fertilization program sufficient trace elements are probably contained in the filler materials used in such fertilizers.

FERTILITY PROGRAMS

Proportioners

The most important part of any fertility program is an accurate record of the materials applied and the frequency and rate of application. This information correlated with frequent soil tests will enable the grower to become thoroughly familiar with the soil mixture that he is using. This is extremely important when using any of the fertilizer proportioners now available as a means of providing nutrients to the crop.

The theory of the proportioner is to apply fertilizers to the plant at each watering. The plant uses water in relation to the amount of growth it makes. The more water required the more growth that is being made. By applying a little fertilizer at each watering the nutritional needs of the plant can be met without the problem of high salts that occurs from sporadic feedings of large quantities of material. This is only true if sufficient water is added at each application to ensure some leaching of the plant growing area. If insufficient water is added the soluble salt content can increase very rapidly to the point where plant damage occurs.

The application of fertilizer at each watering also eliminates the need to do the fertilizing job separately.

There are many types of fertilizer injectors or proportioners available. (Figures 6.2, 6.3, 6.4, 6.5, 6.6). All of them operate on the basis of introducing a small volume of highly concentrated fertilizer stock solution into a known larger volume of water. The most common ratios of injection of fertilizer to water are 1 to 100 and 1 to 200.

Because the machines are expensive and also operate on close tolerances only completely water soluble fertilizers or those already in solution should be used. To avoid damage to injectors the fertilizer should be dissolved in one tank and siphoned over into another tank. Polyethylene garbage cans of the 24 gallon size make excellent containers. The use of a plastic or wooden tank will eliminate the problem of corrosion that occurs when metal tanks are used.

When using an injector at least one-half gallon of water should be applied for each square foot of growing area. This will produce some leaching and prevent the build-up of soluble salts.

If superphosphate or treble superphosphate is incorporated prior to planting only nitrogen and potassium need be added in the liquid form. This will result in a saving in dollars since soluble phosphorus is the most expensive nutrient in any completely soluble fertilizer.

Recent work at Massachusetts on carnations showed best results when nitrogen and potassium were each at 200 ppm in the irrigation water applied to the soil. If a grower has just started using an injector in his cultural program these levels may be used as a base point of reference. It will be necessary to soil test frequently to determine the trend of the nutrient levels in the soil. Until this is established supplemental feedings may have to be made as the stock solution is either increased or decreased in concentration to obtain the desired levels of fertility. Since completely soluble materials tend to have an acid residue a check on the soil pH should also be maintained.

Table 6.1 by Caldwell and Kiplinger (1) gives the amounts of vari-

time to make such applications
p.
the fertilization program suffi-
in the filler materials used in

AMS

program is an accurate record
rate of application. This infor-
enable the grower to become
he is using. This is extremely
portioners now available as a

ply fertilizers to the plant at
on to the amount of growth it
rowth that is being made. By
nutritional needs of the plant
hat occurs from sporadic feed-
only true if sufficient water is
ing of the plant growing area.
content can increase very rap-

ing also eliminates the need to

rs or proportioners available.
erate on the basis of introduc-
izer stock solution into a known
ios of injection of fertilizer to

lso operate on close tolerances
e already in solution should be
er should be dissolved in one
yethylene garbage cans of the
se of a plastic or wooden tank
urs when metal tanks are used.
llon of water should be applied
ill produce some leaching and

ate is incorporated prior to
added in the liquid form. This
phosphorus is the most expen-
r.
ons showed best results when
in the irrigation water applied
an injector in his cultural pro-
of reference. It will be neces-
nd of the nutrient levels in the
lings may have to be made as
sed in concentration to obtain
soluble materials tend to have
lso be maintained.
) gives the amounts of vari-

