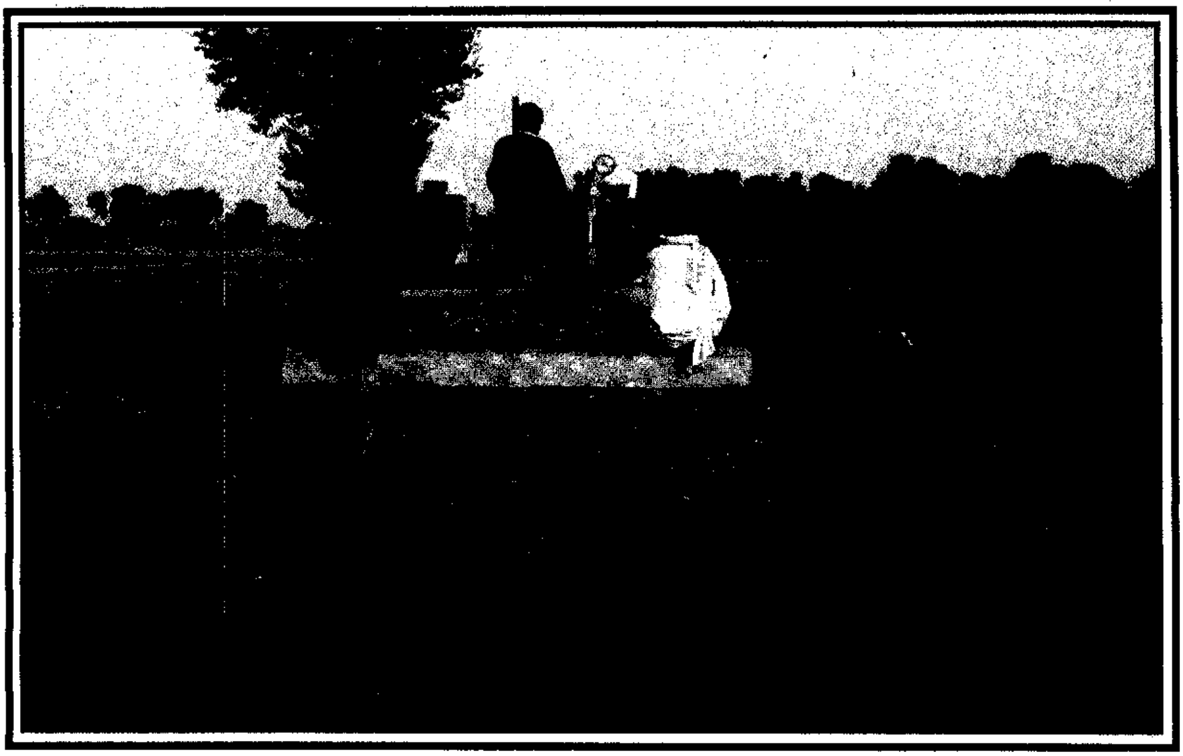
METHOD OF SHALLOW CORRUGATIONS FOR THE SOWING AND IRRIGATION OF CLOSE GROWING CROPS ON FLAT BASIN



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1 INTRODUCTION

Pakistan is land-abundant, but water-short. Irrigated agriculture in the country is primarily confined to the Indus Basin, where the groundwater quality varies considerably. A substantial area has brackish groundwater, and recharging surface water is irrecoverable in these areas. "Real – Wet" savings in water can be achieved in the area only if the recharge to groundwater is minimized.

The basin irrigation method is the most prevalent form of irrigation practiced within the Indus Basin. Recharge to groundwater under this method is significantly higher than improved irrigation methods, such as laser-leveled fields, sprinkler or drip systems. The adoption of these methods is hampered by high capital costs and unreliable water supplies. Therefore, there is a need to develop an irrigation method which require minimal capital costs and irrigation practices for circumstances where surface water supplies are unreliable. The new irrigation method is desired to reduce the advance time for a unit area of land to be irrigated and for deep percolation in different parts of the field to be minimized.

