This manual is part of:

Ecological Recycling Agriculture
Vol. I Farming Guidelines
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The software is also available at:
www.zalf.de/de/forschung/institute/lse/downloads/Seiten/oekolandbau.aspx

Why it matters

Ecological Recycling Agriculture (ERA) aims at effective nutrient recycling through self-sufficiency in fodder and manure production and low levels of external inputs. Well-planned crop rotations are therefore a key element to successful ERA farming.

Crop rotations should provide sufficient fodder, high yielding cash crops and ensure the long-term productivity as well as sustainability of the system. This includes phytosanitary restrictions, effective weed management, sufficient nitrogen supply through legumes, stable N- and humus-balance and reduced nitrogen losses.

Why to plan with ROTOR

Planning organic crop rotations requires to consider the management of nutrients, humus, weeds, diseases, cash and fodder crops, catch crops and manure applications.

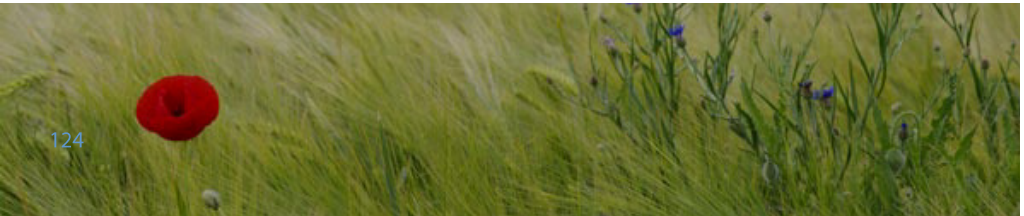
ROTOR is a static rule-based tool for long-term planning at field level to regulate:

- Supplying sufficient fodder
- Regulation of weed infestation
- Taking phytosanitary restrictions into account
- Maximising N-fixation from legumes
- Minimising N-losses via leaching

ROTOR supports advisors to consider all these factors simultaneously. It provides complementary information to the local knowledge and experiences!

Who can use it?

ROTOR requires some previous software skills, and in some cases the installation of software (see software requirements). It has been designed for advisors, but can also be used by farmers, lecturers and students.



How it works

ROTOR calculates on the basis of predefined crop production activities (CPA). These describe all field operations per crop, beginning with stubble tillage and ending with the harvest. Each crop can be cultivated differently, therefore different CPA's exist with varying preceding crops and different field operations i.e. ploughing or non-inverting tillage, undersowing, use of catch crops, manuring, straw harvesting, and mechanical weed control.

Crop rotations describe a succession of CPA`s which are evaluated with agronomic criteria i.e. N_2-fixation, N-removal, N- and humus-balance, N-leaching, phytosanitary restrictions and the weed infestation risks.

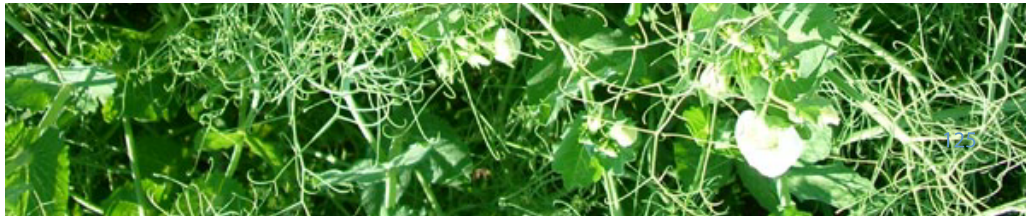
How to use the tool

ROTOR has been adapted to specific countries in the Baltic Sea Region. Within a country, different soil types are distinguished.

- ➔ Results can be used to compare between different crop rotation options.
- ➔ Absolute values should be taken with care.
- ➔ If you use ROTOR for other countries and sites it needs to be adapted if this is not done, please handle the results with great care!

