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CALCIUM AS A FACTOR IN SEED GERMINATION[1]

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THAT the soil should be a factor in determining the percentage germination of seeds may seem an overemphasis of the soil's service in plant growth. When the ash content of a plant is approximately only 5% or, as a maximum, 10%, then this is a relatively small contribution by the soil. But when growth as a synthesis of carbon-dioxide and water into compounds by means of sunshine energy will occur only after the soil has made its seemingly small contribution, this diminutive offering mounts in its importance. Since the major part of the nutrients from the soil enter the plant in the early phases of its life history, it seemed logical to determine whether variation in soil fertility, particularly of calcium, might not register its effects so early in plant life as even to influence the percentage germination of the seeds of a crop like the tomato, for example, which is not commonly considered a calcophile.

PLAN OF EXPERIMENT

The tomato seeds were planted in ordinary greenhouse flats at increasing rates, starting with 14 seeds per row, or a spacing of 1 inch between the seeds, and increasing to 5, 10, 15, and 20 times this number per consecutive row. The rows and the rates were duplicated in the second half of the flat. The soil treatments used consisted of (a) none, (b) calcium chloride, (c) complete fertilizer, and (d) calcium chloride plus complete fertilizer. These treatments were duplicated by duplicate flats.

Three trials, each with a growth period of approximately 4 weeks, were carried out in February, March, and May, respectively. The soil treatments were mixed as chemicals and ground with fine quartz sand so as to provide sufficient bulk for uniform distribution by hand in the bottom of the rill. Water was sprinkled on the applied fertilizer, the flats were covered, and 3 or 4 days allowed before the respective seed numbers previously counted out were planted and covered. Observations of the early plant appearances were made and the growth with possible disease incidence studied. After 27 to 29 days the counts were made of the plants per row.

RESULTS

When the number of plants produced (Table 1) is considered in relation to the number of seeds planted, regardless of soil treatments, a decreasing germination with increased rate of seeding is clearly demonstrated. These data represent a combination of all the soil treatments with 12 cases in each growing period and 36 cases in the mean. The mean is expressed for the plants as percentage of the seeds planted and also as percentage, assuming the plants in the lowest

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seeding rate as representative of the viable seeds of the lot. The large decrease in number of emerging plants with the increased rate of seeding was observed in the counts of the individual rows as well as in the summation of the data.

TABLE 1.—*Plants produced and percentage germination represented thereby with increased rate of seeding.*

Seeds planted per row	February		March		May		Mean	
	Plants	%	Plants	%	Plants	%	% of seeds planted	%
14	6.6	47	7.7	55	9.3	66	56	100
70	21.3	30	22.5	32	41.6	59	40	70
140	21.0	15	30.5	21	69.1	49	28	48
210	13.7	6	34.7	16	89.6	42	21	35
280	21.7	7	40.8	14	93.8	33	16	30

These observations raise the question as to the soil condition responsible for the decrease in germination, when careful attention was given to such items as provision of ample moisture, as covering the planted flats with a thin surface layer of quartz sand, and other means of providing optimum conditions for germination. There is an improved germination with the advance in the season, but all three trials suggest that there is some soil factor which may be sufficient for the limited seed numbers but becomes insufficient for their increasing numbers.

That some soil factor, such as a nutrient element, is responsible herein is suggested when the same data are assembled to show the variable germination in relation to the different soil treatments, as presented in Table 2.

TABLE 2.—*Percentage germination as influenced by soil treatments.*

Seeds planted per row	No treatment		Calcium only		Complete fertilizer		Calcium and fertilizer	
	Plants	%	Plants	%	Plants	%	Plants	%
14	7.6	54	9.3	66	6.8	48	8.0	57
70	27.9	39	36.5	52	20.8	29	29.1	41
140	35.6	25	51.6	36	28.6	20	45.1	32
210	40.3	19	64.5	30	32.1	15	50.0	23
280	48.1	17	66.7	23	32.6	11	57.1	20

It is significant that the complete fertilizer applied and watered well into the soil for 3 days in advance of the seeding should give the lowest germination of all the trials. This fertilizer addition may be credited with an injurious effect, since the numbers fell below those for the soil without treatment. When the calcium, which was a chloride and not in an acid-neutralizing carbonate form, was added along with the fertilizer, it served to offset the injury. It improved

the germination beyond that in the untreated soil. This improvement was relatively greater as the seeding rate was larger. It was most startling, however, to find that the introduction into the soil of calcium chloride alone gave the highest percentage of plants from the seeds planted.

CONCLUSIONS

Such increases suggest a possible significance of calcium in the soil for better seed germination. Its effects can not be ascribed to changes in soil reaction. It must be related to the role of calcium as a nutrient, and gives the calcium of the soil an importance for possible attention in practice in terms of exceedingly small amounts for significant benefits.