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Foliar Analysis of Carnation

Part III: Development of Standard Tissue Concentrations

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In the June 1964 issue of this bulletin a sampling scheme was outlined for collecting leaf tissue from the carnation plant. Following collection the leaf tissue is washed in distilled water to remove dust, sprays and other contaminents which might contain elements for which the analyst is testing. Then the live tissue is placed in a forced draft oven at a temperature of 70°C. Within two hours moisture loss comes to a stop and the dry tissue is removed. It is important that the tissue be "killed" by drying as soon after collecting as possible to prevent any large loss of materials such as sugars through respiration. In addition the drying process also eliminates the action of microbes upon the tissue and leaves the tissue in a workable state for the next step in the sequence.

After drying the tissue is ground in a mill to pass a 20 mesh screen. The small particles permit uniform mixing of the tissue and make it possible to remove small but representative sub-samples of a magnitude of ¼ to ½ gram for the subsequent chemical analyses. Before weighing out the sub-samples the tissue is dried once again in an oven to expell moisture absorbed during handling.

When the chemical analyses are finished an interpretation based on the nutrient content of the tissue sampled must be made in order to determine the fertilizer requirements of the crop sampled. This means that it is necessary to be able to relate the nutrient content of the plant tissue to the nutritional status of the crop sampled. This was essentially the objective of this second experiment, i.e., the establishment of a set of standard nutrient concentration curves for the essential elements; nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and boron (B), which can be equated to a desirable carnation yield.

METHODS

For the purposes of this experiment 30 plots were established which involved one with an adequate soil level of all essential nutrients, five each for the nutrients N, P, K, Ca and Mg involving three below adequate and two above adequate soil levels of each nutrient, and four plots for B involving three below adequate and one above adequate levels of this nutrient. Only one nutrient was varied in each plot, all others were maintained at the adequate level. The nutrient contents of the solutions used to maintain the 30 treatments are given in Table 1. These solutions were applied with every watering at the rate of 3 liters per sq. ft to ensure leaching and thereby avoid a build up of soluble salts. The carrier compounds used for varying the nutrients in these treatments were, sodium nitrate, phosphoric acid, potassium chloride, calcium chloride, magnesium sulfate and boric acid.

The cultivar used was Improved White Sim. It was planted at a spacing of 6" by 6" with a total of 54 plants per plot. The cuttings were removed from the propagation bench on June 20, 1962. For the boron plots the root media consisted of a 1 to 1 mixture by volume of horticultural grade vermiculite and perlite, and in all other plots it was comprised of a 9:6:4:2 mixture of Fulton silt loam, sphagnum peat moss, perlite and sand. Night temperatures were maintained whenever possible at 50°F. and day temperatures 10 to 15 degrees higher depending upon weather conditions. The crop was grown according to a

Table 1. The nutrient contents of the 30 solutions used in this experiment expressed as parts per million. The D series represents the adequate nutrient levels.

Nutrient											
N		P		K		Ca		Mg		B	
Tr.	Conc.	Tr.	Conc.	Tr.	Conc.	Tr.	Conc.	Tr.	Conc.	Tr.	Conc.
N-A	5	P-A	0	K-A	5	Ca-A	5	Mg-A	0	B-A	0
N-B	35	P-B	5	K-B	35	Ca-B	40	Mg-B	7	B-B	0.5
N-C	100	P-C	25	K-C	100	Ca-C	70	Mg-C	15	B-C	1
N-D	**150**	**P-D**	**40**	**K-D**	**150**	**Ca-D**	**100**	**Mg-D**	**25**	**B-D**	**2**
N-E	300	P-E	80	K-E	300	Ca-E	200	Mg-E	50	B-E	15
N-F	900	P-F	240	K-F	900	Ca-F	560	Mg-F	150	...	..

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single pinch procedure. The pinch was made on July 23.

During the third week of each month beginning in August 1962 and ending in May 1964, 20 leaf pairs were collected from each plot and analyzed for their nutrient content. Nitrogen was determined by the Gunning-Kjeldahl procedure using selenium in the catalyst (1), P by the molybdovanado-phosphoric acid method using a Baush and Lomb Spectronic 20 colorimeter to measure the transmittancy at 470 mu, K, Ca and Mg were determined on a Beckman Model B flame spectrophotometer at wavelengths of 759 mu, 418 mu, and 368 mu respectively, (3), and B was determined by the curricumin-oxalic acid method as outlined by Dibel et al. (2). The leaf tissue was sampled according to the procedure outlined in an earlier article of this series appearing in bulletin 223 (4). In the way of a brief summary, the fifth pair of leaves up from the base of the main stem were sampled from the time the cuttings were benched until the primary lateral shoots developed seven leaf pairs. Then the fifth leaf pair down from the terminal end of the primary lateral shoots were sampled until flower buds become macroscopic. At this point sampling was shifted to the same leaf pair on secondary lateral shoots. The same procedure was used for the third and fourth sets of lateral shoots.

