

BULLETIN 263-A

AUGUST, 1926

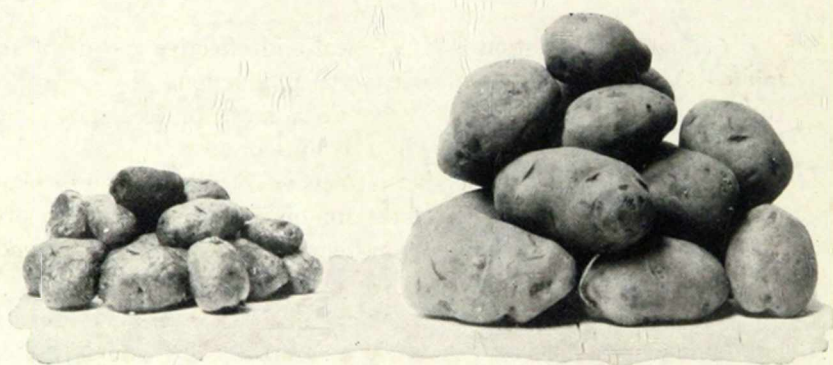
Colorado

ROTATE YOUR CROPS

LIBRARY

COASTAL PLAIN EXPERIMENT STATION
TIFTON, GEORGIA





The cover picture shows two fields of potatoes ; that on the left has been in potatoes for several years. The adjoining field shows potatoes in a rotation after two years of alfalfa.

The piles of potatoes shown on this page represent the crop from the two fields. The pile at the left is from the continuously cropped field and is unharvestable ; the one at the right represents a yield of 140 sacks to the acre from the land under rotation.

These illustrations are from an unpublished manuscript by Dr. Wm. P. Headden, Chemist, Colorado Experiment Station.

ROTATE YOUR CROPS

BY WARREN H. LEONARD

A good crop rotation is a practical and effective means of maintaining soil fertility and increasing crop production. By a crop rotation is meant the growing of crops in a more or less fixed scheme where one crop follows another in a definite order.

One writer¹ says that the farmer who follows a well-planned cropping system and properly cares for his crops will realize a profit; while the use of a poor cropping system will cause him to lose money tho he gives his crops the best care.

In spite of overwhelming evidence in favor of crop rotations, one finds much naturally fertile soil in this state being rapidly depleted thru careless cultural practices.

Essentials of a Good Rotation

Every crop rotation should include alfalfa, sweet clover, or other leguminous crop, and the use of barnyard manure to maintain the productiveness of the land. A cultivated crop like corn, potatoes, or sugar beets is needed at intervals to subdue weeds and retain soil moisture thru tillage. Small grain is usually desirable in a rotation only when alfalfa or sweet clover is seeded with it. All rotations should include forage for livestock kept on the farm. As large an area as possible should be devoted to the most profitable crop.

Advantages of a Crop Rotation

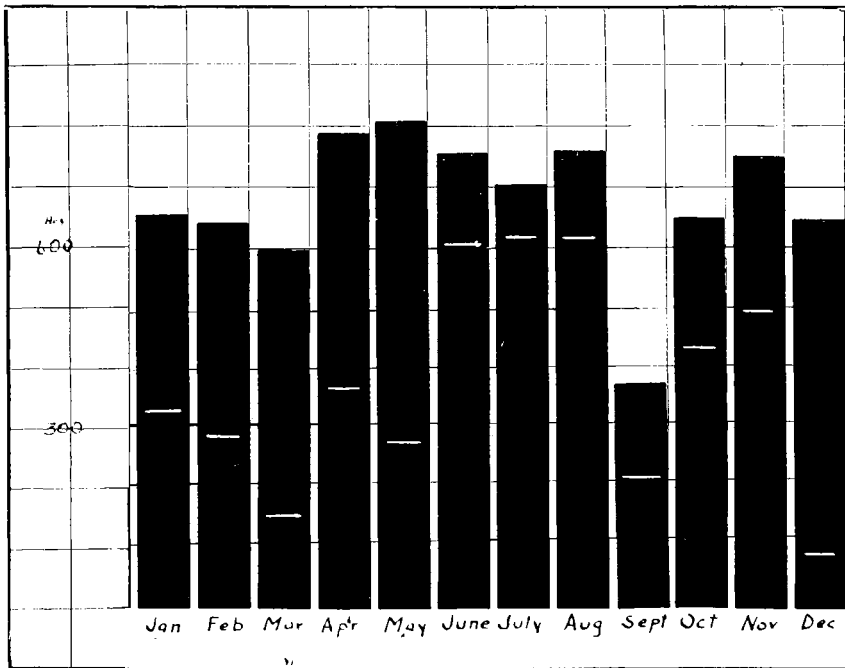
Distributes Labor.—When the rotation is properly planned, the farm labor will be more evenly distributed thruout the year. It is obvious that some crops require very little labor at certain seasons and a great deal at others. For instance, the bulk of work on a wheat crop comes in July at harvest time, while the labor on sugar beets is distributed thru the season, with the heavy work coming at pulling time late in the fall. A good sequence of crops often prepares the land for the next crop, as in the case of sugar beets which can follow potatoes without plowing the land. Wheat follows beans without plowing, also.

