

WATER MANAGEMENT – LARGER YIELD AND LOWER COSTS

Christian HALDRUP

The Knowledge Centre for Agriculture, 15, Agro Food Park, DK8200, Aarhus, Denmark,
Phone: +4587405000, E-mail: chr@vfl.dk

Corresponding author e-mail: chr@vfl.dk

Abstract

Water is the limiting factor for plant production. From “black” soil, soil without plants, there is almost no evaporation. All plants are using water for growth and when the soil is covered by plants, no matter whether it is crops or weeds, it is consuming up to 5 litres of water per m² per day. When the soil is cultivated under dry conditions, an evaporation of 15 litres per m² of water can be expected. Weed control and soil tillage are key factors in water management. To avoid unnecessary evaporation, the weeds must be controlled from harvest, before harvest if possible, until a new crop is to be planted. And the weeds must be controlled in the early growth stages of the crops, to secure water, neutrinos and light for the crop. To minimise the evaporation, the soil tillage and the working depth by tillage must be reduced to a minimum. By new technologies no tillage and strip tillage are possible to reduce the evaporation, machine costs, and diesel and labour costs. To reduce the temperature of the soil, the speed of the wind and a better penetration of the precipitation, between 30-50 per cent of the straw and stubbles are recommended to be kept on the top of the soil. The water which is available for the crops depends on the precipitation, loss of water and crop rotation. Wheat grown after rapeseed, barley or wheat has about 120-150 more litres of water available per m² than wheat grown after maize or sun flower, if good water management is practiced.

Key words: evaporation, precipitation, tillage, weed control.

INTRODUCTION

Very often water is the limiting factor for plant production. By good water management more water can be available for the plant production. Water can be limited in more ways; the amount of precipitation can vary from year to year and from month to month, but nothing can be done. Only by irrigation more water can be supplied. The water capacity of the soil is essential for the availability of water for the plants in the growing season. The main challenges for water management is:

- To make the water able to penetrate the soil;
- To store the water in the soil;
- To avoid unnecessary evaporation.

Soil tillage and control of weeds are main factors in relation to water management. By each soil tillage water is evaporating; most under dry conditions in combination with severe cultivation. Under more humid conditions the evaporation is lower. For growth all plants needs water whether it is

weeds or crops. To save water for production, weeds needs to be controlled as early as possible.

MATERIAL AND METHOD

Studies A literature study has been made. Results from field trials and from farm experiences have been submitted.

RESULTS AND DISCUSSIONS



Fig. 1. Evaporation is low from “black” soil but up to 5 mm per day when the soil is coverage by plants. 2009
Sustainable Agriculture Research and Education

Evaporation

From “black” soil without plant coverage, there is almost no evaporation, but when soil is covered by plants the evaporation is raising. The evaporation depends on the percentage of plant coverage and the weather conditions.

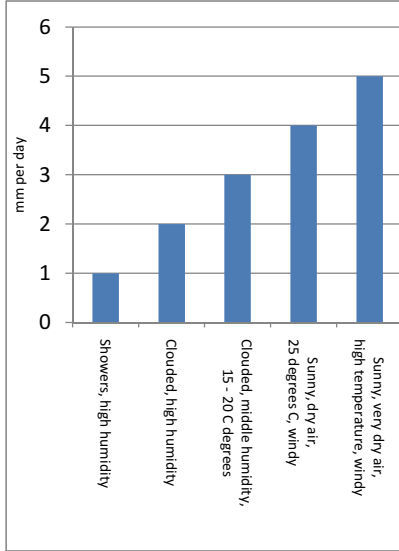


Fig. 2. Evaporation from a well established crop [1]. Danish Agricultural Advisory Service

The evaporation from the plants is largest under sunny, dry, windy and hot weather conditions. When the soil is covered by plants, crop or weeds, the evaporation is up to 5 l/m² or 5 mm per day. Under more cool or/and humid conditions the evaporation is lower.

