Rice Production Manual

Land Preparation

Rationale

Land preparation or soil tillage is one of the most expensive and critical operations conducted on a farm each season. The primary reason for tillage is to prepare the soil so that a crop can be established. The type of seedbed prepared will depend on the crop to be planted and the equipment or system used to establish the crop.

Objectives

At the end of this section participants will:

- Understand the reasons for tillage
- Identify different tillage implements
- Have a basic understanding of how the implements operate and when they should be used

Key Activity

This section introduces the concept of soil preparation through tillage, different tillage implements, plowing patterns and hands on experience in using different tillage equipment

Land Preparation

1. Introduction

Land preparation is the disturbance of the soil in preparation for establishing a crop. Land preparation covers a wide range of practices from zero-tillage or minimum tillage, which minimizes soil disturbance through to a totally 'puddled' soil, which actually destroys soil structure. It may include land leveling and bund construction.

The objective of land preparation includes:

- Decrease ped or clod size to give good seed soil contact for plant establishment
- Remove, incorporate or modify plant residue
- Manage soil water (both wetting and drying)
- Control weeds
- Mix and incorporate soil amendments such as lime and basal fertilizer
- Control or destroy insects, their eggs, larvae and breeding places
- Reduce wind and water erosion by leaving a rough surface.

Land preparation normally includes some form of tillage because irrespective of the farming system some form of soil disturbance and particle rearrangement will be necessary to establish the next crop.

2. Types of Tillage

Tillage is normally classified as primary or secondary tillage. While soil puddling can be classified as a secondary tillage its primary purpose is to restrict water movement or deep percolation from the soil surface.

Primary tillage is the first working after the last harvest and normally the most aggressive tillage operation. Tillage is best done when the soil is wet enough to allow the soil to be plowed and strong enough to give reasonable levels of support for the tractor. This can be immediately after the crop harvest or at the beginning of the next wet season. The dryer the soil, the more power that will be required to shatter and break the surface layers into smaller clods. In human and animal based system, the time of plowing is often

determined by the weather as rain or water is required to soften the soil before plowing can begin.

Primary tillage is done using disc plows, moldboard plows, tined plows and in some instances rotovators and is generally the deepest plowing (100-150mm) and requires the most energy.

Secondary tillage is any working completed after primary tillage. Secondary workings are usually shallower (50-75mm) and less aggressive than primary tillage. Normally 1-3 secondary workings are done after primary tillage and before planting but this will depend on the cloddiness of the soil, the number of weeds, the need to incorporate fertilizer and the need for puddling.

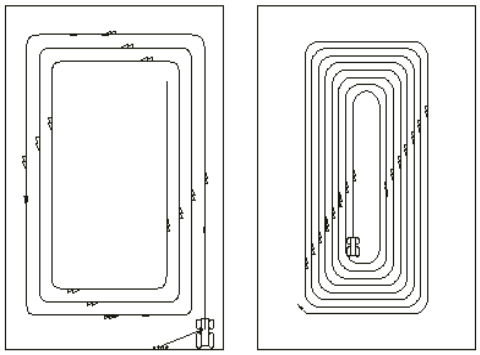
Implements used for secondary tillage include disc and peg tooth harrows, tined cultivators, rotovators.

Puddling is the working of the soil in a totally flooded state to realign soil particles in a manner that will reduce the deep water percolation and leave the surface level for crop establishment. It is normally done using tractors and rotovators or animals and peg tooth harrows. In Africa soils are often puddled by human labor

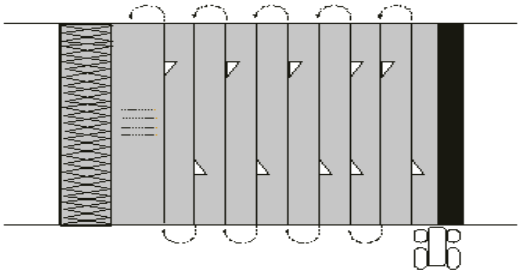
3. Plowing Patterns

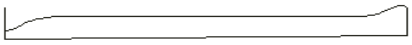
The plowing pattern adopted will normally be pre-determined by the implement being used. When using a one way plow or a plow that throws soil in one direction, a continuous or round and round pattern will have to be used. If a tined, offset plow or rotovator is used then and up and back or land pattern can be used.

Continuous pattern. Plowing begins at the edge of the field and works toward the center of the field always throwing the soil towards the outside of the field. This pattern is used with one-way disc and moldboard plows.



