THE CULTIVATION OF CORN

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MASTER OF SCIENCE

By

JOSEPH MARSHALL TRIMBLE, B. S.

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I N T R O D U C T I O N

"Jethro Tull said, 'Tillage is manure', and this axiom has been more or less accepted and inculcated into our theories regarding the interculture of hoed crops". To just what extent we should accept this is questionable. Tull believed that the roots of crops had the power of taking up the small particles of soil and using them in their growth. We know now that this is not true, but there is yet so much truth in his statement that we cannot afford to ignore it. It can probably be applied to the corn crop more readily than any other field crop grown in the United States.

Good corn can be grown on average land with good cultivation, but good corn cannot be grown on good land with no cultivation at all, except under rare conditions. Therefore, when applied to corn, we might modify Tull's axiom to read 'Tillage is more important than manure'. Manure furnishes plant food which is very essential to the growth of the corn plant, but without cultivation, certain factors enter in that prevent the proper development of the plant.

The important results to be obtained from cultivation are:

Destruction of weeds
Conservation of moisture
Aeriation of the soil
Increase of availability of plant food.

Of these four, the destruction of weeds seems to stand first. This has been shown by practically all the cultivation experiments that have been carried on at the various Experiment Stations. Where the weeds have been destroyed without cultivation, the yields have often compared favorably with those where the corn was cultivated.

Next in importance is the conservation of moisture. It is a well known fact that cultivation retains moisture in the soil by keeping a dust mulch on the surface. The number of cultivations necessary to best retain the moisture varies with the amount of rainfall, while it is generally recommended to cultivate frequently during a dry season. Our results at Blacksburg during the summer of 1914 did not show any material advantage in frequent cultivation. The most important time to cultivate is as soon after a rain as practical. It is then that the greatest amount of moisture is being lost by evaporation.

The aeration of the soil and increase of availability of plant food are rather of minor inportance to the other two. However, we know that on certain heavy clay soils, cultivation to aerate the soil and set free plant food is necessary.

STATEMENT OF PROBLEM

The purpose of this experiment is to determine, if possible, the number of cultivations to give corn in order to get the most profitable and economical results. One or two extra cultivations may increase the yield slightly, but unless this increase is sufficient to pay for the extra work done, it will not be profitable.

Before taking up the discussion of work done on this problen some results of cultivation work done at other Stations will be presented.

RESULTS OF CORN CULTIVATION

EXPERIMENT - KANSAS STATION 1893.

Times Cultivated	Times Cultivated During season	Bushel Per acre
Three times a week	20	23.28
Twice a week	14	26.05
once a week	7	28.65
once in two weeks	4	22.25
once in three weeks	3	21.34
once in four weeks	2	18.02

AVERAGES OF TWO YEARS' TRIALS

AT KANSAS STATION

Times Cultivated	Times Cult. During Season 1891	Times Cult. During Season 1892	Times Cult. During Season 1893	Bushels per Acre
Three times a week		15	20	24.86
Twice a week		11	14	27.15
once a week		6	7	27.86
once in two weeks		3	4	25.25
once in three weeks		3	3	24.09
once in four weeks		2	2	16.91

AVERAGE OF THREE YEARS' TRIALS.

Twice a week	9	11	14	40.31
once a week	6	6	7	41.29
once in two weeks	4	3	4	40.86

THREE YEARS CULTIVATION

EXPERIMENT AT THE KANSAS STATION.

TIME CULTIVATED	YIELD PER ACRE IN BUSHELS			
	Total Averages	1896	1895	1891
One time	30.52	37.62	23.42	----
Two Times	47.77	44.42	30.88	68.03
Three times	35.11	43.77	26.45	
Four times	48.59	48.94	20.77	76.06
Five times	34.39	48.27	20.51	
Six times	45.50	49.34	17.08	70.08

CORN CULTIVATION

Experiment at

NEW HAMPSHIRE STATION, 1899.

