

Soil preparation for potato planting

INTRODUCTION

Good potato production starts with good field selection followed by correct tillage practices. It is essential to properly prepare seedbeds to develop maximum potato quality and yield. Even the best soil will produce inferior yields and quality if the soil isn't prepared correctly. The soil where all production takes place is a dynamic resource that supports life. Soil provides several essential services:

-) soil supports plant growth,
-) soil regulates the distribution of water,
-) soil stores and manages nutrients,
-) soil acts as filter to protect resources and
-) soil supports structure.

The overall goal in soil management is to maintain or improve soil quality without adversely affecting other resources. The main aspect that should be looked at is soil structure. A good structure is built by stable aggregates (groups of soil particles and organic matter that bind to each other more strongly than to adjacent particles giving the spaces for exchange of air and water). A good structure allows good water infiltration into the soil and water drainage through the soil, exchange of gases (CO₂ & O₂) in and out of the soil, and optimal root development. Mechanical compaction and low organic matter content are the main causes for bad soil structure. Common results of bad soil structure are surface crusts, hard layers in the soil, and clods. Organic matter is the key

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Think again. Think McCain.

factor in good soil structure: It makes heavy soil more friable, and easier to work. It also gives light sandy soils a better degree of aggregation and increases available water content.

For uniform sprout emergence and young plant vigour a uniformly firm, porous, moist seedbed is one of the aspects necessary to achieve this. Uniformity of plant emergence is related to a uniform planting depth. Without a well-prepared and moist (70-80% of available soil water) seedbed at 13-16°C, a uniform emergence will not be achieved (Figure 1). Harvesting damage increases if hard clods aren't broken into sizes below 40mm. The pre-plant tillage practices

have a large influence on the amount of soil aeration and compaction that exist late in the season. Aspects that need consideration before the start of soil preparation are: the previous crop grown, depth of compaction, level of soil aggregation needed, and a level and firm seedbed.

Before the start of soil preparation

Choose a field suitable for potato production: at least 40cm soil depth, avoid stones, avoid very high clay percentage (>25%), and avoid steep slopes.

Mark problem areas in the field before tillage to avoid planting these areas. Problem spots can be stony spots, low

depressions where water-logging will occur. If these areas are planted the yield and quality definitely will be low. It can act as a starting point for disease/rot to spread through the crop in the field or in store. It can cause difficulties during harvest such as slowing down and equipment breakdowns.

Evaluate the conditions the field is left in after the previous crop is harvested. Look at size and amount of residue left in the field; dig down to detect compacted layers.

After these three handlings start to put together an optimal tillage strategy regarding timing and type of implements that will be used.

Aspects with regard to seedbed preparation

Previous crop

Disease tolerance of preceding crops is an important aspect that should be taken into consideration when deciding on rotation systems but from a soil structure point of view the crops preceding the potato crop should have a deeper root system than the potato plant. The potato plant is seen as a crop with a relative shallow root system (bulk of roots less than 40cm deep). A good deep root system from the previous crop improves (sub-)soil structure. Grain crops in general have deep root systems for improving soil conditions.

If a lot of large residue is left from the previous crop (maize), chop plant debris as fine as economically feasible (at least <20cm), spread evenly and incorporate into the soil, as soon as possible after harvest, so that decomposition is maximum before planting

Figure 1. Potato crop canopy development in the 2002/3 Highveld potato season.

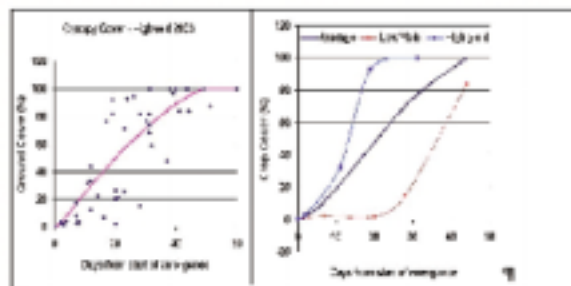


Figure 1. Potato crop canopy development in the 2002/3 Highveld potato season.

