given only untreated food, were released in the cage. Each cage contained from 15 to 20 females. Different ratios of sterilized or normal males were used to establish the desired competitive ratio. Four groups of tests were made; each group included a cage containing only normal males to provide information on the normal oviposition and hatching rates, and several cages containing various ratios of chemosterilized males to normal males. A cage that contained only chemosterilized males demonstrated the adequacy of the treatment.

Oviposition medium in the form of aged larval rearing medium was made available to the females for 4 hours once a week for 3 weeks. The moist medium was wrapped in black cotton cloth and partially encased in a 9-dram pharmaceutical vial, then placed in an 8-oz drinking glass. Twenty glasses were placed in each cage; the cages were kept under close observation, and whenever a female entered a glass the glass was immediately covered with a Petri dish so that the egg clusters of individual females could be examined separately. Occasionally two females entered the glass and were trapped at the same time. Two hours later the females were released into the cage and the containers of medium on which egg masses had been laid were moistened and held for 48 hours. After this interval the number of eggs and the percent hatch in each mass were determined. The effect of the sterile males in the population on the fertility of the females was judged by two criteria: (i) the percent sterility among all the eggs laid by all females in the cage and, (ii) the number of individual females that laid egg masses containing an abnormal proportion of sterile eggs (more than 20 percent, based on 12-percent sterility among normal eggs). The results are given in Table 1, series 1.

The average sterility among eggs laid by normal males and females was 12 percent, and 15 percent of the individual egg masses contained more than 20 percent sterile eggs. When chemosterilized males, normal males, and normal females were present at various ratios from 1:1:1 to 10:1:1, the proportion of sterile eggs exceeded that expected from the proportion of chemosterilized males present, as indicated by the following comparison of the induced sterility (actual sterility adjusted by Abbott's formula to compensate for 12-percent sterility occurring in the checks) and the expected sterility (in parentheses): 1:1:1, 61 (50); 1:1:2, 64 (50); 2:1:1, 91 (67); 3:1:1, 97 (75); 5:1:1, 100 (83); and 10:1:1, 100 (91).

The same trend was exhibited by the percentage of egg masses in each group containing more than 20 percent sterile eggs.

Additional experiments were made by a slightly different technique. When the flies in the mating cages were 8 to 10 days old, a quart container of larval rearing medium was presented for oviposition. Twenty-four hours later the medium was examined for eggs. If the number of eggs appeared normal, as compared with the number from cages containing only normal males, the medium was held for larval and pupal development. The percent sterility was estimated from the number of pupae obtained from normal males and from mixtures of normal and chemosterilized males. The results are given in Table 1, series 2 and 3. In these tests also the percent sterility was as high as, or higher than, that which would be expected from the ratio of chemosterilized males present.

In most of the experiments, the percentage of sterile eggs produced by normal females exposed to both normal and chemosterilized males exceeded the expected level. The only exception was the 46-percent production of pupae in comparison with controls obtained in one of two tests in which the ratio of sterile to fertile insects was 1:1:1 (1 sterile male, 1 normal male, and 1 normal female). In all other tests the level of sterility was in excess of the expectancy level.

It is difficult to explain these results. The chemically sterilized males may be more vigorous sexually than normal males or mating by sterile males may in some way tend to nullify the effects of prior matings by normal males. At any rate, the results are extremely encouraging in that they suggest that chemosterilized males are at least as competitive as normal males in mating with normal females. In order to realize the theoretical advantage in population control over that obtained by killing organisms, it is essential that sterility be produced in the organism without adversely affecting sexual vigor or behavior, as pointed out by Knipling (*2*). If subsequent investigations under field conditions substantiate the greater-than-expected results obtained in the laboratory, the chemosterilant approach to fly control should offer unusual opportunities for success provided practical and safe ways can be developed to achieve sterility in a substantial part of the total population (*7*).

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Petrofabric Study of Deformed Salt

Abstract. Petrofabric examination of salt crystals in Grand Saline salt dome reveals a preferred orientation that may bear significantly on other physical properties and on the genesis of salt domes. The symmetry of the orientation patterns indicates that translation gliding in halite may occur predominantly on cubic glide planes.