Soil tillage

According to results from Agricultural Water Conservation Clearinghouse, USA, the evaporation by soil tillage is 15 mm or 15 l per m² per treatment.

To get a good penetration of the rain, to reduce the evaporation, to reduce the speed of the wind, to give shade and reduce the temperature of the soil, and to trap the snow during the winter Agricultural Water Conservation Clearinghouse recommend to keep 30-50 pct. of the straw and stubbles on top of the soil.

Weed control

Control of weeds is essential. Weeds in the fallow period, from harvest until a new crop is established, can each day use big amounts of water – water which is lost for the flowering crop. The loss of water depends on the amount of weeds and the period the weeds are allowed to grow.

Local conditions

The precipitation is different in different parts of the country - different in amount and different in timing. And the amount of precipitation varies from year to year. Statistics about weather conditions can be found from different sources. Below are shown figures from Meteo Romania and Meteorologisk Institutt Norge

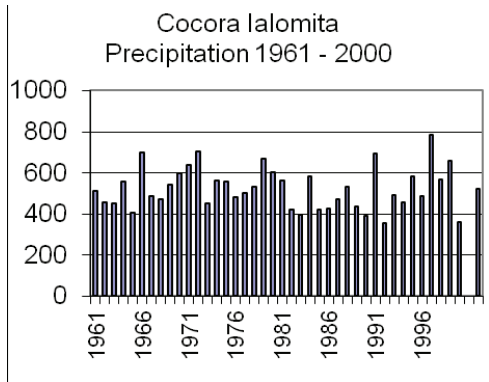


Fig. 3. Precipitation 1960-2000 at the location Cocora. Ialomita, Meteo Romania

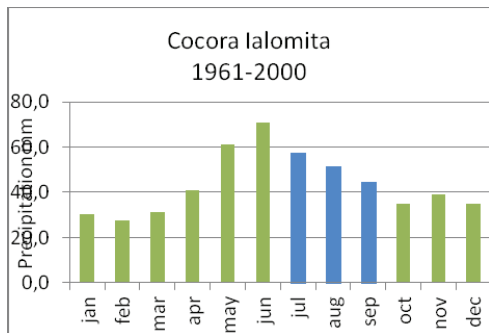


Fig. 4. Average monthly precipitation 1960-2000 at the location. Cocora Ialomita. Meteo Romania

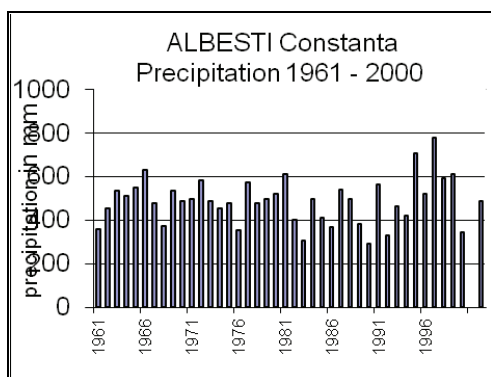


Fig. 5. Precipitation 1960-2000 at the location Albesti Constanta, *Meteo Romania*

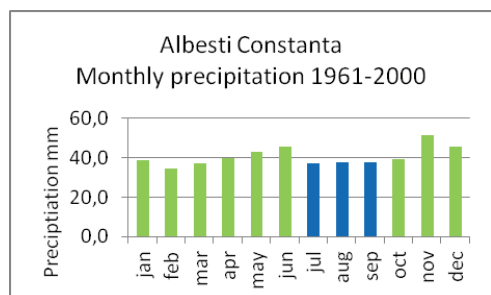


Fig. 6. Average monthly precipitation 1960-2000 at the location. Albesti Constanta. *Meteo Romania*

The months July, August, September are marked, because in these months the land is without production “fallowed”, when cereals and oil seed rape are grown. In this period the precipitation must be stored in the soil and evaporation avoided.