RESULTS

For each plot, the tissue concentration of the nutrient that was varied in that plot was plotted on graph paper along with the curves for each of the other five plots involving that nutrient. The five graphs for N, P, K, Ca and Mg covered two years growth of these plants. The graphs were divided into four periods to correspond with each of the four crops harvested over the two year time interval. The termination dates of these four periods were March 1963, September 1963, February 1964 and May 1964. For each period a quality index value was assigned to each plot. To determine the quality index values each plot was given a visual rating ranging from 0 to 5. This rating took into account color, texture and vigor of the foliage, size of plants, necrosis, chlorosis and other deleterious symptons of nutrient disorders, and delays in flowering time. A second rating was assigned to each plot. This was determined by grading the flowers by the Purdue or North Central system and then multiplying the number of flowers cut during the period by the grade of each. Numerical values assigned to grades were as follows: extra fancy—4, fancy—3, number one—2, and design and split—1. The final values for each plot during a given period, or crop of flowers, were reduced to a scale of 0 to 5. Finally the visual rating values and the North Central grading values were averaged to determine the quality index values. The values are given in Table 2.

At this point standard tissue concentration curves were constructed for each of the five nutrients N, P, K, Ca and Mg. To construct these curves the data for each nutrient were considered separately. For each nutrient the highest quality index value was selected for each of the four periods. The tissue concentrations of the given nutrient corresponding to the selected treatments were then plotted into a single standard curve. Where two quality index values did not differ significantly the corresponding tissue

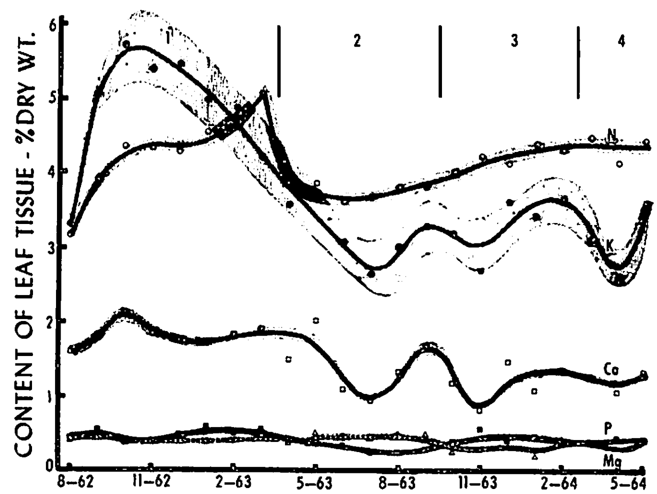

Figure 1. A set of standard tissue concentration curves for N, P, K, Ca and Mg which can be correlated with a satisfactory plant response of Improved White Sim carnations propagated during the first half of June and grown for 2 years.

Table 2. A set of quality index values representing each treatment within each of the four periods. Figures in bold face are from adequate nutrient treatments.

Tr.	Period 1	2	3	4
N-A	1.04	0.85	0.60	0.58
N-B	3.10	1.04	1.69	2.00
N-C	3.83	4.08	4.70	4.32
N-D	**4.71**	**4.70**	**4.50**	**4.20**
N-E	4.34	3.97	4.09	4.30
N-F	3.48	2.10	2.56	3.49
P-A	3.64	2.22	1.62	1.63
P-B	4.41	3.40	3.68	3.77
P-C	4.40	3.80	3.52	3.74
P-D	**4.71**	**4.70**	**4.50**	**4.20**
P-E	4.75	4.69	4.31	4.62
P-F	4.05	3.54	3.10	3.90
K-A	3.85	2.32	2.33	1.34
K-B	4.00	3.08	3.79	3.76
K-C	4.42	4.75	4.69	4.81
K-D	**4.71**	**4.70**	**4.50**	**4.20**
K-E	4.47	4.29	4.63	4.60
K-F	3.61	3.11	2.99	3.32