Assures Better Use of Irrigation Water.—A better use of irrigation water is another very important point in favor of crop rotation. Different crops seldom need water at the same time, so it is

¹ Holden, James A. "Crop Rotation Under Irrigation," Nebraska Exp. Sta. Bul. 190.

usually possible to irrigate one crop before another needs it. A one-crop system means waste of water, except at the critical period in the growth of the one crop.

Lessens Disease.—A carefully planned crop rotation lessens trouble from various pests and diseases. As a rule these travel from one field to another very slowly. Potato scab, Rhizoctonia, and wilt are seldom capable of living over two or three years in a soil where potatoes are absent. The sugar-beet nematode and wilt are effectively combatted only where the sugar-beet crop does not reappear on land more than once in five or six years. Smut infestation is encouraged where the same small grain is grown on a field year after year. Crop rotation will dispel many such fears of disease.



This chart shows the even labor distribution on a northern Colorado farm of 160 acres where a good cropping system is practiced. The part of the bar beneath the white line represents the man labor spent on crops, while that above shows the time spent on livestock.

Controls Weeds.—Weeds are becoming a serious problem in some sections of Colorado—more serious here than in some other states because the seeds are readily carried from farm to farm in irrigation water. Most weeds are at their best in grain fields where they can go to seed unmolested. In pastures and hay fields annual weeds are crowded out, but the more troublesome perennials frequently take their places. Tillage will eventually eradicate weeds, where rotations alternate the crops.

Minimizes Various Risks.—There are risks such as hail and low markets which might prove disastrous to one crop, but seldom to all.

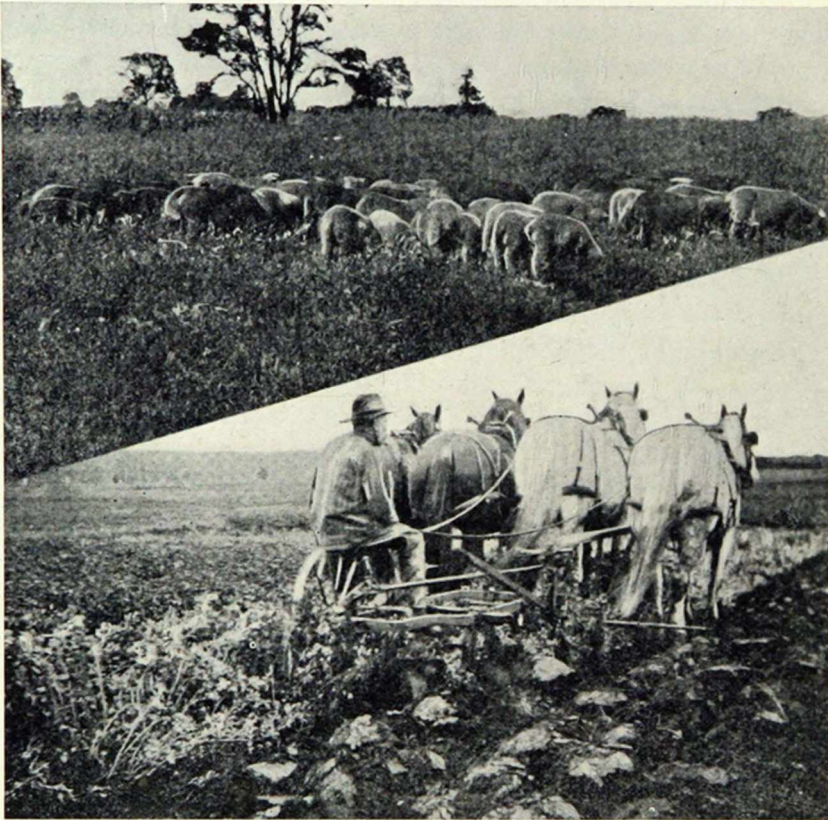
Encourages the Keeping of Livestock.—The cash-crop farmer is generally less successful than the one who keeps some dairy cattle, hogs, and sheep. The well-planned rotation encourages a farmer to keep livestock, which is desirable because of the value of manure in increasing the water-holding capacity and fertility of the soil.

