Cover crops and crop rotation

Exercise 1 Looking at the roots of cover crops

Introduction

Crop roots are important to take up nutrients and water for the plants. Besides this they are very important to keep the soil healthy: they exude gel-like substances and sugars on which (good) microorganisms feed and with which soil particles are glued together. Growing every year the same crop will mean that a certain layer of the soil is constantly explored for nutrients and will impoverish, while the above and below laying layer are not used for crop growth. By using crop rotation and cover crops, this problem will be solved, as all crops use different ways of exploring the soil. Some root systems are very aggressive, while others have a pen root that grows straight downwards. When roots die, they are decomposed by micro and macroorganisms and the channels they leave in the soil will help to circulate air and transport water.

Objectives

- To observe root systems of different crops and cover crops

Expected output

- Understanding the function of roots in soil building processes
- Be able to select certain (cover) crops for rotation in order to tackle certain soil problems.

Preparation required

Identify five different (cover) crops that might be useful in crop rotations in the area. Either sow them before the FFS starts or identify them in the field.

Use crops with very different root systems, like millet, sunflower, casor bean, vetch, horse radish, Crotalaria, etc.

Materials required

- Spade and knife or trowels for all groups
- Buckets with water to rinse the root system for all groups
- Plastic sheets
- Measuring tape, pens and paper

Time required

2 hours.

Timing

When discussing the importance of cover crops and crop rotation.

Procedure

1. Ask the farmers whether they know the identified crop and what use they give to it.

The group can be split up in sub-groups and all groups are dealing with one species. Results can be shared as a plenary session.

2. Dig a pit close to the stem of the crop, but be careful not to harm the roots a lot.
3. Use the knife or trowels to visualize the roots.
4. Measure to which soil depth the roots are exploring for nutrients and water.

Uproot the plant carefully and rinse the soil from the root system. Lay down the plant on the plastic sheet and study the roots.

5. Descripe the roots - fine, many, coarse, thick, few, long, nodules, etc.
6. Make a drawing of the root system and indicate your findings in the drawing.

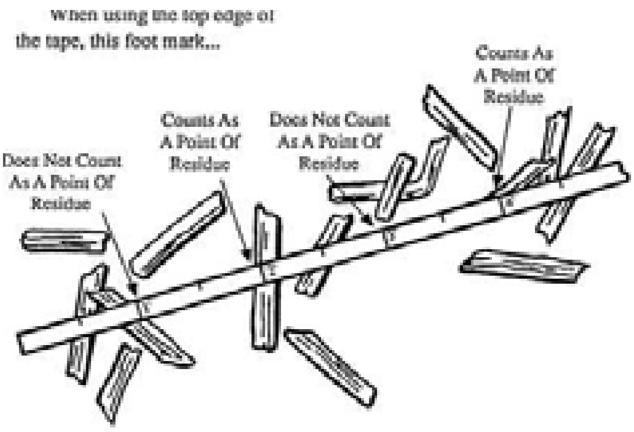
Questions to relate the topic to conservation agriculture

Did you find a lot of differences between the different root systems?

What would be the effect of the different root systems on the soil?

What would be the effect of the different root systems on the next commercial crop?

Can you think of other uses for root systems in building a healthier soil and crop? Do you know any?



Exercise 2 Estimation of soil cover

Introduction

Knowing how to manage crop residues is key to success with conservation agriculture. People always talk about soil cover. Some people even talk about a certain percentage of soil cover that is the minimum for the system to function properly. This exercise will demostrate an easy way of estimating the percentage soil cover.

For most crops, conservation agriculture systems help maintain residue cover levels well above 30%. The exceptions are crops like soybeans, cotton and sunflowers that produce either low quantities or fragile residue which decompose quickly.

Objectives

- To estimate the percentage soil cover by using a rope.

Expected output

- Estimation of the amount of soil cover in a specific field.

Preparation required

Tie a knot at every 50 cm of a 5 m long rope.

