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Review of Experiments done on Cultivation at the Agricultural Research Stations in the Madras Presidency.

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Cultivation is the most widely practised agricultural art; but its effect on crop yields is not yet fully understood. In a series of articles appearing in the Journal of Agricultural Science, B.A. Keen, E. W. Russell and others have discussed the effect of cultivation on increasing crop yields. They have drawn the important conclusion, in this series of papers, that "the yield of field crops is, in general, either unaffected or actually reduced by extra cultivation operations". They draw a distinction between cultivation operations which are absolutely necessary, such as preparing a seed bed and those that are considered desirable but are not absolutely essential. The latter are spare time operations carried on by the cultivator.

In view of these observations it would be interesting to review the results obtained on cultivation experiments conducted at the various Agricultural Research Stations in the Province. The agricultural practices vary from place to place depending on the type of soil, climate and system of cropping. These have been evolved as a result of generations of experience by the cultivator and his system of cultivation is called 'Local Practice' in the following review. The review is based upon information on the following points furnished by the officers in charge of the various Agricultural Research Stations at which the experiments were in progress and covers the period upto 1942-43.

1. Type of soil.
2. Annual rainfall.
3. Main crops grown.
4. Normal rotation.
5. What is the local practice in regard to preparatory cultivation, and after cultivation?
6. Have any experiments been conducted at the station with any variation of the local practice in regard to preparatory cultivation and after cultivation (inter-cultivation)?
7. If so, over how many years was the experiment conducted? What was the layout—arrangement of plots, replications etc.?
8. What was the result?
9. Is any improvement in the cultural practices advocated to the ryots as a result of work conducted at the station?
10. General remarks, if any.

Experiments on cultivation were carried out at the following twelve Agricultural Research Stations; the type of soil, rainfall and crops studied are given in the following statement:

S. No.	Name of Station.	Nature of soil.	Annual rainfall.	Crop studied.
	DRY CROPS			
1.	Central Farm, Coimbatore	Red sandy loam	24"	Cotton & Cholam
2.	Cotton Breeding Station, Coimbatore	Red soil & medium black clay	26"	do do
3.	Agricultural Research Station, Koilpatti	Black clayey soil	30"	do do
4.	Agricultural Research Station, Hagari	do	20"	do do
5.	Do Nandyal	do	28"	do do
6.	Do Guntur.	Clayey loam	33"	Cholam, tobacco & chillies
7.	Do Tindivanam	Light sandy loam	39"	Groundnut
8.	Do Nanjanad	Loamy soils	55"	Potatoes
	GARDEN CROPS			
9.	Do Kasargod	Red sandy loam	145"	Coconut
	WET CROPS			
10.	Do Aduthurai	Alluvial Clay	40"	Paddy
11.	Do Pattambi	Sandy to red loam	106"	do
12.	Do Samalkôt	Heavy alluvial clay	37"	Sugarcane.

The following is the summary of the results obtained at each of the stations mentioned above:—

(1) **Central Farm, Coimbatore** An experiment (Cotton and cholam —red sandy loam) was started during 1942-43 with the object of determining the minimum preparatory cultivation to be adopted to obtain the best crop yields in dryland red soils. The following six treatments were replicated four times in randomized blocks.

A. Ploughing by the country plough thrice-control (Ryot's practice).
B. Country ploughs six times
C. P. S. G. 16-c plough once followed by country plough once.
D. P. S. G. 16-c plough twice followed by country plough once.
E. Guntaka whenever necessary to keep down weeds—not more than four times on the whole.
F. No ploughing but hand removal of weeds.

Results of one year only are available as the experiment was started in 42-43 season. The results from Sorghum were vitiated by extensive attack of Striga, while in that for K. 1 cotton, the differences due to the treatments were significant.

B F D A E C

In other words the effect of these treatments in enhancing crop yields was in the following order:—

Country plough six times—Hand removal of weeds—P. S G. 16-C plough twice followed by country plough once—Country plough thrice—Country Guntaka four times—P. S. G. 16-C plough once followed by country plough once.

