Colorado Flower Growers Association

IN COOPERATION WITH COLORADO A & M COLLEGE

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Some Effects of Additions of Clay and Peat to Carnation Soils

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Greenhouse operators have learned by experience that sandy or light textured soils cause fewer problems in carnation production than finer-textured soils. Gomness found in a survey of the soil types used in 40 Colorado carnation ranges (C.F.G.A.Bul. 36) that 55 per cent had a clay content of less than 10 per cent and that 18 per cent of the ranges surveyed had a clay content of 5 per cent or less.

When fertilizer is applied to extremely sandy soils, growers are confronted with the possibility of root injury. Such soils have a low base exchange capacity and will tolerate less soluble salts. Rapid drainage which causes excessive leaching loss of the fertilizer elements is also a problem in these soils.

The incorporation of small amounts of clay or peat or both to extremely sandy soils should raise their colloidal content and improve their base exchange capacity, water and nutrient holding capacities and possibly other physical and chemical characters.

To obtain information on the value of additions of clay and organic matter to sandy soils, the following experiment was designed. The clay used in every case was a relatively pure calcium saturated bentonite which occurs in natural deposits along the foothills of Northern Colorado. The peat used was well decomposed sedge peat containing approximately 40 per cent organic matter. This decomposed peat came from near Leadville, Colorado, and was used in an attempt to get quicker response from the organic matter.

Preliminary Studies

Clay additions of 0, 10, 20, 30 and 50 per cent by weight were made to a sandy loam soil, which had an initial clay content of 15 per cent. In addition one medium used was 100 per cent clay. Ten per cent peat by weight was added to one-half of the mixtures; the other half received no additional organic matter. All of the mixtures were placed in 6-inch pots, steam pasteurized and one rooted carnation cutting planted in each pot. Each treatment consisted of 12 pots. After 4 months of growth the plants were harvested and weighed to obtain total growth from each mixture (Table 1).

Table 1. The effect of varying clay contents in a soil on the growth of carnations

Percent clay added	Total weight in grams[a/]	Percent clay added	Total weight in grams[a/]
0	548.6	30	548.7
10	544.9	50	522.4
20	507.5	100	456.3

a/ Total weight is the oven dry weight of 12 plants in each level.

The addition of clay up to 50 percent of the total weight produced no real differences in growth. The carnations grown in 100 per cent clay, however, showed a definite decrease in growth. There was little variation between the addition of 10 per cent peat and no additional peat. Pots containing 10 per cent peat produced 1532.8 gram, whereas those without peat produced 1501.8 grams.

General Procedures

Two soils were chosen to represent the two major soil types used for carnation production in Colorado. Valentine sand is similar to soils obtained from the prairies east of Denver while a good sample of the sandy loam from the table mountain area near Golden, Colorado represents the "table mountain" used by Colorado growers.

These soils separated into the following components:

	Sand	Silt	Clay	Organic matter
Valentine sand	83.0	11.8	5.2	1.30
Sandy loam	65.5	18.0	16.5	2.85

Using these soils as basic components of each mixture, the following soil, clay, and peat combinations were prepared on the basis of total weight of the mixture. Each combination was thoroughly mixed mechanically and pasteurized with steam.

Percentage Mixtures with Each Soil

Per cent original soil	Per cent clay added	Per cent peat added
100	0	0
95	5	0
95	0	0
90	10	0
90	5	5
90	0	10
85	15	0
85	10	5
85	5	10
80	20	0
80	15	5
80	10	10
75	20	5
75	15	10
70	20	10

Each set of soil mixtures contained 3 levels of added peat, 0, 5 and 10 per cent; and 5 levels of added clay, 0, 5, 10 15 and 20 per cent of the total weight. This added up to 30 different treatments which were replicated 4 times for a total of 120 randomized plots. Six carnation cuttings were planted in each plot on July 1, 1952. Records were kept on the 4 inside plants of White Sim while the 2 outside plants of Wm. Sim served as buffer rows. Dividers were constructed between the plots in such a manner that intermixing of the soil or soil water was at a minimum. Nutrient levels in all mixtures were maintained at near optimum. Each plot was watered when the soil moisture tension reached approximately 3 to 4 inches of mercury.

Four criteria of measurement were established to determine differences between the soil mixtures. These included: 1) the total number of flowers produced, 2) the average weight of flowers, 3) the green weight of the plants remaining at the conclusion of the experiment, and 4) a measurement of the rate of growth in each soil mixture. This latter was established at the number of weeks from planting time required to produce 51 per cent of the total production.

Effects of Peat

The effects of adding peat to both soils are included in Table 2. The addition of 10 per cent peat (approximately 25% by volume) caused a reduction in average weight of flowers and residual green weight when compared to mixtures containing no peat. These differences were great enough to be significant statistically. The addition of 5 per cent peat produced no significant differences over soil with no peat added. The data in Table 2 are averages for 40 plots in each level.

Table 2. Effects of addition of peat to soils on carnation growth.