2 TRADITIONAL BASIN IRRIGATION METHOD

Under the existing method of basin irrigation , water normally follows along both side *bunds* of the *bunded* unit (Plate 1) Thus, water reaches the tail end first, instead of following the head-middle-tail sequence. The result is over-irrigation in the head and tail reaches of the field, as water remains in these locations for extended period during each irrigation application. Actually, the traditional methods of land leveling leave topographic variations on the soil surface. As a result, non-uniform advance front on such fields increases the irrigation application times. The problem of non-uniform irrigation becomes more severe with the low flow rates available at farm gate under the existing rotational system (Warabandi).

Plate 1. Irregular water advance front under the existing basin irrigation.

3 BASIN WITH SHALLOW CORRUGATIONS IRRIGATION METHOD

This method is based on the hypothesis that shallow corrugations on flat basin facilitate the development of a uniform advance front that ultimately increases surface irrigation efficiencies. Deep percolation losses and irrigation cost is reduced. Thus, water saved by adopting this method can be used to irrigate extra land, and as a result, the productivity of the available water is increased. The whole concept is based on the supposition that minor surface irregularities in basin irrigation can be managed by introducing shallow corrugations.

4 OBJECTIVES OF THE STUDY

a. To check the suitability of the "basin with shallow corrugations" irrigation method for close-growing crops sown at field capacity moisture content.
b. To compare the "basin" and "basin with shallow corrugations" irrigation methods, while considering the productivity of water and irrigation cost.
c. To ascertain the social acceptability and integration of the "basin with shallow corrugations" irrigation method with the existing crop cultivation practices.

5 DETAILS OF THE EXPERIMENT

5.1 Background

An experiment was conducted during the Rabi Season 1997-98 on wheat crop. The research area is located at the tail of Fordwah-Eastern Sadiqia Canals surrounding the Hasilpur town. The only difference in preparing the comparative plots, "basin" and "basin with shallow corrugations", was the use of the traditional and a modified plank in both the respective cases. Further, the use of the different planks is required once, while ending the wheat sowing operation. The traditional wooden plank is simply modified by fixing some pegs on its bottom (Plate 2), which have their special design and dimensions (Figure 1)

Plate 2. Simple modification in the traditional plank by fixing pegs on its bottom.

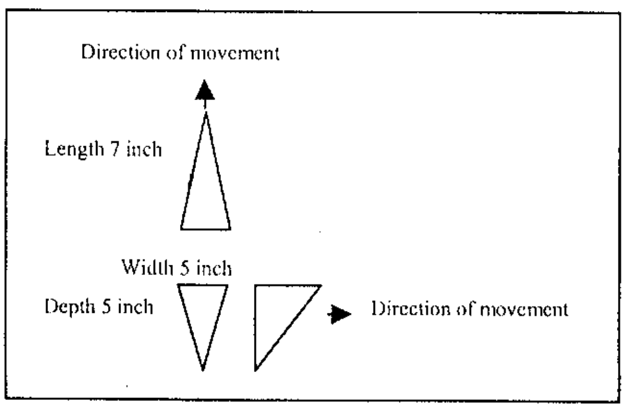

Figure 1. Schematic design of wooden pegs.

The design, dimensions and spacing of pegs were decided after extensive field trials to prepare the shallow corrugations on flat basin. This particular design of the pegs do not gather grass or the residue of previous crop during planking operation. The simplicity of the experiment is that the same plank is used in both the cases by simply changing its side (Plate 3). For proper field operation, the plank should have a six-inch extra length on both sides of the cultivator or drill machine.

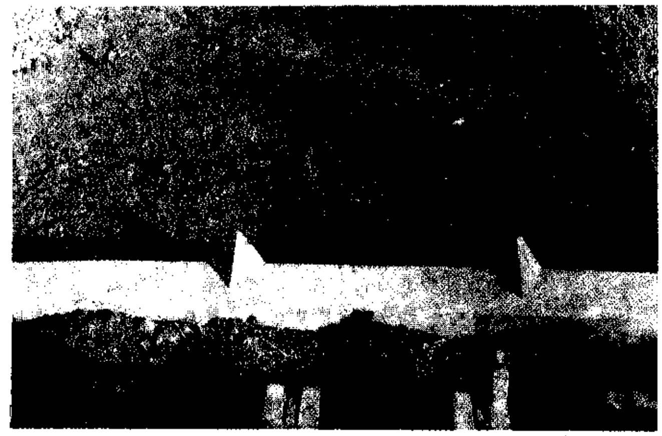

Plate 3. Normal use of the modified plank by changing its side.