FERTILIZER PROPORTIONERS

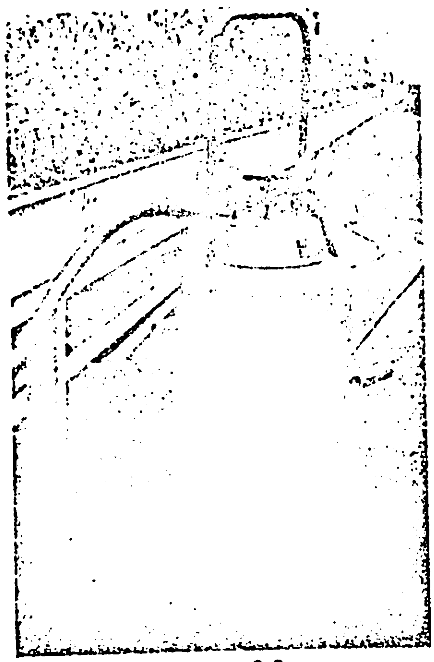

Figure 6.2
The GEWA proportioner

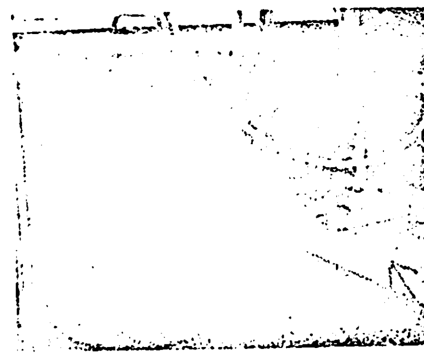

Figure 6.4
The Cameron Bucket proportioner

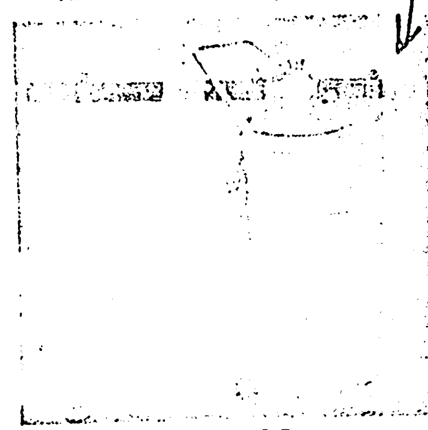

Figure 6.5
The Smith proportioner

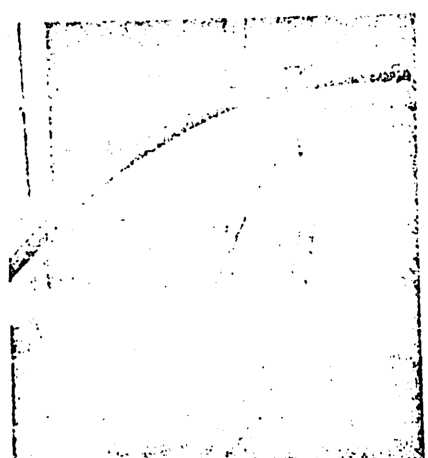

Figure 6.3
The Hozon proportioner

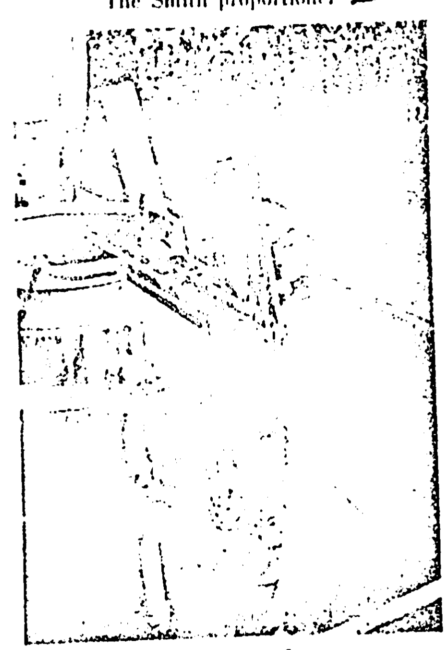

Figure 6.6
The Fert-O-Ject proportioner

Table 6.1—Amounts of Various Fertilizer Materials to Supply 200 ppm each of Nitrogen and Potassium

Fertilizer Combination	Fertilizer Analysis	Ounces per gallon of concentrate: 1:100 injector	Ounces per gallon of concentrate: 1:200 injector	Amount per 50 gallons of concentrate: 1:100 injector	Amount per 50 gallons of concentrate: 1:200 injector
Ammonium nitrate	33-0- 0	8	16	25 lbs.	50 lbs.
Muriate of potash	0-0-60	4.5	9	14 lbs. 1 oz.	28 lbs. 2 oz.
Calcium nitrate	16-0- 0	12	24	37 lbs. 8 oz.	75 lbs.
Potassium nitrate	13-0-44	6	12	18 lbs. 12 oz.	37 lbs. 8 oz.
Sodium nitrate	16-0- 0	12	24	37 lbs. 8 oz.	75 lbs.
Potassium nitrate	13-0-44	6	12	18 lbs. 12 oz.	37 lbs. 8 oz.
Ammonium nitrate	33-0- 0	6	12	18 lbs. 12 oz.	37 lbs. 3 oz.
Potassium nitrate	13-0-44	6	12	18 lbs. 12 oz.	37 lbs. 8 oz.
15-30-15 (for liquid application only)		18	36	56 lbs. 4 oz.	112 lbs. 8 oz.
20- 0-20 (for liquid application only)		13.5	27	42 lbs. 3 oz.	84 lbs. 6 oz.
20-20-20 (for liquid application only)		13.5	27	42 lbs. 3 oz.	84 lbs. 6 oz.
*20- 5-30 (for liquid application only)		13.5	27	42 lbs. 3 oz.	84 lbs. 6 oz.

*Supplies 300 ppm potassium

ous fertilizer materials needed to supply 200 ppm each of nitrogen and potassium.

Where a large supply tank is used for fertilizing, Holley suggests the following materials and rates of application per 1000 gallons of water for each irrigation.