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potatoes. Under-decomposed organic fractions may cause serious nutritional and quality problems. Micro-organisms may compete with the plants for nutrients. Decomposing organic material may also cause external skin blemishes and increase the number of misshapen tubers. Excessive crop debris and heavily manured fields may increase common scab (Wright, et al, 1977).

Some residue left on the surface will have beneficial effects such as avoiding higher crust formation, aeration, better water infiltration and less erosion. From a physical view about 10-20% surface residue is optimal. Existing problems with diseases have to be kept in mind as plant residues can play a role in the survival of pathogens.

Field preparation

There is no standard tillage system used for the preparation of potato fields. The variation in acceptable tillage practices is a result of the wide range of soil types, rotations, time and tillage implements available. Regardless of the tillage system used in land preparation, it must meet the following criteria:

- Work soil under relatively dry soil conditions (about 40%-60% of field water capacity). Figure 2 gives an indication of how soil workability changes as the water content increases.
- Remove compaction down to 45-50cm.
- Leave a level, firm soil. (Cage) rollers and leveling boards attached to implements are very effective.
- Field preparation should be performed in as

few operations as possible. Cultivation steps should therefore be combined where possible. (Figure 3).

- Sufficient crop residue must be incorporated into the soil to allow for trouble-free planting.
- Tillage should produce enough loose soil to allow the planter shoe to penetrate to the desired depth and to provide the hilling discs with enough loose soil to construct a proper hill over the seed and provide adequate available loose soil under the seed tuber to aid the lifting process and avoid the lifting of clods from the deeper layers (Figure 4). Between 15 to 20cm (depending on planting system) of clod-free soil should be prepared for a seedbed.

- Sufficient tillage is required to properly incorporate pre-emergence herbicides. Follow the manufacturers instructions regarding the tillage method required for herbicide incorporation.

The land preparation tillage system that a grower chooses should not:

- Incorporate an excessive amount of trash leaving the soil susceptible to wind erosion. At planting, sufficient crop residue should remain on the surface to prevent wind erosion without hampering the planting operation and to increase water infiltration.
- Dry out the soil surface and reduce emergence vigour.
- Produce soil clods that will remain intact throughout the growing season until harvest. Clods need to be <40mm to be able to fall through the harvester web. Soil clods are difficult to separate from

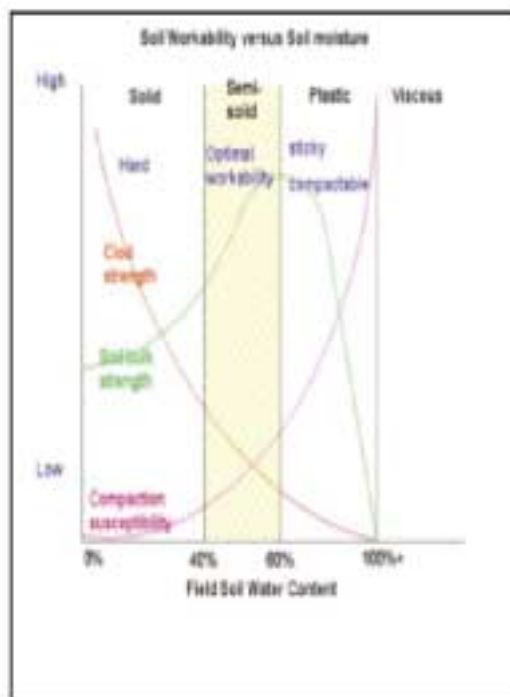


Figure 2. Workability of soils with different soil moisture contents.

the potatoes on the mechanical harvester and will cause black spot bruising. Field preparation should be performed in as few operations as possible. Excessive tillage will increase the cost of production, the likelihood of wind erosion and the amount of soil compaction and loss of moisture.

