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NOTES

MEANING OF THE GREAT GERMAN SOIL FERTILITY SURVEY—A REPLY TO CRITICISM[1]

Recently Willcox[2] in a paper entitled "Meaning of the Great German Soil Fertility Survey" serious attacked the objections that have been raised to the validity of the Mitscherlich effect law and to his concept of "quantitative agrobiology" based on this law.

In the present note I shall confine my comments to these objections, particularly those pertaining to my own paper.[3]

In that paper, I took exception to the conclusion of Mitscherlich[4] and Gericke[5] that the apparently small error of A would prove the validity of the Mitscherlich effect law. It was shown that this error is not small, in view of the large number of experiments. In individual cases we find abnormally high errors. Obviously, either the equation is invalid or in individual cases the value of c varies far more than would be attributable to normal experimental errors. It must be emphasized that the influence of "second-order magnitudes" is so large that similar results (same average c value) cannot be expected with certainty under different conditions of soil or climate or in different years.

It is not quite true that I would propose other values of c than the value 0.6 accepted by Mitscherlich and Willcox. The deviating values of c given by me have been computed from the experimental data showing best agreement with the calculated mean curve. I do not maintain that these values of c for different crops will also hold good under other conditions than the German ones, for example, in the United States.

That these values of c give the best approximation of the experimental facts was proved in my paper by means of an exact method of computation. Thus, it seems rather superfluous to prove this again. But as Willcox has given a calculation which seems to disprove my result, it is necessary to show that he is wrong.

Willcox makes a serious error in using the same value of $b = 1.32$ in the three equations with different values of c. If a different value of c is taken, then the values of A and b are also different.

For different values of c I have found the following for potatoes:

$$\text{For } c = 0.4: A = 293.8 \text{ and } b = 1.78;$$
$$\text{For } c = 0.6: A = 282.5 \text{ and } b = 1.22.$$

[1] From the Agricultural Experiment Station and Institute for Soil Research T. N. O., Groningen, Netherlands. Received for publication May 20, 1955.

[2] Willcox, O. W. Meaning of the great German soil fertility survey. *Soil Sci.* 79: 123–132, 1955.

[3] Paauw, F. van der. Critical remarks concerning the validity of the Mitscherlich effect law. *Plant and Soil* 4: 97–106, 1952.

[4] Mitscherlich, E. A. Das Ergebnis von über 27,000 Feld-Düngungsversuchen *Z. Pflanzenernähr. Düng. Bodenk.* 38: 22–35, 1947.

[5] Gericke, S. Untersuchungen über das Ertragsgesetz: I, II, III. *Z. Pflanzenernähr. Düng. Bodenk.* 38: 54–65, 215–229; 39: 245–258, 1947.

The slight difference between the value for $b = 1.32$, found by Willcox, and my value of $b = 1.22$ if $c = 0.6$ is probably due to a difference in the method of calculation.

Based on these values, the following values of y have been calculated by applying the equation

$$y = A[1 - 10^{-c(x+b)}]:$$

Found Yield	$c = 0.4$		$c = 0.6$ (according to Willcox)	
	Calculated yield	Difference	Calculated yield	Difference
237	236.8	0.2	236.8	0.2
251	250.6	0.4	252.3	1.3
261	261.0	0.0	262.6	1.6
269	268.9	0.1	268.9	0.1
275	274.9	0.1	273.8	1.2
Mean difference.....		0.16	Mean difference...	0.88

This proves that the best-fitting value of $c = 0.4$ gives a much better result than the dogmatically accepted value of $c = 0.6$.

The agreement between the empirical data and calculated yields is satisfactory for potatoes if the value of $c = 0.4$ is accepted. This, however, is an exceptional case.[6]

It must be concluded, therefore, that the "science of quantitative agrobiology" is founded on principles that are not in agreement with the experimental data.

In my opinion this is no disaster. The increase of food production in the world will not depend on the exactness of an equation. Agronomical research is not served by cherishing illusions.

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[6] Paauw, F. van der. *Ibid.*