Table 1 shows basic data of the experiment conducted during *Rabi* 1997-98. These sites were selected under a range of physical conditions for complete irrigation monitoring and evaluation work.

Table 1. Summary of "basin" and "basin with shallow corrugations" (S.C) fields.

Name of Farmers	Soil Type	Area of Plots (m^2)		Number of Irrigations	
		Basin Field	S.C. Field	Basin Field	S.C. Field
Trial 1					
Boota	Loamy Sand	2326.16	2326.16	5	5
Trial 2					
Shafiq	Loam	3879.31	3879.31	6	6
Rafiq	Sandy Loam	3882.24	3882.24	5	5
Bashir	Sandy Loam	1028.40	1028.40	6	6
Riaz1	Loam and Sandy Loam	2780.63	2780.63	5	5
Trial 3					
Amir	Sandy Loam	3883.32	3883.32	6	6
Riaz2	Loam and Sandy Loam	1312.50	1312.50	5	5

5.2. Description of the Trials

Trial 1: Broadcast Sowing and Planking by Bullocks

After broadcasting the wheat seed, bullocks were used for planking on both the fields, of basin and basin with shallow corrugations, selected for comparison (Plate 4).

Plate 4. Making the shallow corrugations by bullocks.

Trial 2: Broadcast Sowing and Planking with Tractor

After broadcasting the seed in both the fields, a tractor was used for the planking operation (Plate 5).

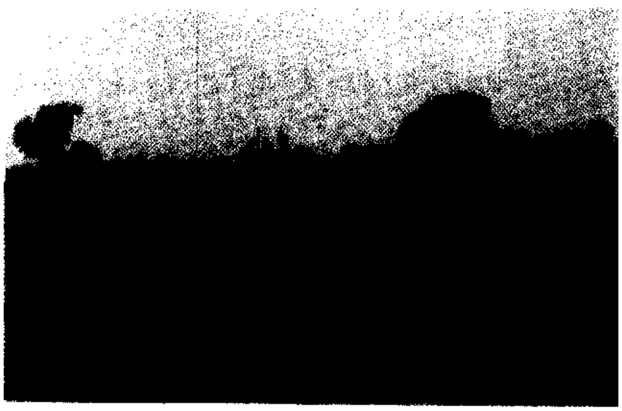

Plate 5. Using the modified plank behind a tractor cultivator.

Trial 3: Sowing by Drill Machine and Planking by Tractor

A traditional drill machine was used for the sowing operation with the plank on the rear, both driven by a tractor (Plate 6).

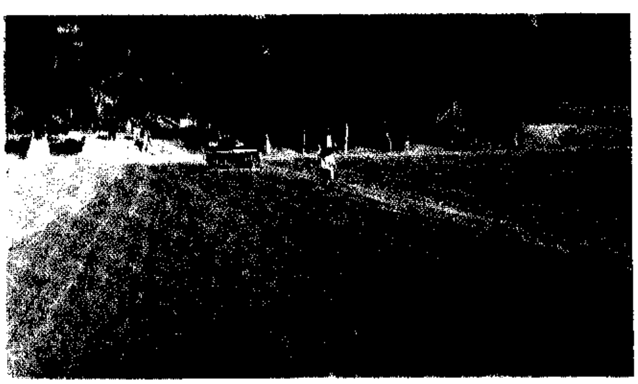

Plate 6. Sowing by drill machine and making of shallow corrugations.

6 Results And Discussion

Table 2 shows the results of the performance of the comparative irrigation methods, basin and basin with shallow corrugations. The effects of both the methods on crop yield, applied volume of water, and productivity of water, are given. Results are based on the data gathered during the complete crop season.

Table 2. Comparative performance of, basin and basin with shallow corrugations (S.C.), irrigation methods.