KIND OF CULTURE	Pounds Corn Stover	Bushels Shelled Corn Per Acre
No culture - weeds permitted	4,420	17.1
very frequent - 14 times	12,016	80.6
ordinary- 5 times	11,496	79.1

CORN CULTIVATION

Experiment at

ILLINOIS STATION, 1893.

KIND OF CULTIVATION	YIELD PER ACRE.		
	No. Ears	Bu. Corn	Ave. Bu. for 5 years
None, scraped with hoe (2 plats)	8,881.6	28.7	68.3
Shallow, ordinary (2 plats)	9,108.9	36.3	70.3
Deep , ordinary (2 plats)	8,938.4	33.6	66.7
Shallow, Frequent (2 plats)	8,881.6	35.9	72.8
Deep. Frequent (2 plats)	7,616.8	30.6	64.5
None, weeds allowed to grow	none	none	----
Frequent (average 4 plats)	8,249.2	33.2	68.6
ordinary (average 4 plats)	9,023.6	34.7	68.5
Shallow (average 4 plats)	8,995.2	36.1	71,5
Deep (average 4 plats)	8,277.6	32.1	65.6

DISCUSSION OF WORK DONE AT OTHER STATIONS

The Kansas Experiment Station seems to have done more work on corn cultivation than any other Station. Their experiments were conducted over a period of six years and were fairly complete. They found that corn can be cultivated too much as well as too little. One cultivation a week through a cultivation period of seven weeks seemed to give about the best results. In one experiment it was found that even less than seven was the most profitable. The average yields in their three year experiment were 41.29 bushels for six cultivations and 40.86 bushels for four cultivations. The six cultivations giving only about one-half bushel more per acre than the four cultivations. When we consider that it costs, on the average, almost fifty cents per acre for each cultivation, we can see that the two cultivations after the four did not pay for themselves. However, there is no way of telling each year just what number of cultivations is going to pay best, so we have to be governed by the average and by local conditions.

The New Hampshire Station found that ordinary cultivation - five times - gave almost as large yields as very frequent cultivation - fourteen times. In this case the ordinary cultivation was much more profitable than the very frequent. It is possible that an intermediate number of cultivations would have given larger yields than either of the two practiced.

P R O C E D U R E

The Illinois Station found very little difference in the yields from ordinary and frequent cultivation. They did find, though, a very great difference in the plats where the weeds were allowed to grow and the plats where the weeds were scraped with a hoe but no other cultivation. They also found a difference in favor of shallow cultivation over deep cultivation.

The Utah Station carried on a very interesting and exhaustive experiment on depth of cultivation. They found that medium tillage gave slightly better yields than either deep or shallow cultivation.

P R O C E D U R E

Two half-acre plats were thoroughly prepared, fertilized with 250 pounds of 16% acid phosphate, and planted to corn. These plots were divided into eight sub-plats, each containing one-eighth of an acre and having five rows of corn. The first year, 1913, they were cultivated as follows: sub-plats 1 and 6, no cultivation at all; 2 and 5, weeds cut with hoe but no other cultivation; 3 and 8, cultivated three times with cultivator; and 4 and 7, cultivated five times with cultivator.

The second year, 1914, they were to have been cultivated as follows: sub-plats 1 and 6, weeds cut with hoe but no other cultivation; 2 and 5, harrowed once and cultivated three times with cultivator; 3 and 8, cultivated three times with cultivator, and 4 and 7, cultivated five times with cultivator. However, this plan had to be changed slightly on account of sub-plat 1 being cultivated by mistake. The plan followed is given below in the table of results. This did not affect the experiment except that duplicates could not be run.

In the plats where weeds were cut with the hoe, care was exercised not to disturb the soil any more than could be helped. The harrowing was done with a light drag harrow and the other cultivation with an ordinary riding, two-horse cultivator.

RESULT OF CORN CULTIVATION

EXPERIMENT - VIRGINIA STATION, 1913.