Tr.	Period 1	2	3	4
Ca-A	2.92	2.28	2.49	2.47
Ca-B	4.59	4.23	4.42	4.42
Ca-C	4.75	4.33	4.30	4.53
Ca-D	**4.71**	**4.70**	**4.50**	**4.20**
Ca-E	3.92	3.28	3.01	3.17
Ca-F	3.72	3.11	2.74	3.22
Mg-A	2.94	2.19	2.32	2.83
Mg-B	4.66	4.27	4.88	4.75
Mg-C	4.12	4.00	3.76	4.24
Mg-D	**4.71**	**4.70**	**4.50**	4.20
Mg-E	4.26	4.73	3.84	4.66
Mg-F	3.49	3.82	3.52	4.18
B-A	4.26	1.70	1.54	1.46
B-B	4.41	4.67	4.82	4.50
B-C	4.44	4.44	4.28	4.46
B-D	**4.71**	**4.70**	**4.50**	**4.20**
B-E	3.95	3.41	2.66	3.43
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concentrations were averaged for that period. This procedure was repeated for each of the five nutrients (Figure 1).

A shaded confidence interval surrounds each curve. This interval takes into account errors due to natural biological variation between plants and sampling, handling and analytical errors. For P, K Ca and Mg the interval encompasses plus or minus one coefficient of variability as determined from a set of 30 leaf samples collected from a uniform block of carnation plants. For the nutrient N the interval encompasses plus or minus twice the cofficient of variability. These coefficients or variability are, for N- 0.018, P- 0.067, K- 0.102, Ca- 0.049, and Mg- 0.056.

DISCUSSION

The curves in Figure 1 can only apply to the crop Improved White Sim and propagated during the month of June. Then the date of sampling is matched to the same date on the standard curves and the tissue concentrations are compared. For an ideal yield the nutrient content of the sampled tissue should correspond to the values on the standard curves. If the sample value does not correspond to the standard curve and lies outside the shaded confidence interval corrective measures should be taken in the fertilizer program to adjust the tissue concentration so that it corresponds to the standard value. If, on the other hand, the sample value falls anywhere within the confidence interval no corrective measures should be taken. Values within the confidence interval do not necessarily differ significantly from the standard value since differences of this small magnitude may be the result of natural biological variation or errors in the procedures.

Boron has not been considered until now because the relationship between B content of the tissue and quality is not a continuous one. As can be seen in Table 2 treatment levels below one point and above a second point cause injury to the crop. But, in the wide interval between these points no relationship exists between B content of the tissue and quality. For the purposes of developing standards for this nutrient it is sufficient to know the upper and lower limits of the safe range of B levels.

The B content of plants in treatments in B-A and B- B, which were supplied no B and ½ ppm of B in the nutrient solution, are plotted in Figure 2a. Deficiency symptoms first appeared in treatment B- A in April 1963 when the second crop flower buds were beginning to expand and persisted until the end of the experiment. No symptoms appeared in plants in treatment B-B and the quality index was in the two upper brackets. From these curves it appears that the lower level for B falls between 50 and 20 ppm in the leaf tissue.

This point is better illustrated in Figure 2b. The two curves show the B content of crops of White Sim and Dusty, a sport of White Sim, carnations. These plants were planted into soil beds in the greenhouse on June 1963. No B was supplied to these plants. In January 1964 the B content of these plants was 28.5 and 25.5 ppm respectively. No visual deficiency symptoms were present. A third crop, White Sim, developed deficiency symptoms when the tissue content dropped to 21 ppm. Thus it appears that the lower threshold limit for deficiency symptoms lies beween 20 and 25 ppm B in the leaves.

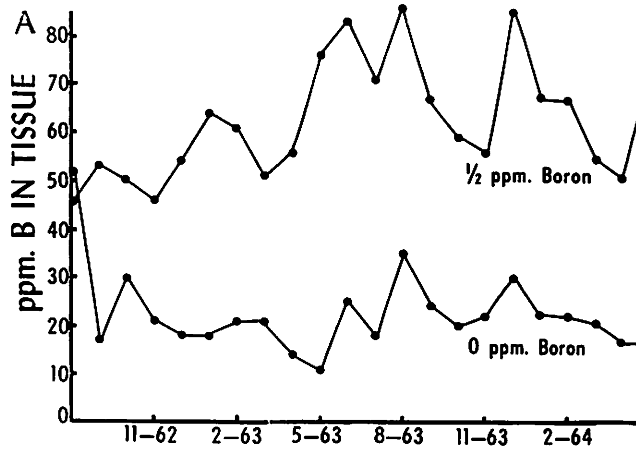

Figure 2a. The boron content of leaf tissue from the 0 and ½ ppm. boron treatments.