The experiment has just commenced and no definite conclusions could be drawn from one year's results

Experiments have just been started under garden land conditions with similar treatments in field No. 60 and no results are yet available.

(2) **Cotton Breeding Station, Coimbatore.** (Cotton and cholam—Red and Medium black soil).

Preparatory cultivation. Experiments on preparatory cultivation were done with the object of finding (1) the best method of preparing the field after the harvest of cholam and (2) the best preparatory cultivation to be given to cotton and cholam on red and black soils.

In regard to (1) it was found that removing the cholam stubbles with the guntaka immediately after the harvest of cholam was better than waiting for good soaking rains to be received as is done by the cultivator.

A number of methods of preparing the land were compared both on red and black soils between the years 1940-41 and 42-43. The treatments were ten as detailed below:—

1) No ploughing.
2) Country plough—twice.
3) Do: 4 times.
4) Do. 6 times.
5) Do. 8 times.
6) Cooper 26 " once.
7) Do. twice.
8) Guntaka once.
9) Do. twice.
10) Standard victory plough—once, and country plough—once.

In the red soil experiments the results are not conclusive; as in 1940-41 the plots where Cooper plough was worked twice gave a higher yield of straw alone but in the next year the plots that received no ploughing, the plots where Guntaka was worked once and the plots where Cooper plough was worked twice, were all found to be equal

In the black soil, experiments conducted in two different fields gave different results. In one case the plots that received 'no ploughing' the plots that received 'country ploughing' twice, the plots that received 'Guntaka' twice and the plots that received 'Cooper' ploughing twice were all alike while in the other case Cooper plough twice was better than no ploughing.

In another field under cultural and rotational experiment with the following cultural operations (1) No ploughing, (2) Victory plough,

(3) Country plough and (4) Guntaka, carried over a period of three years, the different cultivation methods did not affect, the yields of cotton or cholam. The indications are that 'no ploughing' is as good as 'Victory plough', 'Country plough' or 'Guntaka'. The results are not significant in all the three years. The experiment has to be continued for another 6 or 9 years so that there may be a cycle of at least 3 croppings for each of cholam and cotton.

No final conclusions can be drawn from the experiments on preparatory cultivation.

After cultivation. Between 1932-33 and 1935-36 experiments were conducted to determine the nature and frequency of after cultivation necessary for cotton in red and black soils. The following were the ten treatments:—

1) Control.
2) Removal of weeds only.
3) Deep cultivation thrice.
4) Shallow cultivation thrice.
5) Very shallow cultivation thrice.
6) Hand hoeing thrice.
7) Deep cultivation weekly.
8) Shallow cultivation weekly.
9) Very shallow cultivation weekly
10) Hand hoeing weekly.

In the experiment on the most economical method of after cultivation it would appear that mere removal of weeds and keeping the land clean of weeds was quite satisfactory. Intercultivation with bullock power seems unnecessary. Under conditions obtaining at Coimbatore intercultivation to cotton would seem to be unnecessary.

(3) **Agricultural Research Station, Koilpatti.** (Cotton and cholam).

Preparatory cultivation. An experiment on cultivation was started in 1935-36 and is being continued for the 9th year in 1943-44. The treatments were:—

a) Monsoon plough.
b) Guntaka.
c) No ploughing.

Out of 8 years over which the results are available the results of one year alone are significant in favour of deep ploughing for cholam.

Interculture experiment. Experiment was conducted for three years from 1934-35 to 1936-37. The treatments being

1) No hoeings (control).
2) One hoeing.
3) Two hoeings.
4) Three hoeings.
5) Four hoeings.

The results are not significant in any year.

(4) **Agricultural Research Station, Hagari.** (Cotton and Cholam—black clayey soil).

Ploughing and bunding experiment Called the trial of Improved Dry Farming Methods was conducted: one series was started in 1936-37 and another in 1937-38.