		Grain - bu. per A.	Fodder - Tons Per A.
No Cultivation at all	1	8.28	.52
	2	6.71	.79
	Av.	7.49	.65
weeds cut with hoe but no other cultivation	1	21.92	.81
	2	33.71	.95
	Av.	27.81	.88
Cultivated three times with ordinary riding-cultivator	1	27.14	1.00
	2	42.85	1.28
	Av.	34.99	1.14
Cultivated five times with ordinary riding cultivator	1	39.28	1.27
	2	41.85	1.31
	Av.	40.56	1.29

RESULTS OF CORN CULTIVATION

EXPERIMENT - VIRGINIA STATION, 1914.

		Grain - Bu. Per A.	Fodder - tons per A.
Weeds cut with hoe but no other cultivation		40	1.60
Harrowed once and weeds cut with hoe		72.80	1.88
Cultivated three times with ordinary riding cult.	1	81.44	1.92
	2	67.44	1.92
	Av.	74.44	1.92
Cultivated five times with ordinary riding cult.	1	81.12	1.87
	2	69.44	1.76
	Av.	75.28	1.81
Harrowed once and cultivated three times with ordinary riding cultivator		70.40	1.68
Cultivated four times with ordinary riding cultivator		78.80	1.92

D I S C U S S I O N

The results for 1913 clearly show that cultivation is necessary to raise a crop of corn. While none of the yields are large, there is a consistent increase in the averages for additional cultivations. Just how far this will hold true can not be told from these results, as the experiment was not extensive enough to tell. However, this has been tried out pretty thoroughly at other stations, especially the Kansas Station.

The results for 1914 are not quite so uniform as those for 1913. This is due to the fact that the growing seasons of the two years were almost totally different. During the period of cultivation for 1913, while the rainfall was not heavy, it was fairly evenly distributed. Most of the cultivations were given after a rainfall. The sub-plats that received the larger number of cultivations had a decided advantage, and it was then that their relative yields were determined to a large extent. The latter part of the season had a very small rainfall. During the growing season of 1914, the rainfall was just the reverse of 1913. From the time of planting up to the last cultivation, there was practically no rain at all. From that time till the corn matured there was an abundance of rain. The sub-plats that received little cultivation seemed to do almost as well as those receiving much. They retained a fairly good dust mulck all during the cultivation period and when the rains did come, they were not far behind the others.

C O N C L U S I O N S

Another factor which might have entered into the irregularity of the 1914 results was the position of the sub-plats. In 1913 the experiment was arranged so that a sub-plat would be on the outside of the half-acre plat, and its duplicate on the inside. This plan was to have been followed in 1914 also but owing to the mistake made in the cultivation, it could not be carried out. It would naturally be expected that the sub-plats on the outside would have some advantage over those on the inside, due to more sun-light and drawing plant food from the outside, but this was not true in every case either year.

C O N C L U S I O N S

1, That cultivation is absolutely necessary to the profitable growth of corn. Fertility is essential to the production of the best crops but cultivation must accompany it. They must go hand in hand to make the banner yields.

2, That the greatest benefit derived from cultivation is the destruction of weeds. Our own experiments, as well as those at other Stations, show vast increases in yields where the weeds were removed over those where the weeds were allowed to grow. In several cases the yields were doubled and even trebled.

3, That an ordinary number of cultivations pays better than few or very frequent cultivations. No fixed rule can be given to govern the number of cultivations. One season may give a maximum yield from five cultivations while the next will require seven. It seems that the best plan to follow is to cultivate after every rain or once a week or every ten days, if the season is dry.

4, Finally; that shallow cultivation is preferable to deep cultivation. While this phase of cultivation was not included in the original problem, it is so intimately connected that a few words concerning it will not be out of place here. A number of the State Stations have run experiments on the depth of cultivation along with experiments on frequency of cultivation. They have uniformly found that medium to shallow gave better resultd than deep cultivation. It has been known for a long time that deep cultivation destroys many of the small corn roots, thereby reducing the supply of moisture and food that the plant should have.

B I B L I O G R A P H Y

1, Montgomery's "The Corn Crops".

2, Kansas Bulletins Nos. 45 and 64.

3, New Hampshire Bulletin No. 71.

4, Illinois Bulletin No. 31.

5, Utah Bulletin No. 66.