A petrofabric study has been made of six oriented salt samples from the Morton Salt Company mine in Grand Saline salt dome, 65 miles east of Dallas, Texas. Previous studies of the internal structure of this dome include the work of Robert Balk (*1*) and more recently that of W. R. Muehlberger (*2*), as the mine works have expanded. The three perpendiculars, or poles, to the cleavage faces of each salt crystal were measured on a specially designed type of reflection goniometer, plotted on Schmidt equal-area nets, and contoured in the conventional manner. The orientation patterns consist of sets of three maxima, 90 degrees apart, representing groups of cubes with nearly the same relative orientation.

Dark, anhydrite-rich bands of salt in the dome strikingly indicate the flow structure, which consists principally of isoclinal folds plunging nearly vertically. The axial planes of these folds represent the planes of motion parallel to which the salt moved during emplacement of the dome. Comparison of the petrofabric patterns to structural features of the dome reveals that the patterns are symmetrical to these axial planes. I conclude that the salt moved by translation gliding, and that the planes of gliding were parallel to the axial planes of the folds.

Examination of the crystal structure of salt shows that a group of cubes, oriented so that a dodecahedral (110) glide plane is parallel to the plane of motion, would produce a petrofabric pattern in which one maximum falls in the plane of motion, and in which the other two maxima, 90 degrees from the first and from each other, are bisected by the plane of motion. Patterns showing this symmetry are evident in some of the diagrams (Fig. 1, D–F), but more distinct are patterns in which two of the maxima fall within the plane of motion, and the third is 90 degrees from it (Fig. 1, *B* and *C*). To produce this type of symmetry a cubic (001) glide plane must lie parallel to the plane of motion, and I propose that in these instances the salt has moved by translation gliding in cubic planes.

One orientation pattern (Fig. 1*A*) shows neither of these symmetries with respect to the axial planes of the folds, but at this locality a planar zone in which there is distinct crystal elongation closely parallels two of the maxima. Elsewhere in the dome crystal elongation zones usually parallel the axial planes of the folds. This is a structurally complex part of the dome, but if the elongation zones here represent the plane of motion, this diagram indicates another case of cubic gliding of the salt. Two of the diagrams (Fig. 1, *D* and *E*), from samples taken nearest the edge of the dome, show mixed patterns of symmetry. The salt in these areas is visibly more sheared and strained than elsewhere in the mine. The two symmetries may represent two separate periods of gliding, but it seems more likely that they indicate simultaneous dodecahedral and cubic gliding on a common glide plane.

