by adding the necessary quantities of 0.1 N acid or base to normal Ringer's solution; those for the modified Locke's solution used with the guinea pig atrium, by adjusting the ration of acid phosphate to basic phosphate.

The rate of beat of the frog sinus venosus is not significantly affected when the pH is varied over a wide range. This is true whether highly dissociated acids or bases are present (Table 1) or whether weakly dissociated acids or bases are present (Table 2). Outside of a certain pH range, the sinus venosus usually stopped beating during the period of 1 hour in which it was in these solutions. The rate of beat

TABLE 2

RELATIVE HEART RATE VALUES OF THE FROG SINUS VENOSUS AT DIFFERENT pH'S*

pH				
6.2	6.7	7.2	7.7	8.2
1.00	0.94	0.97	1.00	1.03
1.00	1.05	0.95	1.00	1.05

* Each value represents a determination on one heart. The pH was adjusted with 0.1 N CH_3COOH or NH_4OH. 8 hearts were used in the experiments.

of the guinea pig heart was not significantly affected by the pH in the region studied.

TABLE 3

RELATIVE HEART RATE VALUES OF THE GUINEA PIG RIGHT-ATRIUM AT DIFFERENT pH'S*

pH					
7.03	7.30	7.38	7.52	7.60	7.65
1.01	0.95	1.04	1.00	1.08	1.04
–	0.89	0.99	1.00	–	1.05

* Each value represents a determination on one heart. The proper pH's were obtained by adjusting the ratio of acid to basic phosphate. 4 hearts were used in the experiments. – indicates no experiment was made.

SUMMARY

The rate of the frog or guinea pig heart preparation was not significantly influenced by the H-ion concentration when this was kept within limits which allowed the heart to continue beating. The theory that the H-ion concentration is intimately concerned with the origination of the heart beat is not supported by the results of this investigation.

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SUSCEPTIBILITY TO DISEASE IN RELATION TO PLANT NUTRITION[1]

IF the severity of a plant disease is different under different fertilizer treatments or other environmental conditions affecting plant nutrition, it becomes important to know in what respects nutrition differs under the various conditions and in relation to the severity of the disease. The method of foliar diagnosis[2, 3] as the following example shows, enables the investigator to obtain this information.

In an experiment on greenhouse tomatoes grown on plots of which the cultural conditions, except the fertilizer treatment, were similar, certain plants on some of the plots began to show the characteristic symptoms of streak disease about 80 days after transplantation to the beds. This disease is known to be caused by a virus or a mixture of viruses; the symptoms are light yellow, elongated, irregular areas on young leaflets which later turn brown and die, and elongated brown lesions appearing longitudinally on stems. New growth may appear healthy from time to time during the season, and at other times may show the lesions just described. The latter characteristic serves to differentiate the disease symptoms from those of potash deficiency, in which new, healthy leaves do not develop after lesions appear.

Because the disease was wide-spread on certain plots and entirely absent from others, which were exposed equally to infection, but differed in manurial treatment, an examination was undertaken by the method of foliar diagnosis to compare the course of nutrition of low-yielding plants exhibiting symptoms of streak, grown on a plot fertilized with nitrogen only as commercial sodium nitrate, with that of high-yielding, healthy plants growing on a plot fertilized with rotted manure and complete commercial fertilizer.

In Fig. 1 are shown in trilinear coordinates the equilibrium between the dominant elements for the sixteenth leaf from the base as expressed by the composition of the *NPK-units*, which are derived by converting the percentage values of nitrogen, phosphoric acid and potash to milligram equivalents and finding the proportion which each of these bears to the milligram equivalent total. The samples were taken 85 days after the plants were placed in the beds.

The coordinates are shown for leaves from three types of plants on the plot having diseased plants, namely: plants showing no visible symptoms of disease at the time of sampling (II); plants showing slight symptoms (III); and plants severely diseased (IV). Comparison is made with morphologically homologous leaves from plants on a plot (No. 8L) on which no disease appeared (I). This latter received a complete fertilizer, together with well-rotted horse manure.

The coordinates (II, III and IV) of the leaves from the several types of plants from the plot No. 12L having diseased plants are displaced relative to those

[5] C. R. Spealman, *Proc. Soc. Exp. Biol. and Med.*, 45: 189, 1940.

[1] Authorized for publication as paper No. 978 of the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] Walter Thomas, *Plant Physiology*, 12: 571–600, 1937.

