be answered are (1) what rate of leached Uramite is best, and/or (2) will an ideal nitrogen supply be obtained by mixing leached and regular Uramite? The answer will be useful in pot plant production.

Of the soluble materials tested, ammonium nitrate appeared to be the best and offered an apparently suitable nitrate to ammonia ratio in a single material.

Summary

An experiment was carried out with potted chrysanthemums to determine methods of furnishing nitrogen and potassium, either as a liquid diet or preferably in slowly available forms that could be supplied in a single application. It was concluded that it should be possible to grow excellent potted chrysanthemums commercially with a weekly application of ammonium nitrate at a level of about half a gram per six-inch pot per week. Since this level of nitrogen supply will produce vigorous, tall growth it will be necessary to shorten the lighting period or use less ammonium nitrate with varieties such as Bonnaffon Deluxe and Criterion that normally tend to be tall. Potassium can be adequately supplied by way of a single application of Dura-K at the rate of 3 to 6 grams per pot. Since Dura-K raises the soil pH slightly, attention should be paid to the maintenance of a desirable pH.

Uramite and similar urea-formaldehyde compounds offer a useful method of furnishing nitrogen to potted plants. The use of this type of material is restricted at present, however, by the rapid release of about one-fourth of the 38% nitrogen content and the slow release of the remainder. With Uramite as the sole nitrogen source, it appears that two or more applications may be required, or a grade of material needs to be substituted that has the immediately soluble nitrogen partially or completely removed. When the soluble portion is removed, heavier rates of application are both required and tolerated. Further work is in progress to determine the proper use of leached and unleached urea-formaldehyde compounds singly and in combination.

NEMATODES AFFECTING FLORIDA CHRYSANTHEMUMS AND THEIR CONTROL

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A true appreciation of the damage of nematodes of growing crops has only developed in recent years. Generally speaking the damage caused by nematodes is greater in the South than in the North, due primarily to differences in climate.

For years our prime problem was the control of insects and diseases and the application of certain nutrients essential to the growth of the plant. Thus, the above-ground parts of our plants have received most of our attention. The roots and under-ground parts of the plant did not receive attention although some soil-borne fungi received attention.

Practically all of the cloth houses on the west coast of Florida have been constructed on old land that had previously been in vegetables or gladiolus. Gladiolus growers like to rotate with sweet corn. On untreated land the stubby-root nematode problem is increased since both gladiolus and corn are favored host plants. When cloth houses are constructed on this old land a nematode problem is already present. The problem is aggravated not only by the previously grown crops but by the inroads of Bermuda grass as host of a nematode that will be discussed later. Since many of the Chrysanthemum growers were also gladiolus and corn growers, they were acquainted with the mechanics of control. With new land there is always the element of chance to be taken into consideration the first year a new piece of ground is put into cultivation without soil fumigation.

Fortunately, nematodes are slow to spread. They seldom cause the outright death of a plant, although they cause a reduction in growth and decline in vigor. This is one of the reasons these serious pests have been overlooked and the grower is prone to underestimate their importance.

There is no longer any doubt as to the importance of nematodes as pests of crops. It is believed that all of us are agreed that nematology has reached adulthood and will claim its place along with entomology, plant pathology, parisitology and others of equal rank. Since the branch is comparatively new, specialists' view of this subject frequently change.

What Are Nematodes?

Nematodes are minute, slender wormlike animals generally too small to be seen without a microscope. The size is usually from 1/64 to 1/25 of an inch in length. There are thousands of species but only a very few are parasitic upon chrysanthemums. Some of the more important parasitic nematodes likely to attack chrysanthemums are the root-knot nematode, the stubby-root nematode and the sting nematode.

Root-Knot Nematode

Root-knot nematodes, *Meloidogyne* spp., are hot weather parasites and are particularly adapted to our Florida climate and sandy and peat soils. They have been known to occur in Florida soils since 1889. As the name denotes, these pests as newly hatched larvae burrow into the roots and cause galls or swelling. Varieties may differ markedly in the degree to which they are injured by root-knot. The presence of galls on a plant does not necessarily mean the death of the plant although it can cause decline. Field symptoms are stunting, yellowing, wilting and sometimes decline of the vigor of the plant.

Stubby-Root Nematode

Stubby-root nematodes, *Trichodorus* spp., are small nematodes that feed at the root tips without entering the tissue. The best visual indication is the tips of the lateral roots growing a small compact root system composed of numerous short stubby branches. Sometimes the root tip turns brown but more often there is no discoloration, with the tip merely ceasing to grow. Field symptoms suggesting stubby root include the stunting, wilting and generally hungry appearance of the plant. The symptoms are the result of the root system not functioning even though there is ample moisture and fertilizer. Bermuda grass, a common pest in cultivated soils, is a host for stubby root nematodes.

Sting Nematodes

Sting nematodes, *Belonolaimus* sp., produce symptoms similar to those produced by the stubby-root nematode. This nematode feeds at the root tips mostly from the outside, but sometimes penetrates the tissue. The feeding of the nematode produces discolored areas and the same short, branched stubby roots. Field symptoms are a pronounced stunting, the plants appearing to get smaller each week.