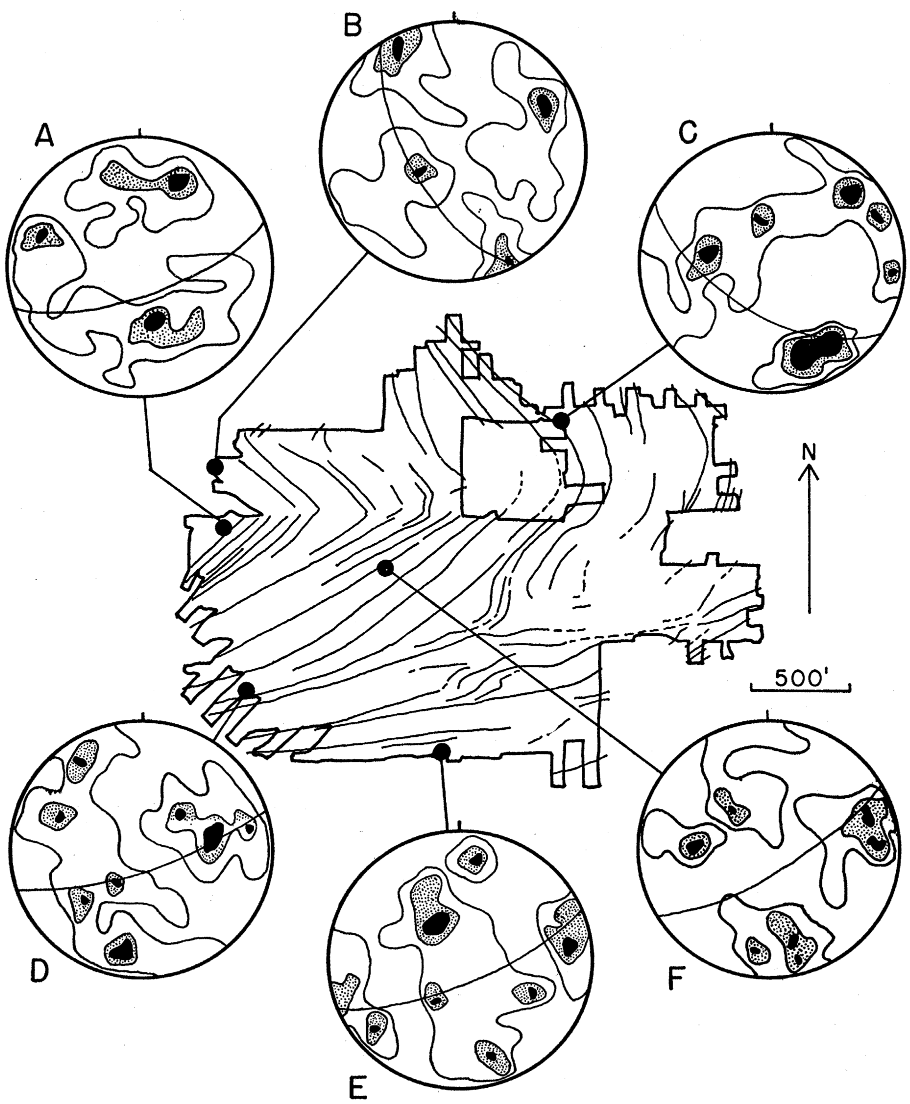

Fig. 1. Generalized petrofabric diagrams of salt samples and (center) outline map of Grand Saline salt dome, showing axial planes of folds. The reference plane in each diagram is the axial plane of fold. Contours show 1 and 2 percent concentrations; solid maxima show concentrations of from 3 to over 5 percent.

The cubic planes in salt are the most widely spaced and densely packed in the crystal lattice, and are therefore logically the planes of easiest slip. Buerger (*3*), in his extensive discussion of halite gliding in 1930, considered both cubic and dodecahedral gliding as of equal importance in the earlier part of his paper. However, he stated in the final part, on the basis of theoretical rather than experimental evidence, that salt glides almost exclusively on dodecahedral planes. This conclusion has been widely quoted ever since. The ease with which salt cleaves in cubic planes may have obscured evidences of cubic gliding in earlier laboratory experiments, but despite a general impression to the contrary, very little work directly concerning glide planes in salt has been done. A great deal of material has been published recently on other physical characteristics and mechanical properties of salt, however, and it is perhaps of serious consequence that some experiments have been specially set up and interpreted mathematically on the assumption that salt glides only on dodecahedral planes.

In addition to supplying this evidence of translation gliding on cubic planes, this petrofabric study, by establishing gliding as the method of motion of the salt, further corroborates the generally accepted concept of upward plastic intrusion of salt from a buried salt layer. Moreover, the individual differences in exact direction of salt movement (which can be inferred from the patterns) is further evidence in favor of proposals (*4*) that the salt moves, not as one great mass, but differentially in irregular lobes.

Of practical significance, the preferred orientation of the salt crystals indicates that the salt, as a mass, is not truly homogeneous. Where the preferred orientation is well defined and a large number of the crystals have similar orientations, the existence of preferred cubic cleavage plane directions should affect the behavior of the salt as a mass. Thus the degree and the directions of the preferred orientations probably influence the directions of blast fracturing and the stability of mine walls and pillars; they may directionally affect the crushing strength of the salt (*5*).

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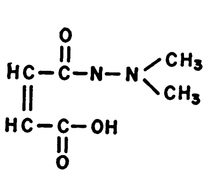
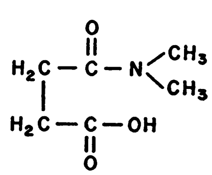
Retardation of Plant Growth by a New Group of Chemicals

Abstract. Sprays of N-dimethylaminomaleamic acid were found to retard the growth of a variety of plants, including legumes, vine crops, potatoes, and ornamentals. It was readily translocated, had a long residual action, was relatively nonphytotoxic, and did not appear to affect adversely root, vegetative, or reproductive development.

N-dimethylaminomaleamic acid (C011) and succinamic acid (B995) retarded the growth of a variety of plants (Table 1) when applied as a spray to the foliage. Their structures are





C011 B995

No activity was noted in the analogous compound derived from phthalic acid. However, chemicals made from tetra- and hexahydrophthalic acids have exhibited a moderate degree of growth regulation. The imides of C011 and B995 were also active but to a lesser degree than the acids.