Circuitous Pattern

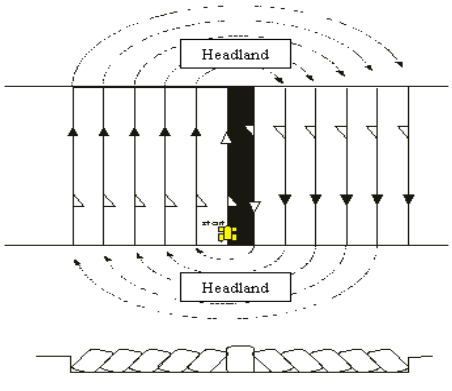


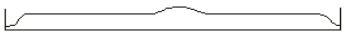


Headland Pattern

Headland Pattern. Plowing begins at one end of the field and works up and back until it reaches the other end of the field. This pattern can be used with reversible plows, rotovator and tined plows. This pattern leaves a level surface

Land Pattern. This system starts plowing in the centerline of the field and works out towards the field's edge. This pattern can be used with all implements but care must be taken to start plowing exactly in the center of the field. This pattern leaves a level surface





Land System Pattern

4. Tillage implements used in rice production

Primary tillage implements

Moldboard plow

The moldboard plow is the most popular plow used in animal based and wet farming systems. The plow is made up of a mold or digging point and a board which turns the soil. It relies on the mold or dogging point to pull the plow into the soil.

Plowing depth is normally controlled through a depth control wheel at the rear on tractor mounted plows or by the operator moving the handle fore and aft on an animal plow. It relies on killing weeds by incorporation and does not handle obstacle such as stumps or rocks well. For animals and 2 wheel tractors it is normal to use 1 plow bottom. For 4-whweel tractors 3-4 plow bottoms are normally mounted on a frame connected by the 3-piont linkage to the tractor. Moldboards may also be mounted as reversible plows which allows them to be used in a up and back plowing pattern. The tractors tire is normally aligned in the last furrow to give complete soil tillage. In broad acre farming applications where more than 4 bottoms are needed they may be set up in a drag or towed version behind the tractor.

One way disc plow

The one-way disc plow, as the name suggests, throws soil one way. The plow relies on its own weight to penetrate the soil. It works best in moist soil and handles obstacle much better than moldboard plows. It comes in as 3 point linkage mounted and as drag models when larger than 4 discs. They also need rear mounted depth control wheels. They normally require less power than moldboards but have higher maintenance costs as they have disc bearings and the discs wear in abrasive soils. Like for 3 point linkage moldboard plows, the tractor tires are aligned in the last worked furrow to give complete field tillage.

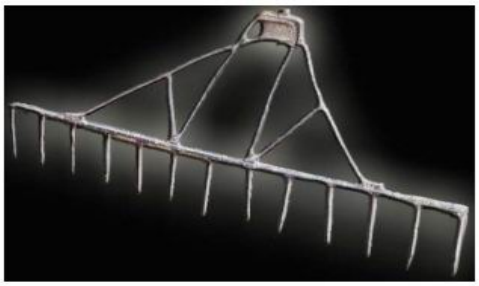
Offset or 2 way disc plow

This plow is made up of 2 gangs of discs. One gang throws soil one way and then the following gang throws soil in the reverse direction which leaves the soil surface in a more level state. The discs are mounted on a common arbor bolt with set spacers between each disc and the gang suspended from a common frame by roller bearings.. As the name suggest this plow can be offset from the center of the tractor and also relies on its own weight for penetration. Adjustments can be made to increase the pressure on the front or rear gang of discs. The tractor can be operated in the plow furrow or on undisturbed soil depending on how the center of pull is aligned. There are 3 point linkage or drag versions available and the depth of working is controlled by the tractor 3 point linkage hydraulics for mounted versions and center mounted depth wheels on the trailed versions.

Secondary Tillage Implements

Tine Cultivator

The tine cultivator is made up of evenly spaced tines mounted on a single or multiple tool bars. They are widely used after the initial plowing to reduce the clods sizes, control weeds and level the soil surface. When mounted behind a 2-wheel tractor or animal they can be used in both flooded and dry conditions. On 4-wheel tractors they are normally only used in dry conditions. They require less power (7-10kW/m) than discs and moldboard and rely on killing the weeds by cutting the roots and leaving them on the surface.



Disc cultivators

These are made up of 2 or 4 gangs of discs. The disc sizes are much smaller than the one way disc (50cm) and may be scalloped or plain. Scalloped discs are more aggressive than plain discs. The disc cultivator relies on the implements weight for penetration and kills weeds band reduced clod sizes by cuttings and burying. They need to operate faster than other plows to maximize performance (6-8km/ hr.) and can be a used as a 3 point linkage mounted or drag type configuration

Rotovators

A rotovator works by hoes mounted along a PTO driven shaft pulverizing the soil in the direction of travel. It kills weeds and breaks down soil clods through pulverization and has high energy requirements (up to 15-30Kw/m width). Rotovators may be mounted on 2 or 4-wheel tractors and can be used in both wet and dry conditions depending on the size and shape of the hoe. Rotovators are often used for wet puddling but care needs to be taken that the gear boxes are properly sealed and lubricated. Rotovators do not handle obstacles, such as stumps or rocks in the field, very well and have high repair and maintenance costs.