Soil tillage operations

Tillage from the previous crop to the end of the potato crop should be looked at in specific phases (Figure 5). It is also possible to combine some of these phases to reduce traffic on the field.

- Post harvest tillage: Remove adverse effects from the previous crop. This must be done as soon as the previous crop is removed to allow for optimal decomposing of plant residues, and the killing of weeds.
- Primary tillage: Prepare soil for the next crop. The aim is to eradi-

cate compaction to at least 50cm depth, to improve pore volume of the arable layer (about 30cm deep) and to cover or mix crop residue.

- Preparation of a seedbed for planting: To prepare a good seedbed the soil should be loose and at the desired aggregation (optimum size is about 6mm) to a depth of 20cm. Always avoid clods bigger than 40 mm, because they will cause trouble at harvest. Remember that working soils too wet will lead to compaction resulting in poor root and water penetration. Loose seedbed soil (5cm) under the seed potato is desired to allow the harvester blade to run through clod-free soil to avoid 'harvesting clods' and/or cutting tubers.

A successfully applied tillage strategy will lead to the right amount of residue on top of the soil and the right amount incorporated into the soil,

no weeds growing, compaction removed and a clod-free seedbed that is uniformly firm around the seed but allows free air and water movement through the soil.

The use of levelling bars and rollers behind bars and rollers behind implements can be beneficial in each stage of tillage. A level soil surface provides a uniform topography to aid the planting and hilling operation and also ensures equal water distribution to the crop roots in all parts of the field. A soil that is slightly firmed shows less tracks from the following equipment passing and ensures an improved hydraulic conductivity.

If the soil is worked too wet, harmful effects will occur including compaction by equipment, formation of tillage pans, and clods will be produced. This can lead to yield and quality reduction and/or increased tillage costs to remove these harmful effects.

A tillage pan occurs when the soil is worked at the same depth year after year, especially when using mouldboard plows, disks and rotary tillers. This can be avoided by working different seasons at different depths and alternating deep-rooted crops with potato crops.

It is important to reduce field traffic to the minimum and to restrict it to lanes, if possible.

Combining tillage operations is very useful to reduce field traffic. To reduce the harmful soil compaction by field traffic keep axle loads as low as possible. Other than avoiding using heavy equipment, the use of wide (or duals) low-pressure flexible radial tires is very useful and practical.

Crop Management Tillage

This is done to shape the



Figure 3. Combine cultivation steps to decrease field traffic: 1 - loosening and mixing; 2 - leveling; 3 - compacting and breaking clods.

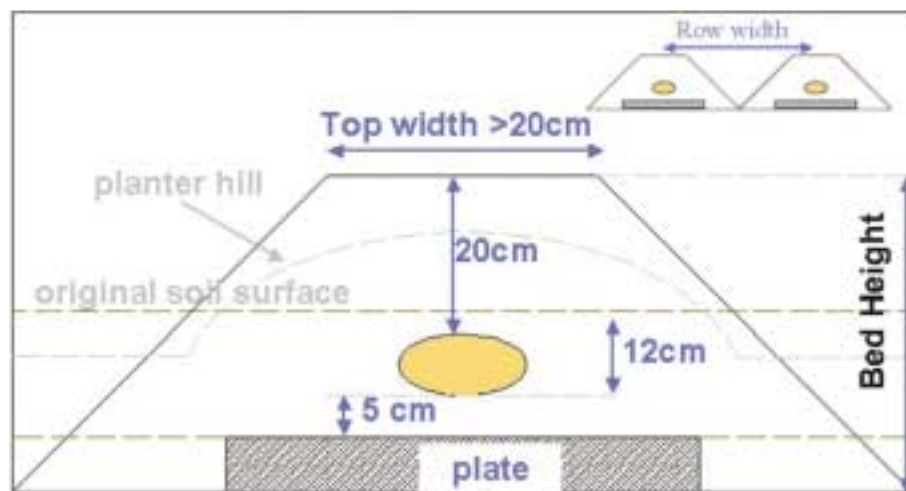


Figure 4. Structure of the potato hill after planting.

