Water Quality in Rice Fields

studies of possible causes of poor rice stands indicate level of total salts content of water influences growth and yield

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Several hundred acres of rice in Fresno County were abandoned in the spring of 1954 because the stands had either died out completely or had become so sparse that it was uneconomical to continue farming them.

After a seedbed had been prepared—to give a typical life story of an affected farm—about 50 to 60 pounds of actual nitrogen as aqua ammonia were drilled in. Rice levees were then made; the field was flooded; and sprouted rice was seeded in the water from airplanes. In a few days, a nearly perfect stand of rice came through the water surface. The plants grew luxuriantly until about 25 days after seeding, when a few tips and edges of the blades became brown. Small brown spots also began to show on the leaves above the water. The leaves later lay over and floated on the surface. In as short a period as five to seven days, an almost solid stand was reduced to a few sickly plants with the stand so thinned the fields were abandoned.

Possible Causes Examined

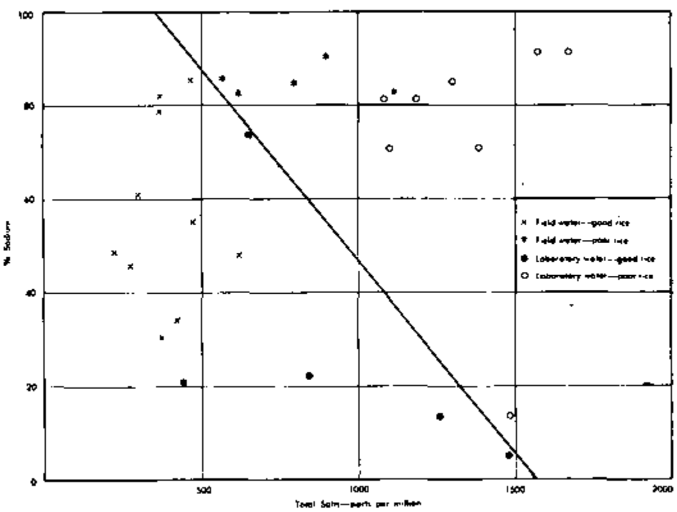
Careful examination of the affected rice plants and fields revealed no insects or plant pests. Several plants were also examined for diseases, but none serious enough to cause such a widespread destruction could be found.

The possibility of poor growing weather as a contributing cause was eliminated, since there were several fields of lush rice near fields that had died out.

Alkali soil—in the usual sense of the term—was considered not to be the cause since most of the affected fields, although never producing rice before, had yielded fair to good crops of winter grain, cotton, and milo in years past.

Analysis of the water from the wells and irrigation ditches showed it to be of good quality. However, since the rice plants were presumably able to live for about 25 days because of the minerals and energy stored in the seeds—and did not die until they were forced to get their nutrients from the soil and water in the paddy—the quality of the water in the paddies themselves was suggested as the cause.

Water at the source was of uniformly good quality, and in most cases, the paddies near the inlets of fresh water survived or were at least much better than the paddies near the outlet. As water passes over the soil, the quality is altered by the free salts in the soil and by exchanging cations with the soil itself. The salts in the water are also concentrated by transpiration of the plants and, to a limited extent, by evaporation from the water surface.



Several samples of water from the rice paddies—each sample noting the condition of the rice growing in the fields—were taken to the laboratory where they were analyzed for total salt content, pH—relative acidity-alkalinity—and per cent sodium in the dissolved salts.

The results were plotted on two working graphs—sodium percentage plotted against pH, and pH plotted against total salts. These graphs showed a scatter pattern, which therefore eliminated pH as a factor within the limits found in the fields. When the total soluble salts in the water were plotted against the sodium percentage, however, the waters from good fields and the waters from poor fields grouped themselves on a summary graph, as shown on this page.

Predicting the survival of a rice stand now became a possibility, although the exact location of the dividing line between good-quality water and poor-quality water was still somewhat doubtful because water with high total salts and a low sodium percentage could not be found in the fields. In order to supply the missing data, the trials were continued in the laboratory.

Laboratory Trials

Rice seed was sprouted in soil under about 3″ of water and allowed to grow for about three weeks. The plants were then pulled, and the roots were washed, blotted reasonably dry, and placed in beakers of solutions made up to the total salt concentrations and sodium percentages designed to fill the missing area on the graph. Plant nutrients to sustain the plants were added to the solutions.

The level of the solutions was kept fairly constant. As soon as any plants showed symptoms of dying similar to those found in the affected fields, they were removed and the water immediately analyzed for total salts and sodium percentage. After several days, the plants still growing well were also removed and the solutions similarly analyzed.

From these data, it appears that a straight line—as shown on the graph—separates the good- and poor-quality water in the rice paddies. Waters in paddies that lie on the lower left side of the line should be of good quality for rice, and waters that lie on the upper right side of the line will probably not support rice.

These findings have been borne out in the fields. One field showing the initial symptoms of dying was immediately flushed out with quantities of water—low in total salts—diverted from the Kings River. This water was used for the remainder of the season. The plants recovered, and just before harvest appeared to be yielding a normal crop of grain.

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