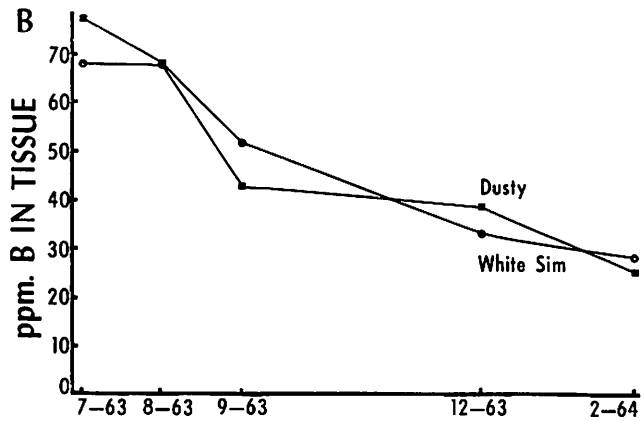

Figure 2b. The boron content of crops of Dusty and White Sim carnations planted in June 1963. No boron was applied during this time.

The upper limit for B cannot be accurately ascertained from the data of this experiment. Toxicity symptoms first appeared when the B content of the leaves reached 420 ppm. Since the B levels were in excess of 600 ppm throughout the remaining period of toxicity it is not possible to determine whether the upper limit of 420 ppm holds for other times of the year or stages of growth.

SUMMARY

A set of standard tissue concentration curves have been presented in Figure 1 for N, P, K, Ca and Mg. The curves relate to the first two years of growth of a crop of Improved White Sim carnations propagated during the month of June. Since both variety and propagation date influence the nutrient content of the crop it is imperative that these variables be taken into account when establishing standard tissue levels. While many varieties fit the standards presented in this paper other varieties such as the miniatures do not. This topic will be discussed in a subsequent article of this series.

While the B data have not been presented in graphic form a tissue concentration of 20 to 25 ppm of the dry weight of the leaf tissue has been set as the lower limit

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of the safe zone. The upper limit to the safe range is set at 420 ppm for young plants up to six months of age. Beyond this point no upper limit has been established.

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Boodley on Sabbatic

Dr. James W. Boodley, Associate Professor of Floriculture, Cornell University will be on sabbatic leave from February 1 through July, 1965. The first two months, he will be doing library research and writing of research manuscripts for publication of his extensive research work in Ithaca. The next four months will be a study tour of research at Europe an Agricultural Experiment Station and commercial flower production areas overseas. He not only will see commercial establishments in various parts of Europe, but will present lectures on floriculture crop nutrition in various countries.

Pennell New Entomologist

Dr. James Pennell has been appointed assistant professor of Entomology and fills the position vacated by John Naegele. Jim was born in England and obtained his B.S. from the University of London in chemistry, botany and zoology in 1951. The following year he was awarded Special Honors B.S. in zoology with entomology as the special topic.

Between 1953 and 1955 he was with the Royal Navy and the Fison's Pest Control Ltd. Jim was a research entomologist at their Chesterford Park Research Station where he tested greenhouse pesticides, systemics and soil insecticides. This was followed by work in Sudan, Africa for the Fison's Pest Control to study cotton insect control. In 1956 he came to Canada and studied at the University of British Columbia and was awarded the M.S. degree in 1960. His Masters thesis was on the effect of crystal size and shape on the availability of Lindane deposits to an Ambrosia Beetle. This was followed by more graduate work at the University of California at Berkeley, where he studied Dieldrin resistance. He was awarded the Ph.D. in 1963. Jim was on a Ford Fellowship at the University of British Columbia upon his arrival at Cornell in the late summer of 1964.

Jim intends to fulfill the dedication of the Blauvelt Memorial Laboratory "to advance floriculture through research"—to work on pest problems of flowers and to acquire basic knowledge of the organisms involved. At the present time he is working on aphids and their behavior and response to insecticides.

We all welcome Jim and are sure he will be a big help to New York State's Floriculture Industry.

