Fertilization of Potted Chrysanthemums with Urea-Formaldehyde Materials

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The potted plant grower has a continuous problem of maintaining an adequate and uniform nitrogen supply during the growing period. Because of the limited amount of soil used for potted plants, soluble nitrogen is easily leached by the large quantities of water required for their production. Recently, the value of fertilizers containing urea-formaldehyde as a source of slowly available synthetic organic nitrogen has been demonstrated for a variety of potted plants (1) (3) (4).

For producing potted chrysanthemums, a standard recommendation is to apply a complete liquid fertilizer every week once the plants are well established (2). In the experimental work on potted chrysanthemums at the Waltham Field Station, a satisfactory fertilizer application is one pound of ammonium nitrate and one pound potassium nitrate per 100 gallons of water. This solution is applied weekly during the summer months and every two weeks during the winter months. The calcium and phosphorus requirements are met by adding superphosphate and ground limestone at the time the soil is prepared for potting.

This standard fertilizer application does not require additional labor for it takes the place of one watering. It is, however, an additional detail that the grower must remember to do because omitting this regular fertilizer application will reduce the quality of the crop. There also is no assurance that a uniform nitrogen supply is available to the plants between application of nitrates.

Experimental Methods

Five rooted cuttings of the variety Bonnaffon Deluxe, supplied through the courtesy of Yoder Brothers, Incorporated, Barberton, Ohio, were potted directly into 6-inch standard clay pots. The plants were lighted for five hours during the middle of the night, soft pinched one week later, and placed under natural short day conditions two weeks after potting. The minimum night temperature was 60-62°F. Experiments were begun December 28, 1955 and January 20, 1956 and completed approximately three months after planting.

Three parts of soil previously, used for carnations and medium low in nitrates (Morgan test) were mixed with one part of sphagnum peat moss. Superphosphate and ground limestone were added to the above soil mixture at the rate of 2 ounces per bushel (5 lbs. per 100 sq. ft.). Except where sterilized and unsterilized soils were compared, the soil mixture was steam sterilized the day before potting.

Two commercial compounds containing urea-formaldehyde nitrogen were used in these experiments: a 38-0-0 fertilizer (Uramite) with essentially all of the nitrogen in the urea-formaldehyde form and a 6-10-4 fertilizer mixture (Golden Vigoro) with 80 per cent of the nitrogen

as urea-formaldehyde. When the 38-0-0 and 6-10-4 fertilizers were compared in these experiments, rates of application were adjusted to supply equivalent amounts of nitrogen.

These urea-formaldehyde fertilizers were mixed thoroughly with the soil after steam sterilization. Severe injury to plants will occur if these fertilizers are added to the soil and then steamed (5).

The standard nitrogen-potassium treatment with which these urea-formaldehyde materials were compared consisted of one pound of ammonium nitrate and one pound of potassium nitrate per 100 gallons of water applied every two weeks. Plants treated with the 38-0-0 compound were supplemented with potassium by applying muriate of potash at the rate of 12 ounces per 100 gallons of water every two weeks.

Results

The release of nitrogen from the urea-formaldehyde fertilizers is dependent upon the activity of soil microorganisms. As soil sterilization decreases the number of nitrifying bacteria present in the soil, it is important to know the effect of this essential cultural practice on the availability of nitrogen from these urea-formaldehyde fertilizers.

When mixed with sterilized soil, the release of nitrogen from the 38-0-0 urea-formaldehyde fertilizer was not affected as indicated by plant growth. In sterilized and unsterilized soil, growth of potted chrysanthemums fertilized with a single 6 gram application of the 38-0-0 compound was slightly poorer than growth of plants maintained with the standard nitrogen-potassium solution (Table 1 and Figure 1). Plants were significantly better when the 6 gram rate of 38-0-0 was supplemented with the standard nitrogen-potassium solution.

As listed in Table 1, the light green foliage color of the plants fertilized with the single 6 gram application of 38-0-0 indicated that sufficient nitrogen was not available at the time of flowering. A higher rate of application corrected this deficiency as demonstrated in later experiments. The soil used in this trial was low in reserve nitrogen and growth was drastically reduced unless nitrogen was added either as urea-formaldehyde or in the standard nitrogen-potassium solution.

In a second experiment (Table 2), sufficient nitrogen was available to maintain deep green foliage color at the 12 gram rate of 38-0-0 and at the 37.5 and 75 gram rates of the 6-10-4 fertilizers. (The 12 gram rate of 38-0-0 and the 75 gram rate of 6-10-4 are equivalent in nitrogen). Growth, as measured by plant weight, was increased at the higher rates of application of the 38-0-0 and 6-10-4 fertilizers. Plant height, however, was decreased slightly at the highest rates of application.

