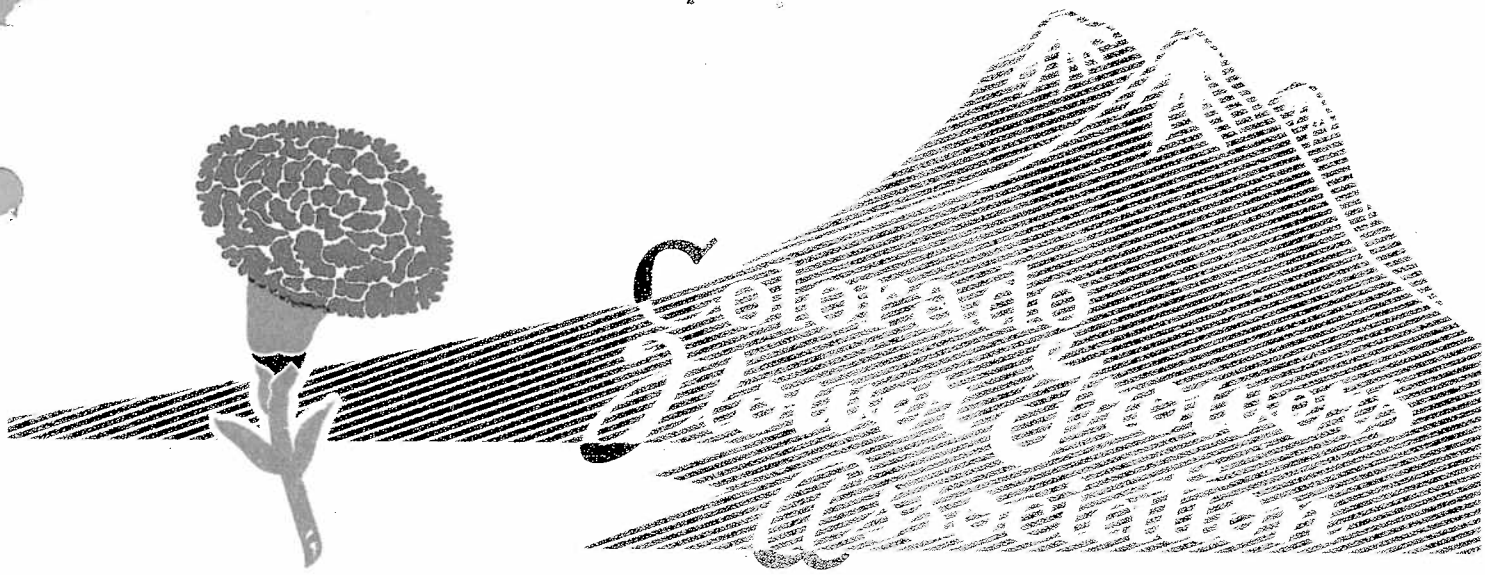

IN COOPERATION WITH COLORADO A AND M COLLEGE

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Bulletin 85 Denver, Colorado December 1956

Further Investigations on the Effects of Nitrogen Sources on Carnation Growth

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A preliminary report on carnation response to various nitrogen fertilizer sources was given in Bulletin 81. Up to that time plants had grown equally well when fed with diammonium phosphate, ammonium nitrate, calcium nitrate, and sodium nitrate. Growth was reduced by ammonium sulphate. Two different urea fertilizers had not been tested adequately.

Further results are now available from plantings made May 21, and August 21, 1956, which enable the separation of the seven nitrogen sources into classes of good, medium, and poor.

Four-gallon glazed crocks of volcanic ash were used as the medium. This material is porous and cinder-like and almost inert chemically. Each planting consisted of 3 crocks with 5 plants per nitrogen source, or a total of 21 crocks.

Previous to planting, treble superphosphate and gypsum were added and the crocks and medium steam sterilized. The plants were fed by a slop culture method a nutrient solution containing 112 ppm nitrogen, 250 ppm potash, 50 ppm magnesium and minor elements in trace quantities. All treatments received the same amount of nitrogen although from 7 different nitrogen carrying fertilizer chemicals.

After the cuttings were established they were pinched. They were watered with the nutrient solutions exclusively throughout their life. The May 21 planting was harvested and weighed on July 25. The August 21 planting was harvested November 17. After fresh weights were taken, plants were wrapped individually, and dried to constant weight in an oven. Table 1 shows the fresh weights, dry weights and the percentages of dry matter from plants grown with the 7 nitrogen fertilizers.

Table 1. The effects of 7 nitrogen sources on mean fresh weight, mean dry weight and percentage of dry matter of Red Sim carnations.

Nitrogen source	Mean fresh weight in grams	Mean dry weight in grams	Percentage of dry matter
Diammonium phosphate	68.2	11.1	16.2
Ammonium nitrate	78.8	13.3	16.9
Ammonium sulphate	45.9	8.6	18.7
Calcium nitrate	72.5	12.8	17.6
Sodium nitrate	75.1	11.6	15.4
Urea 45	60.6	10.4	17.1
Urea USP	66.6	11.5	17.3

Urea 45 = a commercial fertilizer
Urea USP = reagent grade chemical

The nitrates of ammonium, sodium and calcium produced the best plants in appearance and in diameter and strength of stem (Fig. 1). Plants fed with these three nitrogen sources were the highest in mean fresh weight. Ammonium and calcium nitrates also produced the highest mean dry weights.

Fig. 2 illustrates the appearance of plants grown with diammonium phosphate and the two ureas. These plants were weaker and thinner, being intermediate in mean fresh and dry weights.

Plants grown with ammonium sulphate (Fig. 3) were stunted and hardened, which are typical nitrogen hunger signs.

Ammonium sulphate increased the percentage of dry matter by this stunting, while sodium nitrate decreased the percentage of dry matter. The percentages of dry matter in plants grown with the other 5 nitrogen fertilizers were reasonably close together.

The pH of the media from the several treatments following the first harvest varied from 5.7 for ammonium sulphate to 7.0 for sodium nitrate and urea 45. This pH range should not limit carnation growth.

Fig. 1--Typical growth produced by Ammonium nitrate, Sodium nitrate, and Calcium nitrate

Fig. 2--Typical growth produced by Diammonium phosphate, Urea USP, and Urea 45.

Fig. 3--Typical growth produced by Ammonium sulphate.

Discussion and Conclusions

The nitrogen metabolism of plants is a series of complicated processes which are pretty well understood by plant physiologists. Before nitrogen is used inside the plant it is changed to ammonia. However, only minute amounts of ammonia can be detected in healthy plant tissue. On the contrary, large quantities of nitrate nitrogen are present in healthy plants of most species. Urea nitrogen must also be converted to ammonia inside the plant before it can be utilized.

Nitrate nitrogen is taken in readily by carnation plants and is stored in this form for later use. If ammonium nitrogen accumulates in a plant, it depresses nitrogen metabolism and plant growth.

Much of the ammonium or urea nitrogen would be changed to the nitrate form in a soil or medium which has optimum growing conditions for soil microflora. Conditions were not good for microflora in the medium used in this investigation for it was steamed every three months and its organic matter content was low. Our present greenhouse practices seldom favor the growth of soil microflora. With low soil temperatures and frequent sterilization we often have low populations of the bacteria which change nitrites and ammonia to nitrates.

On the basis of these comparisons of nitrogen fertilizer sources, it seems safe to assume that at least half the nitrogen supplied carnations should be in the nitrate (NO_3) form.