A Pathologist's Request

If a disease problem is suspected we will be very happy to diagnose the situation. One of the major problems, however, the samples arrive in such poor condition it sometimes has been impossible to diagnose anything.

We suggest you follow and consider the following list:

1. Send or bring a representative sample of all stages of the problem (i.e., severely diseased, moderately diseased, initial stages of disease, healthy plants).
2. Protect specimens against dessication, frost, excessive moisture buildup in the package, etc. when sending via mail.
3. Send total plant specimens, even if you don't consider necessary. Often, seemingly restricted plant part problems are actually symptoms resulting from problems elsewhere on the plant.
4. Send as much information as possible as to the practices in handling the crop, (i.e., spray schedule and type of chemical used, soil mix type, soil sterilization program, source of stock, etc.).
5. Send the parcel by the most rapid means. Address samples to Dr. A. W. Dimock, Department of Plant Pathology, Cornell University, Ithaca, New York.
6. Remember, a full report from you may mean a quicker diagnosis of the cause of the problem and subsequent incorporation of control measures.

J. Knauss

A Report on Europe's Highly Successful Flower Marketing System*

Paul Schneeberg Sr.
Schneeberg's Roses
Sayville, New York

PHENOMENAL GROWTH IN EUROPE'S FLOWER SALES

The flower business is booming in Europe! In Aalsmeer, Holland, total sales have increased from $5,222,352 in 1950 to $10,414,050 in 1958. And Straelen in Germany sold over $1,900,000 worth of flowers last year; six years ago this section produced and sold none! The lower Rhine region formerly used a marketing system similar to ours. When production increased greatly, this system proved inadequate, inefficient and expensive; they found that to increase sales they had to change to a better method. England's marketing system is like ours; their flower sales are not skyrocketing, and they are not satisfied with their present method of selling flowers and are looking for a better one. While in Nice, France, they have hopes of becoming Europe's Flower Capital. Last year alone, almost 25,000 tons of flowers were produced in this area. In order to streamline marketing of these flowers, plans are being made for the construction of a giant auction hall near the international airport.

And look at these significant figures: In 1957 Holland's total sales were $17,500,000, while New York State's were not quite $7,750,000. Holland's acreage is smaller and her population less than half of New York State's!

Yet these are prosperous times, and ours in the richest country in the world; our standard of living is higher than Europe's and we can afford more luxuries.

Question: What is causing New York's decline in flower sales?

Answer: Compared with Europe our system of marketing is outdated, expensive, inefficient and unfair to the flower grower.

A NEW KIND OF MARKETING

Let us consider, for example, the flower buyers of Aalsmeer, Holland, who, seated at the Growers' Auction, keep their eyes intent on the electric auction clock. They have already inspected the lot of flowers being offered for sale from a moveable table in front of them. Now the hand of the clock, started at an unreasonably high figure, is moving slowly downward and the buyers are ready to bid. It seems that several buyers push the electric buttons at their seats at the same time, but this requires split-second timing and one is always first. His permanent seat number lights up on the face of the clock; simultaneously the clock stops. He has purchased his lot of flowers at the figure the hand stopped on; the table moves along and the next lot appears.

OWNED BY THE FLOWER GROWERS

A grower's auction is a cooperative association founded and owned by the flower growers themselves. Simple, ingenious and efficient, this system is new to America but has been used in Holland and Denmark with growing success for almost 50 years. A workable, proven system, long years of experience have shown that grower, commission man and retailer alike benefit by it; nobody willing to cooperate is put out of business.

Europe's Highly Successful Flower Marketing System

About 1953, two sections of Germany adopted the auction system from their neighbors and the explosive growth in sales indicates its effectiveness.

Prior to the formation of the auctions in Germany, the region of Neuss used a commission system similar to ours. By 1953 flower cultivation had increased so much that sales were lagging behind production. A quicker and more efficient method of marketing was needed; the Grower's Auction was chosen because nearby Holland had used it successfully for so many years.

In Straelen, Germany, no flowers were grown prior to 1952. Then competition from Italian early vegetables forced the German hot house vegetable growers to change to flowers. Vegetables have been sold in Straelen by auction since 1941—it worked so well for this perishable product that the same method was chosen for flowers.