Ammonium nitrate	3 pounds
Muriate of potash	1$\frac{3}{4}$ pounds
Magnesium sulfate (Epsom Salts)	$\frac{1}{2}$ pound
Nitrate of soda	$\frac{1}{4}$ pound
Borax	$\frac{1}{2}$ ounce

This has proven satisfactory for Colorado conditions, but may have to be modified for New York soils.

Figure 6.7. Stunted growth and curling, twisting stems are often signs of a high soluble salt content of the soil. This plant was growing where the salt level was 400; 2 water 1 soil test.

Soluble Salts

Although research has shown carnations to be more tolerant to high soluble salts than any other flower crops this does not mean that the salt content of the soil should be allowed to reach abnormally high levels. High soluble salt damage may first appear as a reduction in growth without the usual symptoms of injury commonly associated with the problem. This decrease in, or cessation of growth will probably be accompanied by a crinkling of the leaf terminals (Figure 6.7) a change in color of the plant and rolling of the leaves. If the salt level of the soil is high and the soil is allowed to dry the concentration of the soil solution increases to the point where visible burning or scorching of the leaves may occur.

In addition to proper soil preparation and watering practices the selection of the right fertilizer will aid in keeping the salt level low. The use of potassium nitrate as opposed to muriate of potash or potassium sulfate supplies both potassium and nitrogen to the plants with very little residue left to add to the salt content of the soil. The same may be said for ammonium nitrate as opposed to ammonium sulfate. Although the cost of such fertilizers is greater the amount that may be saved through elimination of high salt conditions will more than offset the few extra dollars spent.

Soil Testing

The reason for testing soils is often viewed incorrectly. Many growers use soil test recommendations as their only guide to fertilization of crops. This is not the intended use of a soil test recommendation. Soil test recommendations are made on the basis that a regular fertilization program is being used. Specific fertilizers recommended should be used to bring the various nutrient levels in balance at the proper range of fertility. If one element is consistently low, the basic fertilization program should be changed. Gradually increase the concentration of the deficient material until the proper levels are maintained.

When an injector or proportioner is used, the nutrient levels maintained need not be as high as present day literature indicates. These recommendations are based on a once monthly or twice monthly application of fertilizer. Since the proportioner applies a small amount of fertilizer at each watering, the plant is never subjected to a deficient supply of nutrients.

Until a grower has become thoroughly familiar with the response of his soil mixture to fertilizer applications, watering practices, etc. he should soil test once monthly. After he learns how the soil responds tests need be made only once every two months. Should there be any change in the cultural program, then a monthly program should be followed.

The Floriculture Soil Testing Laboratory at Cornell uses a modified Spurway system. The test results are reported in parts per million in the extracting solution. Since other soil testing laboratories may use different extracting solutions, and report results on a different basis, it is impossible to convert figures obtained from one laboratory with those of another.

The cost of a proper soil test is small in comparison to the savings that can be made through early correction of a soil problem.

References

1. Caldwell, J. L. and D. C. Kiplinger 1960. Fertilizer injection. Mimeograph.
2. Eck, P. 1960. Continuous solution feeding—the key to planned carnation nutrition—Massachusetts Flower Growers Association Bull. 58.
3. Holley, W. D. 1956. What source of nitrogen for carnations. Colorado Flower Growers Association Bull. 81. 1-2.
4. Holley, W. D. 1956. Further investigations on the effects of nitrogen sources on carnation growth. Colorado Flower Growers Association Bull. 85, 1-2.
5. Holley, W. D. 1959. Potash—the controversial nutrient. Colorado Flower Growers Association Bull. 113.
6. Messing, J. 1955. The visual symptoms of some mineral deficiences of perpetual flowering carnations. Carnation Craft 32.
7. Petersen, R. and W. D. Holley 1959. Response of carnations to liquid feeding. Colorado Flower Growers Association Bull. 114.
8. Petersen, R. 1960. Calcium hunger in carnations. Colorado Flower Growers Association Bull. 119.
9. Tisdale, S. L. and W. Nelson 1956. Soil fertility and fertilizers. The MacMillan Company. 430 pp.

CHAPTER 7

Why is water ne
answered. The comple
erally considered that
is used in the photosyn
part of the total water
water. This is the wat
cally all of the water u
There are thousa
leaves. These openin
that carbon dioxide fr
necessary for photos
which is wet, is expo
leaves. This is called
pires is dependent on
humidity, soil moistu
transpiration is the d
perature. The greater
loss.
The stomates the
conditions the stomat
until the following da
it greatly reduces th
during the day if the
considered as a meth
the exchange of car
producing sugars, w
to supply the plant w
keep the stomates op
Water is absorb
watering practices w
available to the root
with water for tran
supply them with su
The oxygen is obtai
of the soil are fille
unable to absorb w
close, thereby, stop
The result of this is
This problem