Farmers Name and Location of Farms	Average Yield (kg/ha)		Volume of Water Applied (m^3/ha)		Productivity of Water (kg/m^3)		Increase in Productivity of Water
	Basin Field	S.C. Field	Basin Field	S.C. Field	Basin Field	S.C. Field	%
Trial 1							
Boota 10-Fordwah	3355	3411	6982	5392	0.48	0.63	31
Trial 2							
Shafiq 6-Fordwah	2411	2362	6812	4708	0.35	0.50	43
Rafiq 13-Fordwah	4055	4831	2990	2311	1.36	2.09	54
Bashir 62-Fateh	4328	3978	20339	15724	0.21	0.25	19
Riaz1 Vill Bahadarwala	4431	4165	4760	2928	0.93	1.42	53
Trial 3							
Amir 17-Fordwah	3448	3935	1319	995	2.61	3.95	51
Riaz2 Vill. Bahadarwala	4041	3473	5921	3501	0.68	0.99	46

The comparison of yield per unit area has not shown a significant difference. However, the productivity of water varies from 0.21 to 2.61 kg/m^3 in the basin method, and from 0.25 to 3.95 kg/m^3 in the basin with shallow corrugations method over the whole season. Percent increase in the productivity of water, [(S.C.– Basin)/Basin] x 100, is from 19 to 54%.

Further simplified analysis of the observed data is shown in Figure 2, which compares the application time in min/ha on different irrigation events for an experiment site. The same analysis for all the sites over the whole season have shown a water saving range, 3.17 to 45.24 hr/ha, in the case of basin with shallow corrugations method as compared to the basin method. The saving in the time of application, when multiplied by the respective discharge rate, is equivalent to the water saved varying from 324 to 4615 m^3/ha.

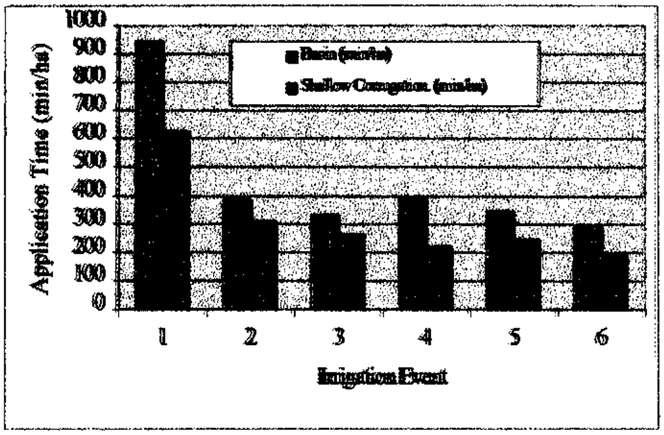

Figure 2. Application time for, basin and basin with shallow corrugations, irrigation methods at Shafiq Farm, Hasilpur.

7 Advantages of "Basin with Shallow Corrugations" Irrigation Method

The following conclusions are drawn from the field observations, farmers' view points and on the basis of results obtained from the experiment:

- Water advance relatively faster and uniformly in the field. Firstly, the water advance front moves in the corrugations from the head towards the tail reach of the field (Plate 7) Secondly, these corrugations are not deep, as it is clear from the name, "*shallow corrugations*". With the increase of surface storage, water from these shallow corrugations spread over the whole field as in the basin irrigation method (Plate 8). As a result, a uniform and an efficient irrigation is achieved which protect the build up of salinity patches and, reduces the deep percolation losses.

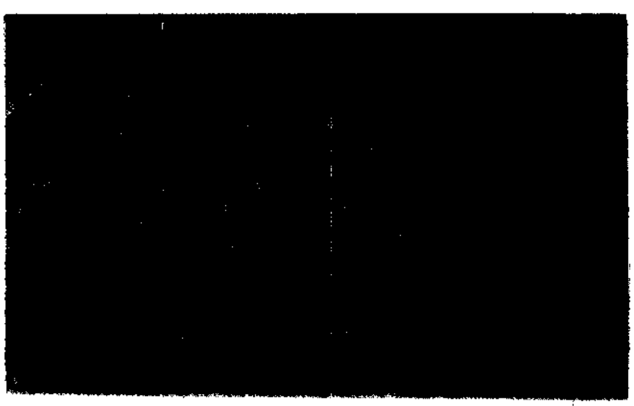

Plate 7. Advance front on a basin with shallow corrugations.

Plate 8. Complete irrigation of a basin with shallow corrugations.