The treatments were as follows:—

A) Deep ploughing once in 4 years and Bunding.
B) Deep ploughing once in 2 years and Bunding.
C) Bunding alone.
D) No ploughing and no Bunding (control).

Results of first series were significant the "ploughed and bunded" plots being superior to the rest while those of the second series were not significant. The results are not conclusive; season had the maximum influence over the results.

2. *Ploughing experiment.* This experiment was conducted since 1938-39 for three years. The treatments were

A) Ploughed every year with P. S. G. 16-A (to a depth of 4").
B) Ploughed in alternate years with the same plough.
C) No ploughing (control).

The results were not significant.

3. *Bunding experiment.* The experiment was in progress for 8 years since 1934 to 1941. The treatments were

A) Putting up bunds about 7" in height with the bund former.
B) No bunds—control.

Bunding is superior to unbunded in normal years but in years of excess rains or subnormal rains (below 15") bunding has not shown its superiority.

4. *Scooping trials*: was in progress for 4 years since 1938. The treatments were

A) Control (No bunds—No scoops).
B) Bunded.
C) Scooped with Basin lister and bunded.
D) Scooped with the Pathi guntaka and bunded.
E) Scooped with danthies and bunded.

There were no differences between the treatments.

After cultivation. With the object of determining the maximum number of intercultures that have to be given to cotton and cholam two sets of experiments were started in 1936-37.

The following are the treatments for the Cotton set and Cholam set respectively.

Cotton.	*Cholam.*
A. Three intercultures.	A. Two intercultures.
B. Four »	B. Three »
C. Five »	C. Four »
D. Six »	D. Five »
E. No interculture-hand weeded.	E. No interculture-hand weeded.

The results of the Agronomic experiment as well as those on soil moisture go to show that weeding is a necessary operation. Two intercultures for sorghum and 3 intercultures for cotton as given by the cultivators seems the best. In areas of precarious rainfall like Hagari the season plays the most dominant part. The treatments given were effective or ineffective depending on the distribution of rainfall. Excessive rains after sowing of crops encourage weed growth and necessitate a greater number of intercultures than in normal years. In years during which rainfall after sowings is scanty an increase in the number of intercultures does not produce a corresponding increase in crop yields.

Bunding as a measure of conserving rain water is being advocated to the ryots.

(5) **Agricultural Research Station, Nandyal.** (Cotton and cholam—clayey loam).

Preparatory cultivation—(Ploughed vs. Guntaka).

Cultivation experiments on cotton. In 1932-33 an experiment was started to compare the yield of cotton on ploughed and Guntaka worked plots. The results show that the yields from the ploughed plots are significantly better than those from the Guntaka worked plots.

Bunding experiment. For two years an experiment on bunding was conducted on cotton and cholam. There was no difference in the treated and untreated plots (Bunded and non-bunded) in cotton (1935-36) and sorghum (1936-37).

Interculture experiment. Over three years an experiment was conducted with the following treatments.

A) No interculture (Weeding).
B) Interculture once.
C) Do. twice.
D) Do. thrice (control).
E) Do. four times.

The treatment differences were found to be not significant.

A new cultural experiment. With an object of determining the minimum limit to which the preparatory cultivation operations can be cut down an experiment was started in 1940-41 with the following twelve treatments.

1) Working gorru guntaka twice (control).
2) Working country guntaka twice.
3) H. M. 2 guntaka twice.
4) Country guntaka once.
5) Gorru guntaka twice and blade guntaka once.
6) Buddala guntaka once.
7) Country plough twice.
8) Cooper No. 11 once.
9) Cooper No. 11 once and Guntaka to break down clods.
10) Cooper No. 21 once.

11) Cooper No. 21 and nolla to break clods.
12) No cultural operations—hand weeding.

The results of the three years show no significant differences due to the treatments.