Foliage color was light to medium green at the 3 and 6 gram rates of 38-0-0 and at the 18.75 gram rate of 6-10-4. Plants of the highest quality were produced at the 37-5 and the 75 gram rates of 6-10-4. In this trial also, the soil was low in reserve nitrogen; plant growth was reduced and symptoms of severe nitrogen deficiency were observed when nitrogen was not added.

To test the availability of nitrogen from the urea-formaldehyde fertilizers with an artificial growing medium, potted chrysanthemums were grown in a mixture of peat moss and perlite (see MFGA Bulletin #32). Except at the lowest rate of application, sufficient nitrogen was available from the urea-formaldehyde compounds to produce growth in peat and perlite comparable to that obtained with the standard nitrogen-potassium solution (Tables 3 and 4). To produce plants of the highest quality in this medium, it was necessary to supplement the urea-formaldehyde compounds with bi-weekly applications of the nitrogen-potassium solution. The data show a decrease in height and weight when the 12 gram rate of 38-0-0 and the 75 gram rate of 6-10-4 were supplemented with the bi-weekly nitrogen-potassium applications. However, the quality of the plants in these later treatments was excellent.

In the peat and perlite, deep green foliage color occurred at the highest application rates of the urea-formaldehyde fertilizers or when lower rates were supplemented with the standard nitrogen-potassium solution. Otherwise, foliage color at the time of flowering was light to medium green indicating a deficiency of nitrogen.

Discussion

Under the conditions of these experiments, the availability of nitrogen from urea-formaldehyde compounds was not affected when added to a steam sterilized soil or when a peat and perlite mixture was used as a growing medium. At equivalent rates of nitrogen, better plants were produced with the complete 6-10-4 fertilizer when compared with the 38-0-0 compound supplemented with muriate of potash at bi-weekly intervals. It was assumed that phosphorus was not a limiting factor in these soils as superphosphate was added prior to potting.

In some soils, it may be necessary to supplement the 38-0-0 compound with potassium. The value of 38-0-0 as a "one shot" source of nitrogen would be decreased if it were necessary to add potassium during the growing period. In a preliminary trial with five varieties of of potted chrysanthemums, mixing muriate of potash with the 38-0-0 at rates equivalent to the potassium contained in the 6-10-4 resulted in extremely high soluble salts and poor growth.

When the urea-formaldehyde fertilizers were mixed with the artificial growing medium, peat and perlite, sufficient nitrogen was available to potted chrysanthemums at the higher rates of application. It would appear that this sterile medium was populated with microorganisms capable of converting the urea-formaldehyde compounds into available nitrogen. In these experiments, the peat and perlite mixture, pots and benches were steam pasteurized; the cuttings were rooted in pasteurized peat and sand by the commercial propagator. Apparently, a buildup of ammonifying and nitrifying bacteria occurs in this artificial medium after planting.

Recommendations for Potted Chrysanthemums Based on these Experiments

1. In SOIL - use 2 teaspoons (37.5 grams) of 6-10-4 per standard 6-inch pot; approximately 1½ lbs. per bushel

to fill 20 pots.

or

use 4 teaspoons (12 grams) of 38-0-0 per standard 6-inch pot; approximately ½ lb. per bushel.

2. In peat and perlite - use 9 teaspoons of 6-10-4 per standard 6-inch pot; approximately 1½ lbs. per bushel.

or

use 2 teaspoons of 38-0-0 per standard 6-inch pot; approximately ¼ lb. per bushel.

Also fertilize every two weeks with 1 lb. ammonium nitrate and 1 lb. potassium nitrate per 100 gallons water.

3. Mix these materials thoroughly with the soil or peat and perlite mixture before potting.

4. In soils low in available potassium, supplement the 38-0-0 compounds with 2 teaspoons of muriate of potash per 6-inch pot.

5. Add superphosphate and ground limestone before potting at the rate of 2-4 ounces per bushel of soil.

REFERENCES

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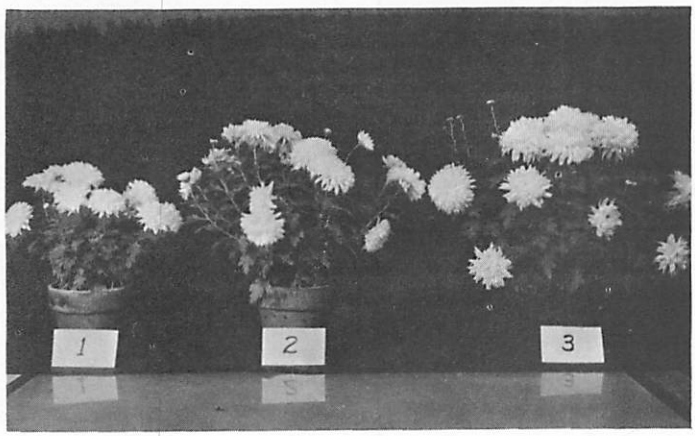

Legend for Figure 1 -

- Growth of potted chrysanthemums fertilized with 38-0-0 urea-formaldehyde fertilizer. (1) Check - no additional nitrogen except that present in soil; (2) 6 grams 38-0-0 mixed with soil at potting; (3) 6 grams 38-0-0 plus bi-weekly applications of ammonium nitrate-potassium nitrate solution.

