Potato Growth Studies

air and soil temperatures compared in Kern County potato fields during spring and early summer

O. A. Lorenz

Soil temperatures in Kern County potato fields average from 60° F to 70° F at 6″ depth, with foliage cooling the soil about 8° F, and irrigation some 4° F.

Temperatures in potato beds were recorded at the 3″, 6″ and 9″ depths during the growing seasons of three years. Most of the temperature data were taken from the 6″ depth, since the majority of tubers are found from 4″ to 6″ below the top of the ridge.

The potatoes were grown according to regular commercial methods. The land was irrigated prior to planting and then received no further irrigation until nearly two weeks after the crop was up. Soon after, daily irrigations were applied in alternate furrows. The plants were spaced approximately one foot apart in beds 32″ apart. Some 600 pounds of ammonium sulfate fertilizer was applied at the time of planting. Soon after planting, the ridges were made to the final height of approximately 8″ above the bottom of the furrow.

Air and Soil Temperature

In early April, the soil temperature averaged about 60° F, as compared with an average of approximately 65° F for May, and 70° F or above for early June. During April, the soil temperature averaged several degrees warmer than the air; during May they were very nearly the same. In June, the temperatures were reversed, the air temperature averaging several degrees above that of the soil.

The soil temperatures at the 6″ depth were similar each year, especially during May, when most of the tuber growth was occurring. The temperature during this month averaged very close to the optimum for tuber set.

On clear sunny days, temperatures at the 3″ depth fluctuated more than 20° F, whereas at the 6″ depth comparable fluctuations were less than 15° F, and at the 9″ depth, less than 8° F.

The maximum temperatures in the potato beds were reached at approximately 3 p.m.—Daylight Saving Time—for the 3″ depth, at 5 p.m. for the 6″ depth; and at 7 p.m. for the 9″ depth.

When the entire growing period of April through June was taken into account, there was little difference between the average temperature of the air or of the soil at the 3″, 6″ or 9″ depths. During April, the soil temperature tended to increase with depth. In June, the soil temperature decreased with depth and for the week of June 3 at the 3″ depth averaged 70.7° F, as compared with 68.9° F and 66.6° F for the 6″ and 9″ depths.

Foliage Cover and Shading

Average soil temperatures of fallow and of planted beds at the 6″ depth were compared. Both series of beds received daily irrigations in alternate furrows. The plants emerged about March 15, and by April 15 were approximately 12″ tall and 12″ in diameter. By early May, the foliage covered the soil of the bed almost completely. Until the week of April 22, the soil temperature of the planted beds was only about 2° F cooler than that of the cropped beds, but from the first of May until harvest the planted beds were approximately 8° F cooler than the fallow beds. The small difference in temperature between the fallow and cropped plots during early April was probably caused by the fact that the foliage gave only partial shading to the soil. Later in the season, good foliage cover accounted for a cooling of nearly 8° F below that of bare soil.

Comparisons were made of planted beds, fallow beds, and fallow beds artificially shaded. This third group was shielded completely from the sun with a large piece of plywood placed about 12″ above the top of the ridge and so mounted that air moved freely underneath.

After the first of May, soil of the planted plots averaged 6° F to 8° F less than that of the fallow plots. The artificially shaded beds averaged 2° F to 4° F cooler than the planted beds.

Effect of Irrigation

The effect of furrow irrigation on cooling of the soil was tested in planted beds. Beds with comparable foliage cover were irrigated until the day the test began. After that one series of beds received no further irrigation, while a second series received daily irrigations in alternate furrows. The most reliable data showing the true effect of irrigation were obtained from three to six or eight days after the last irrigation on the nonirrigated beds. At this time, the soil surface was dry, although the plants had not begun to wilt severely. Wilting caused the vines to open up and exposed some of the soil to the sun. Comparable cooling was obtained for both the maximum and average daily temperatures. In every test the soil temperature at the 6″ depth was cooler in the irrigated beds than in those not irrigated. The maximum amount of cooling observed in the area of tuber set was

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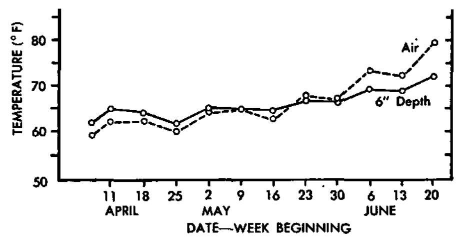
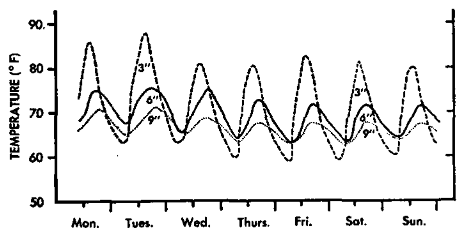
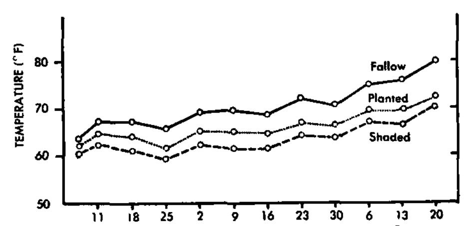


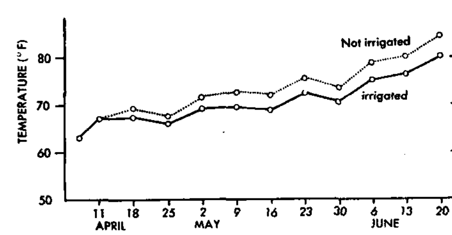
Average weekly temperatures of soil at 6″ depth and of air during one season of the test.