Remarks. In Nandyal valley and adjoining tracts there is a wide variation in soils; and the farm soils are not quite representative of the tract. On account of this, results of the station are to be taken with caution in so far as their applicability to neighbouring tracts is concerned.

(6) **Agricultural Research Station, Guntur.** (Cholam, Tobacco and Chillies—black clayey soils).

Ploughing experiments. Experiments conducted prior to 1940 were on single plots and no definite conclusions could be drawn. This fact was noted by the committee of the Research Council, which reviewed the experiments done at the station in 1940.

An experiment with the object of determining the best possible cultivation was started in 1940 with the rotation, cholam—tobacco—chillies. The treatments in this experiment were eight.

1) 4 ploughings and 2 guntakas and Gorru twice
2) Gorru twice and guntaka twice.
3) Ploughing twice and gorru twice.
4) Ploughing twice and guntaka twice.
5) Two ploughings only.
6) Gorru twice.
7) Guntaka twice.
8) No ploughing.

In all the 3 years No. (1) gave the best results. Maximum cultivation gave the highest yield and this is the local practice. With an assured well-distributed rainfall as occurs in Guntur, cultivation has benefited all the crops that appear in the rotation. The cultural practices are fixed with due regard to seasonal factors and the crops grown.

Bunding experiment. Bunding has not given any enhanced yields and it appears not necessary in these areas of well distributed rains.

(7) **Agricultural Research Station, Tindivanam.** (Groundnut—light sandy loam).

Cultural experiment. An experiment is in progress for one year only the treatments being

A) Ploughing with country plough four times.
B) Country plough twice.
C) Country plough once and Iron plough once.
D) Country plough once.

Differences between the tillage treatments are not significant Instead of giving a large number of ploughings with the country plough it is considered more economic to give fewer ploughings with iron ploughs

Intercultivation experiments. It was found hoeing and weeding once was better than hoeing and weeding twice.

(8) **Agricultural Research Station, Nanjanad.** (Potatoes—loamy soils).

From the inception of the farm fixed cultivation, proper tillage, judicious manuring and planting along contours instead of along the slopes and rotation of crops were adopted.

An experiment with deep ridging and shallow ridging as the two treatments was conducted over a period of six years from 1934—35. The results are not significant. An experiment has just been started in order to determine the evil effects of erosion, with the following treatments in the cultivation of potatoes. Farm method potato followed by lupin, samai during the 2nd year planting along contour, bunding, terracing catch drains and silt traps (vs) Local method potato, samai during 2nd year, planting along slopes, no bunds etc.

(9) **Agricultural Research Station, Kasargod** (Cocoanut—Red sandy loam).

There are no experiments on preparatory cultivation but one plot is under regular cultivation since 1917, being worked with monsoon plough three times a year and the cultivator twice a year while another plot received no cultivation at all. In each of these plots there are five experimental trees with border trees all round and the mean yield of nuts in the cultivated plot is 53·65 over a period of 20 years against an yield of 11·7 nuts from the uncultivated plot for the same period.

Regular cultivation is being advocated to the ryots.

(10) **Agricultural Research Station, Aduthurai**—(Paddy—Alluvial clayey).

Preparatory cultivation experiment:— An experiment was conducted for two years comparing the iron plough with the country plough.

The treatments were as follows —

1) Country plough twice.
2) Do four times.
3) Do eight times.
4) Cooper No. 11 once.
5) Do twice.
6) Do four times.

In 1941—42 the results were not statistically significant. In the next year the results were as follows:— 3, 2, 4, 5, 6, 1. In plots ploughed once with iron plough and twice with country plough there were weeds which had to be pulled out by hand.

Intercultureexperiment. There were two treatments.

1) Control.
2) Intercultivation twice.

There were three crops studied—

	Name.	*Sowing time*	*Duration.*
a)	Kuruvai	June	(100 days).
b)	Thaladi	August—September	(170 days).
c)	Samba	July—August	(170—180 days)

In the case of the Kuruvai crop the control was significantly better than the treated, while it was not significant in the other two cases.