- As the method takes less time to irrigate the field, it encourages the farmers to increase the cropped area within the available canal water supply. In addition, with the reduction of marginal quality groundwater use, the tubewell operation cost is reduced and salinity/sodicity hazard is also checked.
- Less, but adequate, water is applied while using this method and less chances of leaching down the nutrients from the root zone exist. Thus, maximum nutrients stay in the rootzone for the use of plants, which aid better crop growth. And farmers obtain maximum benefits from the costly inputs applied to the field.
- Due to these corrugations, there is less damage to the crop while spraying the chemicals because, the farmer follows corrugations that pass through the field. An additional advantage is that the field is sprayed uniformly because of its proper division by the corrugations, thus, weeds and insects can be controlled effectively.
- The use of the modified plank making the shallow corrugations does not affect the crop germination. The field observation reveals that seed germinates equally on both, the sides of the corrugations, as well as on the flat soil surface between two adjacent corrugations (Plate 9). At a later stage, the crop covers the whole field completely without any wastage of land (Plate 10).

Plate 9. Crop germination on a basin with shallow corrugations.

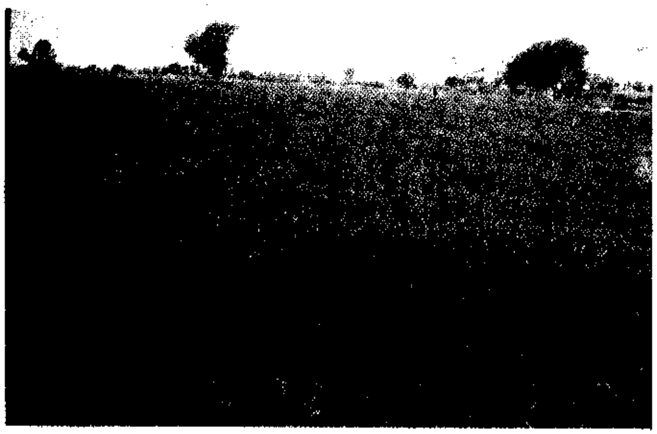

Plate 10. Full crop development on a basin with shallow corrugations.

8. Farmers' Response To The Intervention

In the very first season, after understanding the philosophy of the method, farmers showed keen interest on using the shallow corrugation plank as much as possible. In order to fulfil the farmers' demands, numerous planks were placed at different sites in the study area. More than fifty farmers benefited from this facility. Further, the farmers were willing to fix pegs on their own conventional planks.

9. Recommendations

Considering the improved performance of the basin with shallow corrugation irrigation method, this innovative and simple technique shows tremendous potential for its adaptation on wider scale. We suggest to prepare straight and shallow corrugations in the direction of the water movement on a filed. Perpendicular shallow corrugations should be made at the head and tail ends of the field, following a method similar to that of a normal drill operation for cotton sowing in Pakistan (Plate 11). The distance between two adjacent shallow corrugations should range from 2.0 to 2.5 feet, while the depth and width of a shallow corrugation should range from 4.0 to 5.0 inches for both the dimensions.

Plate 11. A field with recommended form of shallow corrugations.

10. Suitable Crops

The existing sowing practices of the following crops can easily benefit from the shallow corrugations technology:

Wheat, pulses, oil seed crops and fodder.