Control

Prior to treatment, whether steam or chemical, the land should be prepared for planting. This preparation means removal of roots of previous crops and trash. Roots, trash and large lumps of soil plus organic matter harbor nematodes. Ordinarily, if the soil is rototilled, it is of uniform texture. The soil temperatures should be above 50° F. for the best results in chemical control. The soil should be in good tillable condition with ample moisture for optimum control measures.

Chemical Fumigation

Soil fumigants are chemicals in a form (usually a liquid) that diffuse gas when placed in the soil. The ideal gas is one that kills weed seeds, insects, soil fungi and other organisms as well as nematodes. These gases are toxic to plants and the soil must be aerated before planting. The gas must remain in the soil a sufficient length of time to kill the plant and animal organisms and then must be dissipated so that no unnecessary delay takes place. Ordinarily, two weeks between treatment and planting are required for best results. Sometimes it is necessary to shorten this interval, so the soil is left undisturbed for one week and then aerated to allow the gas to escape into the air.

One chemical is Vapam, a liquid applied to the entire area at the rate of 1 quart per 100 square feet. This includes the entire area, beds and walks. The material is applied and then thoroughly watered in. This watering acts as a seal and keeps the gas in the soil. Vapam properly applied has been effective against soil insects, nematodes and Bermuda grass.

Methyl bromide (MC_2) is a highly volatile liquid in pressurized containers. Soil condi-

Table I. Soil Fumigation For Chrysanthemums Spring 1957
Plant Responses of Three Chrysanthemums Varieties
Weight per Plant in Grams

No.	Treatment	Portrait root	Portrait stem	Beauregard root	Beauregard stem	Shasta root	Shasta stem
1	MC-2	11.66	23.0	13.48	21.3	3.76	10.4
2	Crag-Mylone	9.02	22.2	13.23	20.3	5.83	15.3
3	AA+Nemagon	4.35	14.8	13.84	18.5	1.55	5.6
4	AA+EDB	7.81	17.8	12.57	19.2	5.17	5.8
5	Vapam	13.22	24.5	25.75	24.0	2.81	10.0
6	Check	10.18	11.6	21.38	27.7	2.72	6.1

tions are the same as explained above. However, a polyethylene covering is necessary to keep the gas within the confines of the treated area. Methyl bromide penetrates the soil perhaps as deeply or more deeply than any of the other chemicals used. The gas is quite effective against all organisms.

Besides Vapam and Methyl bromide, Crag Mylone, Nemagon and allyl alcohol, EDB + allyl alcohol were compared with plants grown under non-sterilized soil conditions. Comparisons of yields for three varieties (Portrait, Beauregard and Shasta) in Table 1, indicate that nematode control was directly reflected in weight of stems and the production of healthy roots. Root weight of the various varieties was also indicative of variety response to the materials. Nematode counts taken two months after soil fumigation, Table 2, indicated that Methyl bromide, Crag Mylone, and Vapam were excellent nematocides.

Table II.

Relative Numbers of Ectoparasitic Nemadodes Extracted from Fumigated Soil

Treatments	Nematodes Recovered
Methyl Bromide	0
Crag Mylone	4
AA + Nemagon	94
AA + EDB	54
Vapam	4
Check	114

Steam

Steam sterilization is one of the oldest methods known for elimination of plant and animal organisms. The question was how to easily and economically treat large acreages with live steam. When there is a need or demand for something it will be dreamed up and built. A portable soil sterilizer has been designed and put into operation.

In summing up the control measures mentioned, each one has its advantages and its weak points. Until more extensive investigation has been made on various chemicals and the effects of cover crops, our advice is for the grower to select whichever of the three chemicals mentioned or steam if his operation is large enough to warrant such a machine. We have seen all of these methods used and have seen excellent results.

THE POSSIBLE USE OF GIBBERELLINS AS A SUBSTITUTE FOR ARTIFICIAL LIGHT IN GROWING CHRYSANTHEMUMS

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The gibberellins, substances produced by Gibberella fujikuroi, an organism that causes bakanae disease in rice, are capable of elongating cells of many plants. Two materials, gibberellic acid ($C_{19}H_{22}O_6$) and gibberellin A ($C_{22}H_{20}O_7$) of nearly identical action are involved. (1).

It was thought that the increased stem growth due to effect of the gibberellins upon cell length might be desirable in growing chrysanthemums (2). Because of short day length, chrysanthemums (chrysanthemum morifolium) will flower under Florida conditions while plants are quite short. Such plants have limited commercial possibilities since the trade requires a flower with a much longer stem. The grower obtains flowers of desired characteristics by providing extra light artificially to young plants. The extra light delays flowering until a much taller plant is produced. However, providing additional light is an expensive item from standpoint of investment of fixtures, automatic control and outlay for current and moving of shades. If the applications of the gibberellins could substitute for this expense, it would greatly simplify the growing of chrysanthemums.