Maintains Crop Production.—One enthusiast has said “alfalfa and sweet clover are like great men—their influence is felt long after they are dead.” These crops add organic matter and nitrogen to the land thru their residues. Their unusually deep roots touch soil levels out of reach of ordinary crops, and add further benefit in aerating the soil. Experience shows that the richest soils become depleted when all crops produced are sold away from the farm.

In a few regions of Colorado there is an excess of nitrogen in the form of nitrates in the soil due to the activities of the azotobactor, which should not be confused with the nitrogen-gathering bacteria on the nodules of legumes. Even this condition of excess nitrates is arrested by alfalfa and sweet clover in the rotation.

Facts Show That Rotation Pays

At the Scottsbluff, Nebraska, Experiment Substation,¹ a number of different rotations have been under observation since 1912. The results are of unusual concern because the type of farming practiced, soil, rainfall and elevation, are very similar to the conditions found under irrigation in northern Colorado. The rotations vary from continuous cropping to a 7-year rotation. The most profitable over a period of years was a 7-year rotation with (1) oats seeded to alfalfa, (2) alfalfa, (3) alfalfa, (4) alfalfa, (5) potatoes, (6) sugar beets and (7) sugar beets manured. Sugar beets grown in rotations not having al-



Sweet Clover feeds both livestock and land. Courtesy "Through the Leaves."

alfalfa gave 11.7 tons per acre but, when grown in the same cropping system with alfalfa, averaged 18.7 tons. In neither case was the land manured. The difference of 7 tons at present sugar-beet prices in northern Colorado (1926) would give \$56 more income per acre—a direct gain from crop rotation. All *one-crop systems* showed a financial loss, while every rotation having alfalfa in it was a profitable one. All rotations not having alfalfa showed a loss, except one 2-year rotation of oats and sugar beets manured. Small grain always showed a loss from the poor rotations and seldom a profit from the good ones. The yields obtained from a 4-year rotation of (1) small grain and sweet clover seeded, (2) sweet clover pastured, (3) sugar beets and (4) sugar beets,

PROFIT OR LOSS PER ACRE OF CROPS GROWN IN DIFFERENT CROPPING SYSTEMS WITH THE TOTAL PROFIT OR LOSS FROM AN 80 ACRE FARM

SCOTTSBLUFF EXPERIMENT FARM NEBRASKA

ADVANTAGES IN ROTATION

Saves Labor Better use of
water Less diseases Less risk
from hail Lessens effect of low
markets faster to keep live stock

PRICES USED

Taxes Water etc 110 acre
Man & team 5 day
Alfalfa Hay 7 ton
Sugar beets 15 ton
No 1 Potatoes 60 bu
Cull Potatoes 15 bu
Corn 60 bu
Oats 35 bu