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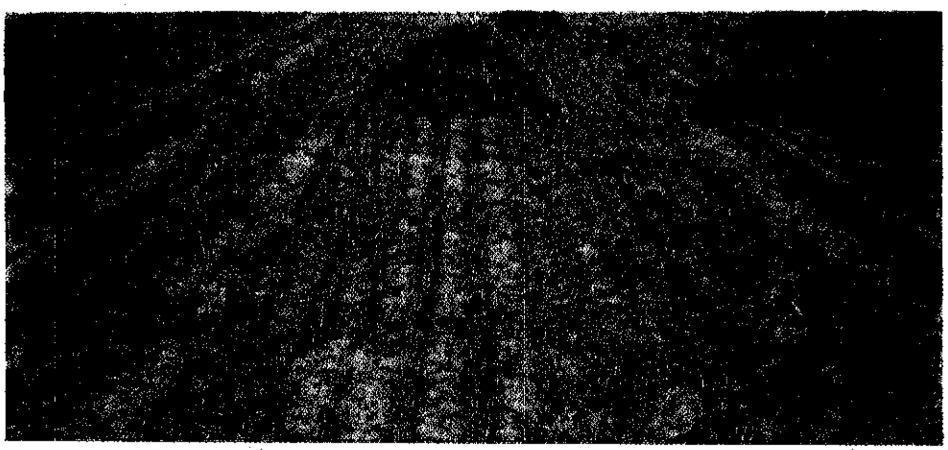
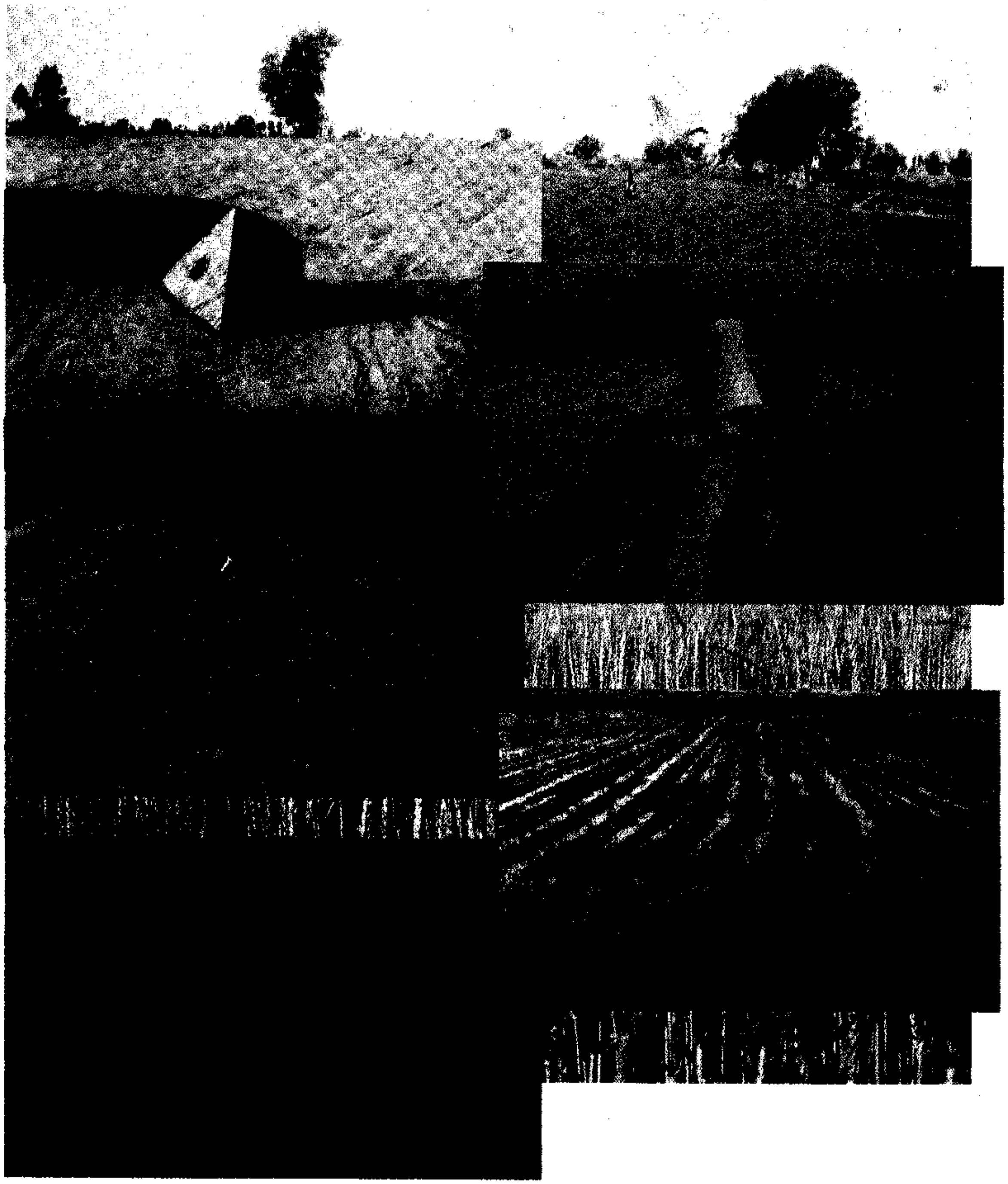


Note: Shallow corrugations are useful throughout the season especially for those close-growing crops, which do not require inter-culture operations after sowing. The above Plates show the existence of the shallow corrugations after wheat harvesting.



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