Daily temperatures of soil at 3″, 6″, and 9″ depths during one week of the experiment in June.



Average weekly temperature of soil at 6″ depth of fallow, planted, and shaded beds.



Average weekly temperatures of soil at 6″ depth of irrigated and nonirrigated fallow beds.

REVOLVING

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of certificates are lost and that frequently the wrong certificates are returned for payment. To avoid delay, confusion and unnecessary expense, book credits are being used. A statement is mailed to each member showing changes in his account during the year, and its status at the year's end adequately serves the purpose of a certificate.

Intermember Adjustments

There are several plans by which western associations transfer investments from members in need of money to those with money to invest. One such plan has been in operation for over 20 years. These plans are a step in the direction of making revolving finance more popular among farmers, particularly those who are getting started in the business of farming and are short of capital.

Giving revolving fund credits negotiability touches two other problems. One concerns the extent to which an association considers revolving finance funds as security when it extends credit to members. Obviously, an association which extends credit to its members must protect itself in any plan to transfer revolving fund credits. For example, the bylaws may give the association a prior lien on all revolving funds to cover any indebtedness of the members.

A second point concerns the matter of paying interest. Revolving fund credits bearing approximately current interest rates are likely to be salable at something like par. In cases where no plan has been worked out to facilitate such transfers, needy members must sometimes assign accounts at heavy discounts.

Risk Aspects

Co-operatives face many of the same risks as other types of business. Associations which derive their revolving capital from stated percentage deductions from proceeds may find themselves short of funds in years of low prices. On the other hand, a flat deduction—say 1¢ per dozen eggs—may seem burdensome to producers with eggs at 20¢ a dozen, equivalent to 5%, but be negligible with prices at 75¢, equivalent to ⅔ of 1%. Associations which revolve capital out of savings will find that savings vary from year to year. Decreased savings may require such lengthening of revolving periods as to cause trouble under fixed maturity plans.

Another sort of risk concerns equities after violent price level changes, particularly in case of dissolution and liquidation when articles and bylaws have not been carefully drawn. In times of significant inflation some well-established co-operatives could pay off all revolving funds and have a large amount of money left. Bylaws could allot such a residual to the stockholders in case of liquidation and not to those who contributed most of it.

Co-operatives, like other businesses, set up reserves for numerous purposes. Recently there has been a tendency to set these up as revolving funds. Some of these so-called reserves are more in the nature of risk capital and should perhaps be so treated. In that case they might be revolved, perhaps on a book value basis.

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ORANGE

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over the 22 years of the experiment was detrimental to the structure of the soil, causing a marked deterioration of tree condition and yields. However, when these fertilizers were used with manure in such a manner that the manure supplied one half of the nitrogen, harmful effects did not occur and the yields were not depressed. When soil conditions are such that the continuous use of these fertilizers is harmful, organic matter supplements appear to be particularly desirable.

In these treatments dairy or steer manure from fattening yards was used. Other treatments with manure, alfalfa hay, cereal straw or lima bean straw indicate that these have equally good effects on yields if equal quantities of organic matter are applied and their use is supplemented with nitrogen fertilizers to reach the same total quantity of nitrogen. The most important consideration in the use of different bulky sources of organic matter appears to be the ratio of the amount of organic matter to the amount of nitrogen—from all sources—applied annually. In the most productive treatments this ratio has been close to 20 to one. This is equivalent to a carbon-nitrogen ratio of about 10 to one.

Fruit Size and Grade

The use of covercrops—with chemical sources of nitrogen—caused a small increase in the size of the fruit. Larger increases resulted from the use of manure.

The effects of organic matter from covercrops and manure on fruit size appear to be due to two factors. One is their beneficial effect on soil structure and the infiltration of water; the other is the effect of applied organic matter upon the supply of potassium which affects fruit size.

The grade of the fruit was not appreciably affected by the growing of cover-crops or the use of manure. However, these factors slightly affected the internal quality of the fruit. In general, manure appeared to act very much like a potash fertilizer and made the juice slightly more acid.

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The above progress report is a summary of part of the results of a long-term experiment at the Citrus Experiment Station at Riverside. The full report is available as Bulletin 722 of the California Agricultural Experiment Station.

POTATO

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about 6° F, the average 4° F. This was true in early April when the foliage gave only partial cover to the bed, as well as in late May when the foliage almost completely shaded the ground.

Records were obtained from irrigated and nonirrigated fallow beds. Water was first applied to the irrigated beds on April 17, after which they received daily irrigations in alternate furrows. Temperatures obtained at the 6″ depth show that, during late April, soil of the irrigated bed was on the average approximately 2° F cooler than that of the nonirrigated beds. During May, the difference was approximately 3° F, and near the end of the test, in June, the irrigated beds were approximately 4° F cooler. It appeared that the higher the air temperature the greater was the degree of cooling of the soil by irrigation. It would seem that growers planting potatoes in this soil at the 6″ depth during periods of high temperature might expect a cooling of approximately 4° F, or possibly slightly more, in irrigated as contrasted with a dry soil.

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The above progress report is based on Research Project No. 1175.

CARTONS

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April 2, a premium has been paid for the new box over the old, often amounting to 25¢ per standard box.

Retail markets gain from the one-half box carton. Many stores find the old box uneconomical because of its size. Decay and shrinkage become serious before all the fruit is sold. The new boxes are lighter to handle and, when empty, can be used as consumer tote box.

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