Materials required

- 5 m long rope with a knot at every 0.5 m, including at the end of the rope
- paper and pens

Time required

½ hour.

Timing

When discussing the importance of soil cover.

Procedure

1. Throw the rope randomly in the field.
2. Investigate whether each knot is in contact with bare soil or soil cover (can be residues, green plant material, stone, etc.)
3. Count the number of knots that are in contact with soil cover
4. Use the following calculation to determine the percentage of soil cover:

$$\text{Percentage of soil cover} = \frac{\text{Number of knots} * 100}{10}$$

5. Repeat in at least ten different places in the plot.

Questions to relate the topic to conservation agriculture

Why is soil cover important?

In what ways can soil cover be increased in the field?

Exercise 3 Soil humidity: cover vs bare soil

Introduction

The exercise on evaporation showed already that soils can "sweat" and loose water from its surface when placed in the sun. We tried to demonstrate that covering the soil has a positive effect on the amount of water conserved in the soil. This experiment will try to do the same.

Objectives

- To observe the soil moisture condition under different land management.

Expected output

- Understanding of the importance of soil cover and the use of cover crops.

Preparation required

Identify two different locations close to each other. One with bare soil or thoroughly ploughed and one no-tillage plot with adequate soil cover.

Materials required

- None

Time required

½ hour.

Timing

When discussing evaporation from the soil.

Procedure

1. Describe the soil cover, indicate the thickness of the cover
2. Lift or remove the soil cover and describe the soil surface, indicating the moisture level, number of organisms and their activity
3. Try to indicate the soil moisture content by squeezing part of the soil in your hand, indicate whether moist, wet or dry, sticky or dusty, etc.
4. Go to the next location and repeat numbers 1-3.

Questions to relate the topic to conservation agriculture

What is the effect of the soil cover on the moisture content of the soil?

Did you notice a difference in number and/or activity of small insects or earthworms at the soil surface in the different locations?

What would be the effect on a germinating crop?

Exercise 4 Soil temperature: cover vs bare soil

Introduction

Bare soil, i.e. soil without a dead or living cover, is exposed to the sun. Like a hat that keeps the head in the shadow, the cover keeps the soil out of the sun and reduces the soil temperature. Soil temperature not only influences the absorption of water and nutrients by plant roots, seed germination and root development, but also microbial activity and crusting and hardening of the soil. Soil temperatures that are too high are a major constraint to crop production in many soils and ecoregions of the tropics. The ideal rooting-zone temperature for germination and seedling growth ranges from 25-35ºC. Temperatures exceeding 35ºC reduce drastically the development of maize seedlings and there is hardly no germination of soya seed when temperatures exceed 40ºC.

Objectives

- To measure the soil temperature under different land management practices different moments of the day.

Expected output

- Understanding of the importance of soil cover and the use of cover crops.

Preparation required

Identify two different locations close to each other. One with bare soil or thoroughly ploughed and one no-tillage plot with adequate soil cover.

Materials required

- (Soil) thermometer, ranging from 20-60ºC
- Pens and paper to record
- Maskin tape

Time required

½ hour.

Timing

When discussing crop development (germination, root development, water up-take, etc.).

Procedure

1. Measure distances of 1 and 5 cm from the tip of the thermometer and indicate with maskin tape.
2. Insert the thermometer to a depth of 1 cm in the bare soil of the ploughed area.
3. Observe the rise of the mercury bar and take the thermometer reading.
4. Repeat on 9 other spots in the same area.
5. Move to the covered area and repeat step 2-4.
6. Take the temperature for instance at the beginning, half-way and end of the FFS session. Alternatively sub-groups can take the temperature: every hour an other group.
7. Calculate the average of the 2 * 10 observations and share the results in a plenary session.

Questions to relate the topic to conservation agriculture

Where did you find the highest temperatures?

What happened to the temperature during the FFS session? What was the reason for this?

Do you have specific observations on the two soils?

What will be the effect of this temperature on crop seeds, weed seeds and soil organisms?

Can you think of other ways to reduce the soil temperature?