To test the possible value of the gibberellins for this purpose, a pot experiment was established in the open at Hollywood, Fla. Seven inch clay pots were filled with muck and two rooted cuttings, variety Iceberg, approximately 5 inches tall were planted in each pot on Oct. 6, 1956. The cuttings took hold well and on Oct. 17th, the following treatments were applied as lanolin pastes (1).

(1) The gibberellic acid used here was supplied by Merck, Sharp and Dohme Research Laboratories and is a mixture of gibberellic acid and gibberellin A.

1. Check no treatment
2. 0.1% gibberellic acid
3. 0.5% gibberellic acid
4. 0.1% gibberellic acid
5. No gibberellic acid but additional light.

The additional light for #5 treatment was supplied by a 150 watt Westinghouse flood bulb placed six feet above the pots to be treated. Extra light of 3 hours daily was provided from Oct. 17 to Nov. 19.

All treatments were replicated 4 times and uniform fertilization at rate of 47 grams of 4-8-8 fertilizer was applied before planting. Additional side dressings of 0.4 gram per pot of a 16-16-16 soluble fertilizer containing secondaries was made each week by applying it with about 250 ml. of water.

Measurements of stem length were made on Nov. 15th and then again on Dec. 24. On the latter date, the plants in the first four treatments were in full bloom and these plants were harvested and weighed. Since extra light had delayed the flowering of plants in #5 treatment, harvest of this treatment was not made until Jan. 11, 1957. Measurements of length and weight are given in Table I.

The results show a marked increase due to application of lanolin pastes of gibberellic acid – the increase being proportional to the concentration. From observation, the increase

Table I
HEIGHT AND WEIGHT OF CHRYSANTHEMUMS AS AFFECTED BY GIBBERELLIC ACID AND LIGHT*

Treatment No.	Gibberellic acid	Extra light	Height Nov.15'56	Dec.24'56	Weight**
			cm	cm.	gms.
1	0	none	27.5	31.3	155
2	0.1%	none	29.0	33.3	167
3	0.5%	none	36.6	39.5	149
4	1.0%	none	40.0	41.0	155
5	0	Oct.17-Nov.19	39.0	45.2	401*

* Average of four replicates
** Treatments 1-4 harvested Dec. 24; #5 on Jan. 11,1957.

in height was very marked soon after pastes were applied but seemed to lessen with time. This is also borne out somewhat by the data. In all cases but one, there were greater differences in height between treatments on Nov. 15 as compared to Dec. 24.

On Nov. 15th the height of plants receiving the 1% concentration was actually greater than plants receiving extra light. However, by Dec. 24th, the plants receiving extra light had become appreciably taller than the tallest plants receiving gibberellic acid. In addition, the plants receiving extra light were more vigorous.

Gibberellic acid did not influence the weight of treated chrysanthemums to any marked extent. The increase in height of gibberellic acid treated plants was evidently at expense of thickness of stems and such plants did appear somewhat spindly.

Summary and Conclusions

From these preliminary results it is possible to conclude that gibberellic acid can markedly increase stem length of chrysanthemums. The effect of such treatment seems to lessen as time goes on. In this experiment, even the plants giving most response due to gibberellic acid were far inferior to plants receiving additional light. Therefore, it is not practical to substitute gibberellic acid treatments for use of artificial light with present knowledge. However, it might be worthwhile to determine whether gibberellic acid treatments can be combined with additional light to provide larger plants or to reduce the amount of light provided.

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1. Gibberellins—Data sheet, 1956 Merck, Sharp and Dohme Research Laboratories.
2. Mitchell, John W. Private communication.

SANSEVIERIA FOR ORNAMENTAL USE[1]

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Certain species of *Sansevieria* Thunb. have long been grown for fiber and ornamental purposes. This genus, which contains more than sixty species (1, 3), is native to Africa and coastal areas of Arabia, India, and Ceylon (4).

Sansevieria fiber is produced commercially in the western hemisphere in the Yucatan peninsula of Mexico (8). In many parts of the world leaves from wild stands and dooryard plantings are collected by native people for the fiber to be used for making bowstrings, fish nets, baskets, coarse fabrics and other articles (4).

Some sansevierias are widely grown as indoor ornamentals in the United States. They are particularly important as ornamentals in south Florida because they can be used outdoors as well as indoors. At the present time, only a few standard types are grown extensively on a commercial basis. The potential for ornamental use is theoretically great, because little emphasis has been placed on breeding and selection, and on the utilization of the wide variation among species.

A research program for the improvement of sansevieria for fiber production has been carried out since 1943 by the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture in cooperation with the University of Florida, Agricultural Experiment Stations. This work has been supported by defense agencies because of a possible future need for a domestic source of hard (cordage) fibers. Sansevieria is one of the few hard fibers adapted to large-scale mechanical production (6).

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[1]/The research work on which this report is based was conducted cooperatively by the Crops Research Division and the Agricultural Engineering Research Division, ARS, U. S. Department of Agriculture and the University of Florida Agricultural Experiment Stations, Everglades Experiment Station.

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