Soil tillage

By soil tillage water is evaporating, and soil tillage is expensive, machine costs, diesel and labour.

Table 1. Soil tillage: Labour and machine requirements hours/ha (100 hp) [2]. *University of Nebraska-Lincoln*

Operation	Plow	Chisel	Disk	Ridge Plant	Strip-till	No-till
Shred stalks				0,43		
Moldboard plow	0,95					
Chisel plow		0,53				
Knife fertilize	0,33	0,33	0,33	0,33	0,50	0,33
Disk	0,40		0,40			
Disk or field cultivate	0,40	0,40	0,40			
Plant	0,53	0,53	0,53	0,63	0,53	0,53
Cultivate	0,45	0,45		0,90		
Spray			0,15		0,28	0,28
Total	3,05	2,23	1,80	2,28	1,30	1,13
Index	100	73	59	75	43	37

Table 2. Soil tillage: Diesel consumption litre/ha (100 hp) *University of Nebraska-Lincoln*.

Operation	Plow	Chisel	Disk	Ridge Plant	Strip-till	No-till
Shred stalks				5,2		
Moldboard plow	21,3					
Chisel plow		9,9				
Knife fertilize	5,7	5,7	5,7	5,7	9,5	5,7
Disk			7,0			
Disk or field cultivate	7,0	7,0	7,0			
Plant	4,9	4,9	4,9	6,4	4,9	4,9
Cultivate	4,1	4,1		8,1		
Spray			1,0		2,2	2,2
Total	50,0	31,6	25,6	25,5	16,6	12,8
Index	100	63	51	51	33	26

Establishment

To make the seeds germinate water is needed. The water can either come from precipitation or from capillary water. By soil tillage the capillary transport of water is broken in the depth of the tillage. If the tillage is deeper than the seeding depth, the seeds will not get in contact the capillary water.



Photo 1. Rapeseed established after two cultivations, Calarasi autumn 2011. *Photo Christian Haldrup*

The picture above and under is from the same field autumn 2011 in Calarasi area. The difference between the two parts is that there have been made two cultivations where the rapeseed are well established and three cultivations in the other part of the field. By the third tillage the water for germination has evaporated.

Grain/seed filling period

From flowering the production of grains and seeds are starting. In a good day under good conditions a good cereal crop is producing 200 kg per ha per day. The number of days of production is essential for the production. Water can and are often the factor for the number of production days.



Photo 2. Rapeseed established after three cultivations, Calarasi autumn 2011. *Photo Christian Haldrup*

CONCLUSIONS

Water is a limiting factor for plant production. By good water management more water can be available for the production of grains/seeds. Water must be available for germination and growth and as much water as possible must be “saved” for the crops in the grain/seed filling period.

Unnecessary loss of water must be avoided. The soil must be kept “black” free of plants, in the period between two crops. To save most water it is best to control weeds 10 days before harvest by using glyphosat. After harvest weeds and germinating barley/wheat must be controlled, either by glyphosat or by upper tillage, with a working depth of no more than 4-5 cm.

30-50 pct. of the straw and stubbles must be kept on top of the soil to reduce wind speed, reduce the soil temperature, stop the snow and keep it on the fields and make easier for the rain to penetrate into the soil.

Weeds in the crops must be well controlled and at the early staged. This can avoid unnecessary use of water, shade, use of nutrients and taking space.

To avoid unnecessary evaporation soil tillage and working depth must be reduced as much as possible.

No tillage and strip tillage are new technologies in Romania but common growing technologies in areas in US and Australia which are comparable to Romanian conditions. The technologies are developed to reduce the waste of water, optimise the yields and reduce the costs.

Larger yield and lower costs – Water management

REFERENCES

- [1] Danish Agricultural Advisory Service, <http://app4.landscentret.dk/DyrkVejl/Forms/Main.aspx?page=Vejledning&cropID=105>.
- [2] University of Nebraska-Lincoln, <http://cropwatch.unl.edu/web/tillage/labor>.