DON'T WANT TO RETURN TO FORMER METHODS

Flower growers in Holland and Germany were asked if they would want to return to their former methods of marketing. Their answer was an unqualified "No." They believe the auction system has many advantages. Here are the most important ones:

1. It is fast—about 500 lots an hour can be sold.
2. The buyers can't take advantage of the growers of a perishable product—competition is keen and a minimum price is set.
3. The retailer can be sure of getting fresh flowers—all flowers are run through the clock each day and the unsold ones are destroyed.
4. All sales are cash.
5. Growers are partly indemnified if their flowers are not sold.
6. Auctions have stimulated trade and production by cooperating with the buyers along the lines of publicity, advertising and promotion of sales.
7. It is economical—the savings in overhead and selling costs are tremendous.

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*Presented at the Roses Inc. Annual Meeting, Portland, Oregon. Sept., 1964. Printed in the Roses Inc. Bulletin, November, 1964.

Flower Marketing System

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COMPARISON OF COSTS

AUCTION	PRESENT SYSTEM
1 Auction	50 Stores
1 manager	At least 50 managers
1 bookkeeper (with assistants)	At least 50 bookkeepers
1 auctioneer for each block	At least 200 salesmen
Real estate & equipment is owned by Auction members, making cost of ownership very low	50 Stores are paying high rents and duplicating equipment
Insurance on one Auction	Insurance on 50 stores
Prices are in the open, Grower gets market price, be it high or low	Grower has no voice or influence on price. "Backroom" deals, favorites and manipulating are possible.

MOST GROWERS JOIN

Many growers did not join when the first flower auctions were formed in Germany, but waited to see if the system would work. Now one cooperative reports new members joining at the rate of 80 a year. The other auction announces, "All critics were soon won over to this method. At the beginning (1953) there were 50 members; today there are at least 500!"

FORMATION OF THE GERMAN AUCTION

Capital was raised by bank loans, government subsidies and dues from members. Each member gradually paid about $100—to be returned if he leaves. A committee of six elected growers runs the association; they are also responsible for finances. The chairman runs the auctions, or designates people to run them. Specialists advise members about sorting and cultivation.

Depending on the season, auctions are held 3 to 5 times a week. Trucks pick up the flowers from the farms at about 6 am and they are taken to the place of auction; there they are unloaded, sorted according to grower and displayed on movable tables. Growers must sort their flowers according to sorting rules, pack them in cartons, and have them bundled and ready for market. Buyers arrive at about 3 pm and the tables are first driven past their platform so they can get an idea of sorting, quality and bundling. Minimum prices are fixed, or the grower is consulted after a buyer has bid to make sure the price is acceptable to him.

QUALITY TESTED

Before flowers are run through the clock, claims of quality are tested by a controller. He makes a note of errors in sorting or labeling on the form filled out by every grower. Complaints about quality or bundling arising after the sale are settled by a commission made up of the controller and a representative of the growers. The buyer can appeal this decision and ask a further commission to hear his complaint.

EQUIPMENT AND SUPPLIES ALSO SOLD

During the first few years the German auctions bought and sold only natural fertilizer, glass, coke and coal in small quantities. Later all other gardening needs were carried, and they feel that this has also helped to keep the growers' costs down.

FEES COVER AUCTION COSTS

Growers pay 5 to 7% of their gross sales as an auction fee. Non-member growers pay 12% and the buyers 1%. Refunds are made providing favorable balance is produced at end of fiscal year. Each grower receives a weekly sales report and financial settlement. The flower growers agree to sell their whole production through the auction. Trespassers are fined 1% of their past year's turnover the first time; 2% the second time. A third violation would bring expulsion, but this has never occurred.

Here in the U.S. more than one-fourth of our farm products are marketed through farmer-owned cooperatives (but not through auction clocks), and this amount is steadily increasing. Grocery, drug and hardware producers have also found it advantageous to market their products this way. Our flower industry, too, could greatly benefit by cooperative association.

GROWERS SHOULD LEAD FLOWER INDUSTRY

In spite of being responsible for the largest capital investment of the three branches, proportioned something like 100 to 1, the flower producer has nothing to say in the marketing of his products. In no other industry is the producer in such a poor position. As flower growers we should lead the flower industry; our position demands leadership in production, quality, marketing, publicity and advertising. We cannot afford to be satisfied with the present third-grade position and the resulting tremendous cost in loss of capital and earnings! The Auction Clock is the only way you can take your rightful place as leader of the flower industry. European growers led the way; the "clock" system is a proven one. Flower growers—be the "master spring"; start the clock ticking here!

In This Issue

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YOUR EDITOR,

Bob Langhans