These chemicals decrease internode growth in a manner similar to the quaternary salts Amo 1618 (*1*), Phosfon (*2*) and "CCC" (*3*). This report describes the biological activity of only one compound, C011.

The free acid of C011 is completely water-soluble at 200,000 ppm (20 percent). Metal and alkanolamine salts are readily formed. The salts also function as growth-retarding chemicals. In the tests described below the free compound was used exclusively.

In foliage spray tests under greenhouse conditions, solutions were made by dissolving C011 in water and adding one drop of Triton X100, a nonionic emulsifier. Seedling plants were sprayed to runoff at a rate of 5000 ppm. Data on height reduction compared to untreated control plants are shown in Table 1. The measurements were taken 1 month (pinto bean, soybean) or 3 months (all other test plants) after chemical treatment. No phytotoxicity effects were noted.

C011 was readily translocated from the primary leaves of pinto bean plants to the growing point when the first trifoliate leaf was beginning to expand. In this experiment only the primary leaves were sprayed to runoff with a 1000-ppm solution of C011. One month later (Fig. 1) when the fourth trifoliate leaf was fully expanded, the average internode length for the treated plants was 1 inch, compared to 2½ inches for the untreated check.

In the field C011 was sprayed on Green Mountain potato foliage at a rate of 8 lb in 40 gal of water per acre. The chemical was applied 20 days after planting. At this time no tuber initials were formed. At harvest the treated foliage was 48 percent shorter than that of the control plants. Tubers were dug,

Table 1. Effect of N-dimethylaminomaleamic acid (C011) on the height of various plants. Seedling plants were sprayed to runoff at a rate of 5000 ppm.

Plant	Reduction in height compared to untreated controls (%)
Alfalfa: *Medicago sativa* (L.)	33
Apple Seedlings: *Malus sylvestris* (Mill.) (McIntosh)	47
Broccoli: *Brassica oleracea* (L.) var. *Italica* (Calabrese)	66
Cosmos: *Cosmos* sp. (Sensation)	53
Marigold: *Tagetes erecta* (L.) (Man-in-the Moon)	52
Morning Glory: *Ipomea purpurea* (Lem.) (Heavenly Blue)	46
Peanuts: *Arachis hypogea* (L.) (Virginia Runner)	50
Petunia: *Petunia hydrida* (Vilm.) (many varieties)	29
Pinto bean: *Phaseolus vulgaris* (L.)	60
Poinsettia: *Euphorbia pulcherrima* Willd.) (Barbara Ecke Supreme)	34
Scabiosa: *Scabiosa pratensis* (Moench.) (Mourning Bride)	50
Soybeans: *Glycine hispida* (Max.) (Harasoy)	36
Squash: *Cucurbita pepo* (L.) (Table Queen)	80
Zinnia: *Zinnia elegans* (Jacq.) (many varieties)	47

Fig. 1. Unsprayed (left) and sprayed (right) pinto bean plants. The spray of C011 was applied to the primary leaves at a rate of 1000 ppm. The leaves of one plant in each treatment were removed to show more clearly the reduced internode length of the C011 treated plants.

stored at 45°F for 5 months, and planted in peat moss. All tubers sprouted within 7 days. One month later the sprouts from tubers harvested from treated plants averaged 8 inches in height, compared to 16 inches for those from untreated plants. All sprouts had approximately the same number of nodes—13.

Numerous observations and some quantitative comparisons on such plants as pinto beans, peanuts, and squash showed that root growth and rate of vegetative development were not altered by the use of C011. Anthesis was sometimes delayed by 1 or 2 days but total flower number was not affected. Plot size and number of replications were not adequate to make exact yield comparisons. However, in the harvesting of many small plots of potatoes, squash, and Tendergreen beans no obvious differences in number or size of tubers, fruit, or seed were noted.

In conclusion, N-dimethylaminomaleamic acid and certain related chemicals appear to be an interesting new group of growth-retarding chemicals. N-dimethylaminomaleamic acid is effective as a spray, it is readily translocated, and it appears to have a long residual action in the plant. This type of growth regulation is particularly interesting because plant height is reduced while rate of development is not affected.

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