[3] Walter Thomas and Warren B. Mack, *Pa. Agr. Exp. Sta. Bull. No. 378*, pp. 1–33, 1939.

of the plants on plot No. 8L, none of which were diseased (I), further towards the summit apex (N = 100) and away from the right base apex (K_2O = 100), indicating a higher relative proportion of N and a lower proportion of K_2O in the composition of the respective *NPK-units*.

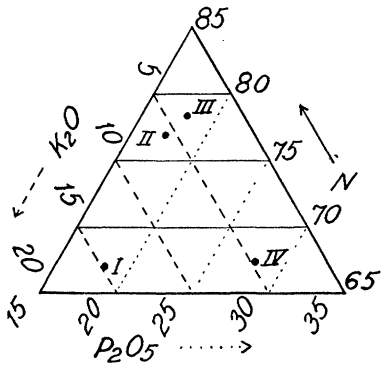

FIG. 1. Relative positions of coordinates of the 16th leaf from plants growing on plot No. 8L on which no disease appeared (I) and of those from plants on plot No. 12L showing no visible symptoms of disease (II), from plants showing slight infection (III), and from badly infected plants (IV). Only a portion of the triangle of which each side is 100 is shown.

The coordinate point (II) of leaves from plants on the diseased plot, which showed no visible symptoms of infection at this time, is displaced, however, further toward the left base apex (K_2O = 100) than that of leaves from the plants on this plot which showed visible manifestations of disease (III and IV).

The intensities of nutrition—the sum of the percentages of N, P_2O_5 and K_2O in the dried foliage—for the plants from the diseased plot were 4.86 (II), 4.43 (III) and 5.65 (IV), and for the healthy plants, 7.90.

The infection by the virus was associated with a type of nutrition having quantitatively a lower intensity with respect to the plastic elements, and qualitatively with a disequilibrium with respect to these elements, characterized predominantly by higher values for N and much lower values for K_2O in the composition of the *NPK-unit* of the susceptible compared with resistant plants.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

HISTOLOGICAL SECTIONING OF HARD TISSUES BY A NEW TECHNIQUE

VARIOUS concretions, bone and other hard or brittle tissues are not easily sectioned on the microtome. Since fluid methacrylates, the basis of "Lucite" and "Plexiglass," can be polymerized to solids *in situ*, it is possible to imbed such tissues in a solid medium firm enough to allow the grinding of very thin sections, using the well-known methods of petrography. We outline below some of the details of such a technique which we have used with good success.

The specimen, which we shall suppose to be about 1 cm on a side, is dehydrated, using the alcohol, acetone or dioxane technique, and is then cleared in xylol. Some care must be taken in the choice of a clearing agent, as some of these are not miscible with methyl methacrylate; while chloroform, for example, may decompose during the ensuing polymerization giving rise to bubbles. With dry substances, of course, these steps may be omitted. The specimen is next immersed in monomeric (unpolymerized) methyl methacrylate, a liquid having a sufficiently low viscosity to allow of complete penetration in twelve hours, using three changes. The monomer, as supplied commercially, contains a trace of hydroquinone in inhibit polymerization; and .05 per cent. benzoyl peroxide should be added to act as a catalyst for polymerization and consequent solidification upon heating. In the case of dry substances reduced pressures may advantageously be used to insure complete penetration of the liquid medium. A test-tube, of about 17 mm diameter, is prepared by polymerizing a 4 cm rod of solid methacrylate in its bottom, this to act as a temporary handle. The impregnated specimen is placed in the test-tube on top of this rod and covered with methacrylate, previously polymerized to the consistency of molasses.

The partial polymer is prepared by heating the catalyzed monomer to 80° C. until thick, about twenty minutes. The use of the partial polymer in this step helps to reduce the overall heat liberated by the reaction, while its presence catalyzes the polymerization of the monomer permeating the tissue. The syrup containing the specimen is now caused to become an integral extension of the solid rod by completing its polymerization in an oven at 40° C. The test-tube should be corked to prevent undue evaporation. This step requires about twenty-four hours, after which the test-tube is cracked away from the rod, which now contains the specimen firmly imbedded near one end. This rod is next cut through the specimen, normal to the rod axis, and the exposed surface, containing the tissue, ground flat and polished. For this grinding process successive grades of emery paper and mild polishing powders suffice.

If serial sections are desired the tissue-containing rod may be cut into wafers, each of which is polished