Profit or loss per acre
of each crop in rotation
1 inch = 400

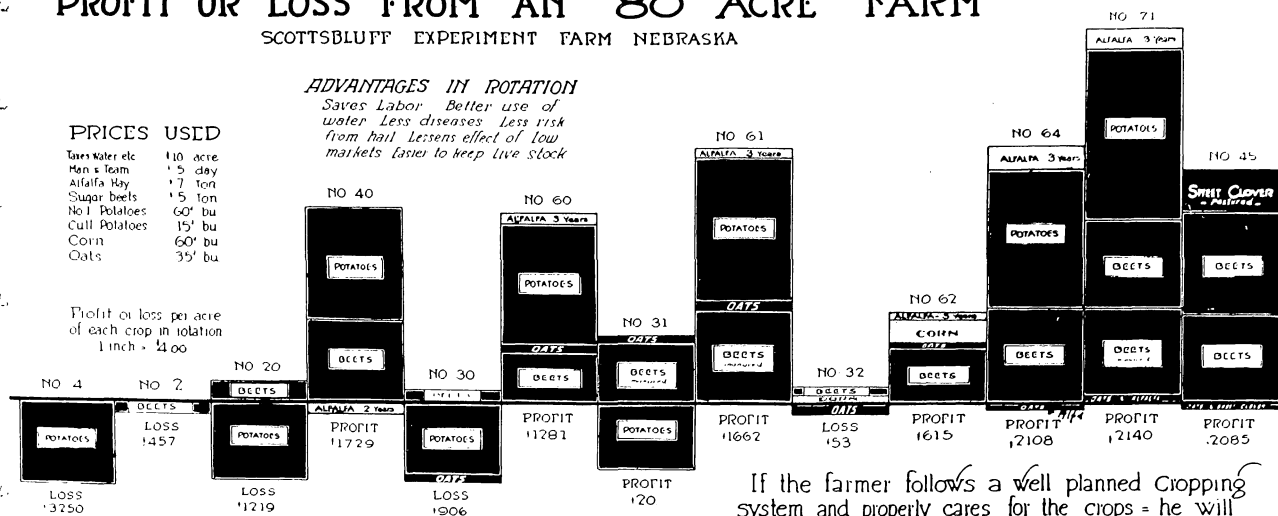


Chart 1. Showing graphically the profit or loss per acre for each crop grown in 13 of the 34 different crop rotation experiments. The profit or loss from the whole farming system is also given when figured on the basis of an 80-acre farm. Scottsbluff Station

If the farmer follows a well planned Cropping system and properly cares for the crops - he will realize a profit - while if he follows a poor Cropping System, he will lose money even though he gives his crops the best of care

showed the beneficial effects of sweet clover on a partially run-down soil. Continuous sugar beets on the land before it was seeded to small grain and sweet clover averaged 11.84 tons per acre. Sugar beets on these same plats following pastured sweet clover, averaged 20.56 tons for the first crop and 17.84 tons per acre for the second crop of beets. The difference between 11.84 and 19.20 tons (average for the two years) is 7.36 tons. This would mean \$58.88 more income per acre at 1926 sugar-beet prices.

Results at the Utah Agricultural Experiment Station,² in a 7-year rotation consisting of oats, alfalfa 3 years, oats, and sugar beets manured 2 years, show that the value of manure is almost doubled when compared with sugar beets grown continuously on land manured every year. Utah observers also found it possible to maintain the nitrogen content of their soil by a rotation system in which about one-third of the land is kept in alfalfa and the manure produced from the feeding of this alfalfa returned to the land. It was found that sugar beets, then potatoes, gave the greatest returns from the use of manure.

A survey³ of the farms in the vicinity of Greeley, Colorado, to determine the labor incomes between operators who fed livestock and those who did not, reveals that the feeder was financially ahead of the non-feeder over a period of years. Results of the farm business as a whole were found to be considerably enhanced when livestock feeding was combined with crop production. This is another argument in favor of crop rotations which provide for livestock on the farm.

OPERATOR'S LABOR INCOME

Year	Number of Farms (average taken)	Non-feeders	Number of Farms (average taken)	Feeders
1914*	53	\$ 340	35	\$ 1,951
1915*	48	1,186	28	3,696
1921*	40	-352	14	3,042
1922†	6	-1,318	6	-1,882
1923†	8	-1,477	5	3,064
1924†	6	-260	7	3,020

² Pittman, D. W. "Maintaining the Productivity of Irrigated Land," Utah Agricultural Experiment Station, Bulletin 18b.