General. "The Burmese Settun" and the puddler. The advantages of their use being obvious no experiment was conducted; but their use along with iron ploughs like Cooper 11 and 25 has been advocated to the ryots.

It may not be advisable to reduce the cultivation to less than 3 ploughings before the application of green leaf

(11) **Agricultural Research Station, Pattambi.** (Paddy)

In the dry lands no experiments were done. In the single and double crop lands an experiment to study the effect of intercultivation on broadcast crop of paddy was laid out in 1942-43 with the following four treatments:—

1) Raking lengthwise and breadthwise with a toothed rake.
2) Shallow ploughing one way with country plough.
3) Trampling by animals.
4) No treatment (control).

The results for 1942-43 are not significant and for 1943-44 it is not yet available

(12) **Agricultural Research Station, Samalkot.** (Paddy and sugarcane).

Cultivation experiments in paddy. (Puddling vs. no puddling). The treatments were

1) Puddling.
2) Dry ploughing.

Puddling was found to be better than no puddling and this is the practice followed by the ryots.

Ploughed fallow vs. Unploughed fallow in summer. Unploughed fallow is better, and this is almost a general practice in the tract.

Dry ploughing vs. Puddling. An experiment was conducted for six years since 1928-29 to 1933-34. The results are only indicative and not definite Dry ploughing tends to reduce the yields, and puddling is a necessary operation which increased the yields of winter series but not for Tholakari series. Winter ploughing was worse than Tholakarai dry ploughing. Application of green leaf and bone meal improved the yields in Tholakarai.

Sanding experiment Sand at the rate of 400 cartloads per acre, was found to depress the yields for the first three years.

Sugarcane: Trench vs. flat bed planting. The experiment was in single plots with no replications for 4 years. Bed planting was found to be better and this is also the ryots practice. Ridge planting also was tried but not found superior to planting in beds as the canes are cultivated amongst paddy fields. Propping and wrapping are necessary and are being practised in the District. It is found that unwrapped canes are harder to mill.

General remarks. It is seen from the above review that the results of cultivation in dry areas are influenced largely by seasonal conditions, especially the distribution of rainfall. In years of low rainfall, increased cultivation does not appear to enhance crop yields. On the other hand, if the rainfall is well distributed, as occurs in Guntur, the maximum cultivation gave the highest returns. Similarly with regard to interculture, intercultivation as a necessary operation for the removal of weeds is desirable. It has not, however, been possible, to fix definitely the number of intercultures to be given to crops. as this is dependent largely on the conditions obtaining during the particular season. As weeding is absolutely necessary for most crops, interculturing cannot be dispensed with. It may also be considered as part of the spare time operations of the cultivator.

Regular cultivation of coconuts has given higher yield of nuts Green manuring and puddling in the case of paddy and bed planting in the case of sugarcane gave good results. In addition to the use of iron ploughs, "The Burmese Settum" and the puddler were found to be very useful in preparing the land for paddy at Aduthurai.

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Contour Embankments in Dry Lands.

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Dry lands situated in low rainfall areas, can be permanently improved by providing contour embankments During rains a good deal of the water runs off the land carrying with it large quantities of silt. Much of this water if impounded on the land, will increase the moisture content of the soil, especially in low rainfall areas where it is badly wanted and result in the production of larger yields of crops. In addition to this, if the water is held the soil also is not removed. When the soil is retained, it stops deterioration by erosion.

Much care is taken by the cultivators of wet lands and garden lands to level and terrace the lands for irrigation. If levelling is done, the maximum benefits of rainfall and the least losses from soil erosion occur. Generally speaking such areas are not extensive as compared to the dry lands. The population in the area is large, the area of each holding is small and the economic position of the cultivators is much more favourable when compared to the dry land cultivators. Terracing the extensive dry lands is out of question owing to the magnitude of the work. It is unremunerative when applied to dry lands where the value of crop yields is low. But, it