Fig. 1

TABLE 1. Effect of soil sterilization on the growth of potted chrysanthemums, var. Bonnaffon Deluxe, fertilized with 38-0-0 urea-formaldehyde fertilizer.

Planted 10-28-55 – Flowered 2-14-56

Treatment	Unsterilized soil		Sterilized soil		Foliage color
	Ave. weight per plant ounces	Ave. height per plant inches	Ave. weight per plant ounces	Ave. height per plant inches	
1. Check - no additional nitrogen	–	–	0.98	9.4	yellow
2. Biweekly application ammonium nitrate - Potassium nitrate solution	2.33	13.5	2.45	14.4	medium green
3. 6 grams 38-0-0 urea-formaldehyde	2.04	12.5	2.36	13.6	light green
4. 6 grams 38-0-0 plus biweekly application of ammonium nitrate - potassium nitrate solution	2.64	13.9	2.80	13.4	deep green
L. S. D. 5%	0.32	1.3	0.32	1.3	
1%	0.44	1.7	0.44	1.7	

TABLE 2. Effect of application rates of two sources of urea-formaldehyde fertilizers on growth of potted chrysanthemums, var. Bonnaffon Deluxe.

Planted 1-20-56 – Flowered 4-9-56

Treatment	Ave. weight per plant ounces	Ave. height per plant inches	Ave. number flowers per plant	Foliage color
1. Check - no additional nitrogen*	0.60	10.3	3.5	yellow
2- Biweekly applications ammonium nitrate - p potassium nitrate solution	1.23	13.2	4.1	medium green
3. 3 grams 38-0-0 urea-formaldehyde	1.20	13.4	4.0	light green
4. 6 grams 38-0-0 urea-formaldehyde	1.36	13.6	4.1	medium green
5. 12 grams 38-0-0 urea-formaldehyde	1.41	12.9	3.9	dark green
6. 18.75 grams 6-10-4 urea-formaldehyde	1.20	12.0	4.1	medium green
7. 37.5 grams 6-10-4 urea-formaldehyde	1.69	12.8	4.5	dark green
8. 75 grams 6-10-4 urea-formaldehyde	1.78	11.8	4.6	dark green
L. S. D. 5%	0.22	0.89	0.45	
1%	0.29	1.20	0.61	

*Not included in statistical analysis.

TABLE 3. Effect of the 38-0-0 urea-formaldehyde fertilizer on growth of potted chrysanthemums in peat and perlite. Variety - Bonnaffon Deluxe.

Planted 1-20-56 – Flowered 4-9-56

Treatment	Ave. weight per plant ounces	Ave. height per plant inches	Ave. number flowers per plant	Foliage color
1. Standard bi-weekly applications ammonium nitrate - potassium nitrate solution	1.06	12.9	3.9	medium green
2. 3 grams 38-0-0 urea-formaldehyde	0.72	11.4	3.2	light green
3. 6 grams 38-0-0	0.98	12.6	3.6	medium green
4. 12 grams 38-0-0	1.12	11.5	3.7	medium green
5. 3 grams 38-0-0 plus standard solution	1.23	12.8	4.2	dark green
6. 6 grams 38-0-0 plus standard solution	1.42	13.4	4.2	dark green
7. 12 grams 38-0-0 plus standard solution	1.08	11.1	4.0	dark green
L. S. D. 5%	1.15	0.9	0.5	
1%	0.20	1.2	0.7	

TABLE 4. Effect of 6-10-4 urea-formaldehyde fertilizer on growth of potted chrysanthemums in peat and perlite. Variety - Bonnaffon Deluxe.

Planted 1/20/56 – Flowered 4-9-56

Treatment	Ave. weight per plant ounces	Ave. height per plant inches	Ave. number flowers per plant	Foliage color
1. Standard bi-weekly applications ammonium nitrate - potassium nitrate solution	1.06	12.9	3.9	Medium green
2. 18.75 grams 6-10-4 urea-formaldehyde	0.779	11.6	3.6	light green
3. 37.5 grams 6-10-4	1.01	11.6	4.1	medium green
4. 75 grams 6-10-4	1.29	11.9	4.2	dark green
5. 18.75 grams 6-10-4 plus standard solution	1.29	12.6	4.5	dark green
6. 37.6 grams 6-10-4 plus standard solution	1.50	13.1	4.6	dark green
7. 75 grams 6-10-4 plus standard solution	1.46	11.4	4.3	dark green
L. S. D. 5%	0.27	1.1	0.4	
1%	0.37	1.5	0.6	