³ "Preliminary Report on Livestock Feeding in Relation to Farm Returns in the Greeley Area," L. A. Moorhouse and R. T. Burdick, Department of Economics and Sociology, Colorado Agricultural College.

*Farm-business-analysis survey. †Detailed farm accounting records.

Some Suitable Crop Rotations

Northern Colorado Irrigated Lands.— In those sections of the state where potatoes can be grown profitably, a rotation of (1) small grain and alfalfa seeded, (2) alfalfa, (3) alfalfa, (4) alfalfa, (5) potatoes, (6) sugar beets, (7) and sugar beets manured will prove a desirable one. These crops, as well as others named in rotations in this paper, are given in the order in which they should be grown for the best results. Where the land is too heavy for potatoes, corn or wheat may be grown in their place. This would also hold where corn is a choice over potatoes. A good sweet-clover rotation for potato and beet-growing areas of northern Colorado as proved by a Scottsbluff test is: (1) Small grain and sweet clover for hay, (2) sweet clover as green manure followed by potatoes, (3) beets, (4) and beets. Another which largely does away with volunteer sweet clover in beet fields is: (1) Small-grain and sweet clover, (2) sweet clover pastured, (3) beets, (4) and beets. Where distance to market makes beet raising unprofitable, corn may be substituted in this rotation.

Arkansas Valley Irrigated Regions.— Soil and climatic conditions are somewhat different in the Arkansas Valley. An agricultural program⁴ for that section sets forth recommendations for crop rotations based on knowledge of actual conditions, and on cropping systems that have proved successful in the past. A short rotation with alfalfa which is given as suitable is: Alfalfa 3 years, sugar beets and small grain seeded to alfalfa. It is advisable, however, to crown the alfalfa in the fall where beets come after alfalfa. A short rotation taking advantage of red clover was recommended in the survey: Red clover, sugar beets, lima beans and sugar beets. A longer rotation allowing still more diversity in crops would be: Alfalfa 3 years, vines or small grain, sugar beets, sugar beets and small grain seeded to alfalfa. This allows for more cash crops, such as beets and vines, both of which thrive in the Valley.

Landlords Favor Rotations

Many landlords and bankers interested in the permanent tilth of their land, or its upkeep, realize the value of crop rotation for this purpose. Especially is this true where land leased to a tenant has been

⁴ "An Agricultural Program for the Arkansas Valley of Colorado," Extension Bulletin 239A. Thos. H. Summers and E. D. Smith.

robbed of its fertility thru heavy growth of cash crops removed from the farm each year. It has been suggested as a remedy and a protection that a good crop rotation be made a provision of the lease. This is a measure looked upon with more and more favor by such land-owners. At the same time it is advisable that the tenant be favored with a long-time lease that he may be able to share the benefits of crop rotation.

Conclusions

Crop rotation is a solution for many soil-fertility problems. In long-time experimental tests on rotations, where all crops, and all soils are considered, crop rotation is practically as effective as fertilizer in maintaining crop yields. Since manure is often scarce and insufficient, and commercial fertilizers expensive, crop rotation is the common-sense choice. Moreover, it has other advantages common to manure: The growing of legumes in a rotation adds organic matter and allows the soil to hold more moisture, a thing very desirable under Colorado conditions. Crop rotation also means labor saved, higher yields, and consequently more and surer cash returns.

Valuable aid and advice in the preparation of this bulletin was given by Professors Alvin Kezer and R. T. Burdick of the Colorado Agricultural College; James A. Holden, Superintendent, Scottsbluff Experiment Substation, Nebraska; the Great Western Sugar Company; and the American Beet Sugar Company



CO-OPERATIVE EXTENSION WORK IN AGRICULTURE AND
HOME ECONOMICS, COLORADO AGRICULTURAL COLLEGE
AND U. S. DEPARTMENT OF AGRICULTURE CO-OPERATING

Distributed in Furtherance of Acts of Congress of May 8 and June 30, 1914