Puddling Equipment

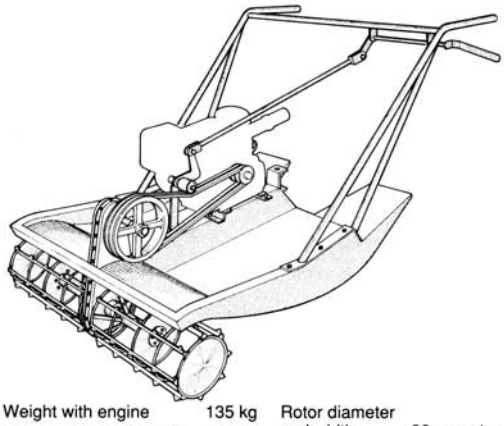
Puddling the soil to decrease deep water percolation and control weeds is done in many different ways.

Cage wheels

Steel cage wheels are used on both 2-wheel and 4-wheel tractors to puddle the soil and bury weeds by operating at high levels of wheel slip. This may be done in association with using a mounted rotovator or draging a leveling board behind

Hydrotillers

A hydrotiller puddles the soil and buries weeds and residue by a powered rotor. Hysdrotillers are propelled forward by an engine driven rotor attached to a platform that incorporates airtight floats. They are normally driven by a 7-10kW engine and the speed of operation and level of puddling controlled by the wieght applied to the rear of the machine by the operator. They only work in flooded conditions and transportion to and from the field may cause problems. In some instances wheels are fitted to the outside of the rotor for transportation purposes



Weight with engine	135 kg	Rotor diameter and width	38 cm x 1 m
Horsepower (brake hp)	7.5-12	Rotor speed	325 rpm
Fuel	diesel or gasoline	Field capacity, first pass (puddling and incorporating)	1.8 ha/8 h
Length	195 cm		
Width	100 cm		
Height	75 cm		

Tractor Mounted puddlers

A 3 piont linkage puddler is very similar in design to a rotovator excepthey are less robust and have smaller rotating drums and shoes. They are designed to operate at a maximum of 50-75mm depth and are normally wider than a conventional rotovator. They can be used in both wet and dry conditions but standing water in the field is preferred. They leave the field level and work best when laser controlled

Table . Comparison of different tillage implements and mode of action

	Moldboard	One way Disc	Offset disc	Tine Implement	Rotovator
Power source	Animal, 2 wheel and 4 wheel tractor	2 wheel and 4 wheel tractor	4 wheel tractor	Animal, 2 wheel and 4 wheel tractor	2 wheel and 4 wheel tractor
Width	1-3 shares	2-4 disc	9-21 discs	1-15 tine	0.5m-3.0 m
Soil disturbance	High	Medium - high	High	Low	Very high
Plow action	Total inversion	Inversion	Inversion /cutting	Cutting and lifting	Total inversion and pulverization .
Soil Penetration	Share design	Machine weight	Machine weight	Weight/ design	Rotary action of tiller
Weed control	Bury	Bury	Cut/bury	Cut and lift to surface	Bury and chopping
Handle obstacles	Poor	Good	Good	Medium - good	Poor
Power requirement	High	Medium - heavy	Medium - heavy	Low-medium	Very high

5. Operating Tillage equipment

Maintenance checks prior to going to field

- Make sure all nuts and bolts are tight especially on plow discs and plow shares
- Grease all nipples before use, especially disc bearings
- Adjust tire pressures on trailing equipment (280 kPa or 40 psi)
- Check for hydraulic leaks on tractor and implement hydraulic cylinders and hoses
- Carry tools for adjustments in field

Attached implement correctly

- Ensure implement is attached correctly and all safety fittings in place e.g. PTO cover in place, 3 point linkage pins in place, side chains connected and adjusted
- For 3 point linkage equipment, connect the non-adjustable bottom arm first, followed by the adjustable bottom arm and then the adjustable top link
- Make sure sway chains are tightened to stop excessive side to side movement of the equipment
- Make sure the implement is level front to rear and also across the width of the machine. For 3 point linkage mounted equipment the top link can be used to adjust front to rear and the adjustable side arm on the bottom link for side to side levelness
- On trailing and semi mounted equipment make sure the drawbar pin is attached through the top cleat and will not come out during work

Set up in field

- Select the correct plowing pattern by understanding how the machine interacts with soil. One way disc and moldboard always throw soil to the right hand side. With, offset plows, the front gang throws soil one way and the rear gang covers by throwing soil back over the first cut.
- Ensure the implement is set at correct depth. This can be done via the hydraulic depth control on the tractor and the depth control wheel on the implement. Make sure the depth is even across the working with

Operating speed

- Select the correct tractor gear and throttle setting for the type of work to be done. Primary tillage should be done at a slower speed, 4-6km/hr, where as secondary working such as offset disking is best done at higher speed of 7-8km/hr. Check the gear speeds labels attached to tractor
- Position tractor and implement in correct part of field.
- Make sure the foot brakes are not connected and move off slowly using the hand throttle at about 50% setting. When confident that everything is in order then increase the operating speed to full throttle.

- If the tractor engine is laboring with the load then select a lower gear
- If the tractor tires are slipping excessively then reduce the load by reducing the operating width of the implement or depth of operation.

Monitoring and checking

- Continuously monitor the job that is being done by observing the implement, the soil conditions being left and the tractors performance.
- Listen for abnormal noises both from the tractor and implement
- Periodically stop and check tractor and implement.
- Stay alert continuously