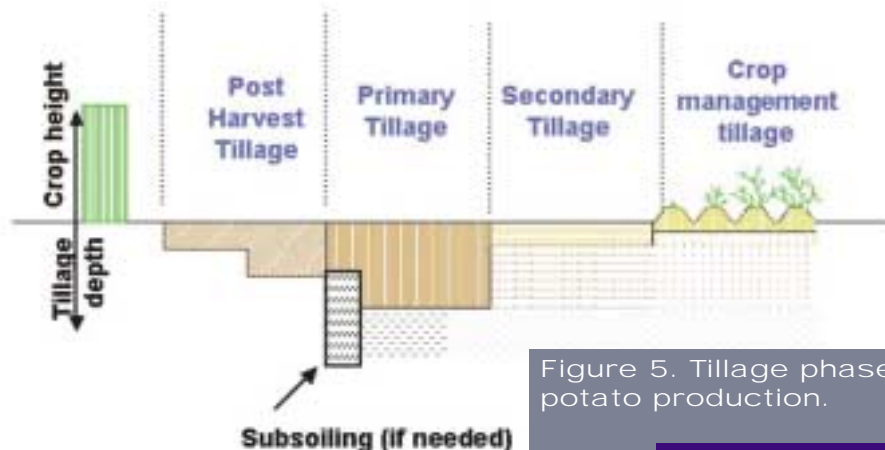


Figure 5. Tillage phases for potato production.
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optimal potato hill that avoids green tubers, surface crusts and erosion. Also weed & water control can be an objective (Figure 4).

The most effective hill parameter to prevent green tubers (ex. Santana) is increasing the height above the seed piece (at least 20cm) and increase top width of hill (at least 25cm). Larger hills will improve water management by holding more water and lowering temperatures. This will lead to shorter stolons and less greening. Shape the ridge top according to the climate. With a high rainfall leave a sharp top and with a water shortage flatten top or even leave a shallow furrow on top. The optimal water holding capacity, heat transfer and reduced damage at harvest are achieved with an aggregate size around 6mm. Some soils can

cause severe cracks in the hill, leading to green tubers and damage by the tuber moth. Cracking can be reduced with a higher degree of crumbling and a low degree of hill compressing.

Harvesting

Most damage in the field occurs during harvesting on the harvester. For more information on bruise prevention see guidelines on the "Handling of potatoes to reduce bruising". Timing of operations is critical in managing for a healthy damage-free potato crop. Tillage affects harvest bruising primarily by influencing clod formation. Clods are a significant source of bruising during harvest. All field operations should be managed to minimize soil compaction and clod formation.

Potatoes intended for long-term storage should

not be harvested until the vines have been dead for at least 10-14 days to allow for skin set. Soil moisture and temperature must be monitored closely. Optimal soil conditions are 60-65% available soil water and a tuber temperature of 10-18°C.

Conclusion

- Always check the effect of an implement by digging down behind the implement. Remember soil settles after tillage, so effective depth will be lower over time than shortly after the implement had passed.
- Never work soil that is too wet.
- Soil preparation starts as soon as the previous crop is removed.
- Leave a level surface. Every time you create unevenness, it takes energy and time to level it out later.
- Avoid big hard clods

drying off on top of surface.

- Adjust implements and soil beds to the situation/environment in a specific field and even certain spots.
- Restrict field traffic to the minimum by combining cultivation actions.

Literature

Wright D.N., Bishop J.C., Harvey O.A., Baghott K.G., Voss R.E. & Timm H. 1977. Potato preplant tillage practices. Leaflet 2682, University of California. Plissey E.S. 1993. Maintaining tuber health during harvest, storage and post-storage handling. In: Potato Health Management. R.C. Rowe, ed. APS Press. Minnesota. USA.