Percent peat added	No.fls. per plot	Wt.of fls.in grams	Green wt.at conclusion in grams	No.weeks to produce 51% of crop
0	19.48	22.78	932.14	27.13
5	18.85	22.34	942.21	26.90
10	18.45	21.90	863.72	27.02

Additions of peat produced similar results when added to each soil, with the exception of the residual green weight. The addition of 10 per cent peat decreased

growth more from the sandy loam than from Valentine sand. Five per cent peat added to Valentine sand significantly increased the green weight at the conclusion of the experiment, indicating a beneficial effect on second and later crops. The residual green weight from the sandy loam soil decreased with each addition of peat, Table 3.

Table 3. Effect on carnation growth of adding peat to the two soils.

	Percent peat added	Green weight at conclusion of experiment in grams
Valentine sand	0	838.35
	5	920.54
	10	851.99
Sandy loam	0	1025.92
	5	963.89
	10	875.46

Effects of Clay

Additions of various percentages of bentonite clay to the two soils produced little effect on any of the growth measurements. There was a trend toward a decrease in residual green weight and a consequent retarding of the second crop when 15 or 20 per cent clay was added, but this difference was not large enough to be significant. This trend was not obtained in the other three measurements. Average growth measurements in 5 clay levels, 24 plots per level, are shown in Table 4.

Table 4. Effects of addition of clay to soils on carnation growth.

% clay added	No.fls. per plot	Wt.of fls.in grams	Green wt. at conclusion in grams	No.weeks to produce 51% of crop
0	19.96	22.18	932.54	26.79
5	17.75	22.20	919.38	26.91
10	19.17	22.31	951.78	26.71
15	18.50	22.64	892.44	27.33
20	19.25	22.37	867.32	27.33

Additions of clay gave similar results on each soil individually, with the exception of rate of growth. The addition of either 15 or 20 per cent clay delayed production on Valentine sand, while the same addition of clay had little effect on sandy loam.

Effects of Interaction Between Peat and Clay Levels

Peat produced the greatest differences in both residual green weight and speed of growth when no clay was added. Likewise clay produced the greatest differences in those measurements when no peat was added. Tables 5 and 6 present these data. The addition of peat tended to counteract effects from clay levels and clay additions offset effects from peat levels. The interaction between peat and clay had little effect on the number or weight of flowers.

Table 5. Effects of additions of clay on carnation growth when no peat was added.

Percent clay added	Residual green wt. in grams	No. weeks to produce 51% of crop
0	1076.20	26.00
5	926.68	27.00
10	952.15	27.40
15	835.96	27.10
20	869.70	28.10

Table 6. Effects of additions of peat on carnation growth when no clay was added.

Percent peat added	Residual green wt. in grams	No. weeks to produce 51% of crop
0	1076.20	26.00
5	934.83	26.70
10	786.60	27.60

A Comparison of the Two Soils

The sandy loam ("table mountain") soil proved significantly more productive than the Valentine sand. It produced more flowers, more residual green weight and the rate of growth in sandy loam was significantly faster. Only the average weight per bloom was not affected by the soil type used. Average results from the two soils are presented in Table 7. There were 60 plots of each soil.

Table 7. Effects of two soil types on carnation growth.

	No.fls. per plot	Wt.of fls.in grams	Residual green wt. in grams.	No.weeks to produce 51% of crop
Valentine sand	18.33	22.50	870.29	27.35
Sandy loam	19.52	22.18	955.09	26.68
Difference required to be significant with odds of 19 to 1	1.12	N.S.	58.20	0.47

Summary

The colloidal content of extremely sandy or porous soils can be raised by additions of peat or clay without detriment to the growth of carnations and with possible long time benefits. Contrary to the general idea and to results published previously (Colo.Flow.Gro.Bul.32), no increase in growth or production was obtained by additions of 5 or 10 per cent sedge peat. Additions of peat did not produce the same results on both soils. When peat was added, Valentine sand (the lighter textured soil) produced more green weight at the conclusion of the experiment, which indicates faster or larger second and later crops. On the sandy loam ("table mountain") soil, the trend was toward a reduction in residual green weight from additions of either 5 or 10 per cent peat by weight.

The addition of 10 per cent peat (approximately 25 per cent by volume) caused a significant decrease in weight of flowers from both soils.

These results indicate that 10 to 12 per cent peat by volume is near the upper limit which we should add at one time. Probably less than this amount would be adequate.

When various percentages of bentonite clay were added to the two soils, little effects on growth measurements were found. Benefits derived from increasing the colloidal content of a soil would be more in the nature of long term responses such as less rapid leaching of nutrient elements and a greater base exchange capacity of the soil. Probably 5 to 10 per cent (by weight) of clay is adequate to accomplish these ends.

The rate at which water would percolate through each soil was reduced by additions of either peat or clay.

The addition of clay increased the number of irrigations, while the addition of peat caused a decrease in irrigations required during the experiment. This change in frequency of irrigation should be considered when a soil is altered by either peat or clay. If you water by the feel or appearance of the soil rather than by tensiometer, you may be easily misled.

Your editor,

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