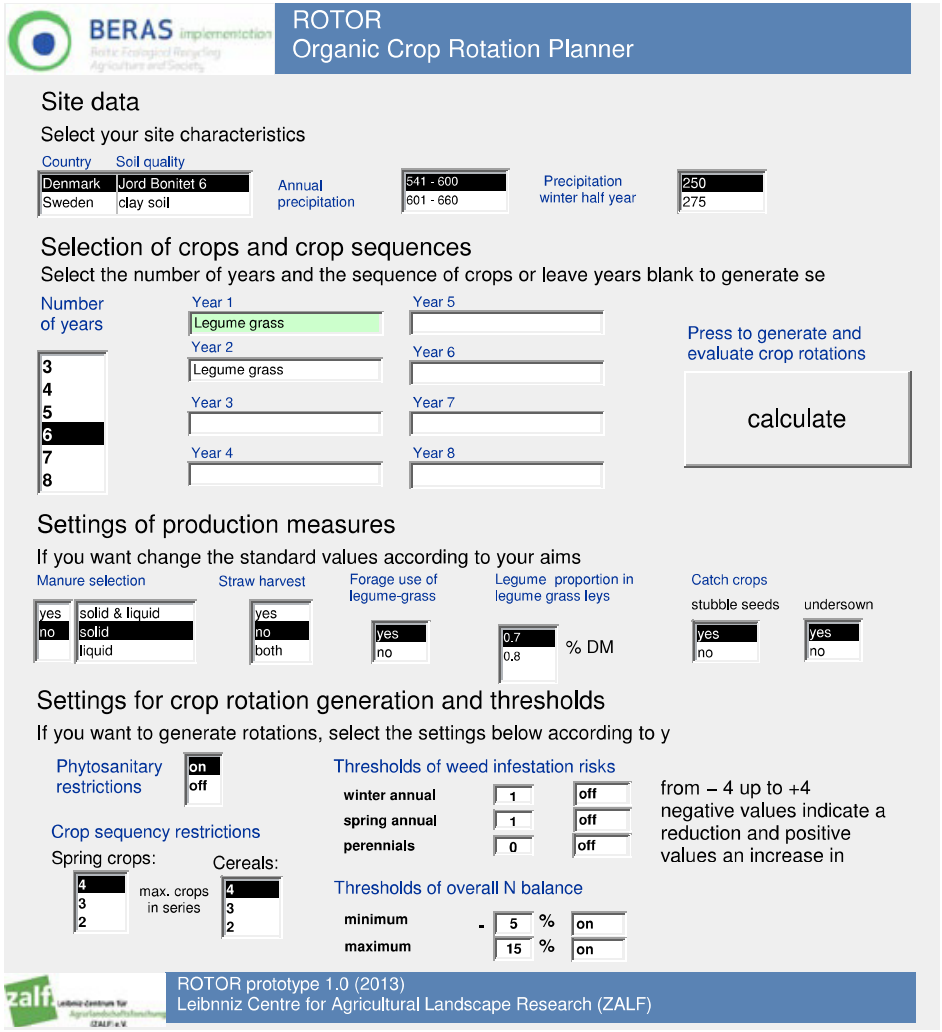
Microsoft Access, minimum version 2000

Software requirements



User interface

The user operates with two interfaces, the data entry form and the report of results. The data entry form is shown below.



Evaluate your crop rotation in a few steps

1. Open the Microsoft Access file.
2. The data entry form opens.
3. Select your site data (country and soil quality, mean annual and winter precipitation), if your site is not included you may use a comparable site or contact the developers.
4. Select the number of years and the crops of the rotation you want to evaluate, starting with a legume-grass mixture.
5. Specify the production measures or leave the standard values (manure, straw harvest, forage use of legume-grass, legume percentage in legume-grass, catch crops).
6. Press 'calculate' to evaluate the rotation.
7. The report of results will open (this can take a few seconds).
8. If you want to change the crop rotation or other settings please close the report of results and make the changes.

Generate crop rotations

1. Select the number of years of the rotation.
2. In the 'selection of crops and crop sequences' you can leave all or several years blank.
3. Change the settings for crop rotation generation and threshold.
4. Continue with step 6. from the list above.

To sort the report of results

The standard sorting of results is by 'N surplus' from lowest to highest; to change this:

1. Open the report of results and go to the 'draft view' (right click and select 'draft view').
2. Go to 'grouping and sorting' (right click and select 'grouping and sorting').
3. Find 'grouped by' (e.g. bottom of the report) and select a criteria from the list.
4. Define the ranking (from 'highest to lowest' or 'lowest to highest').

Interpretation of results

The report of results shows calculated values per crop and per rotation. Several options of crop rotations will be displayed, sorted by the N surplus (this can be changed).

Description of crop production activities
Details of crop production i.e. catch crops, undersowings, tillage and manure applications.

Yield [t/ha]
Dry matter yields calculated specific to soil, rainfall, pre-crop and manure (1 dt = 0.1 t)

N_2-fixation [kg N/ha]
Nitrogen fixed by legumes as a main crop, undersowings, intercrops and catch crops

N-leaching [kg N/ha]
Annual leaching of nitrogen → should be as low as possible

N-removal [kg N/ha]
Annual nitrogen removal through the harvest of crops

N-balance [kg N/ha]
Mean annual N balance calculating N input – N output → should be close to neutral (-10 kg to +10 kg) for long-term sustainability

N-balance % N-input [%]
N balance in % from the N input → should be close to 0 to ensure long-term sustainability (set thresholds in the data entry form)

Humus reproduction [%]
Annual humus reproduction [25] → should be more than 100% to ensure a stable humus-balance

Weed infestation risks [score]
Negative scores reduce and positive scores increase the infestation risk with perennial, spring and winter annual weeds (score from – 4 to +4) → depending on your soil and farming, ensure to keep the infestation risk low and aim for negative values.

Example evaluation

An example crop rotation with two cropping options for a marginal sandy soil in Germany (Brandenburg), soil rating index 25 (sandy soil)
Precipitation: 500 mm annual and 225 mm in the winter half

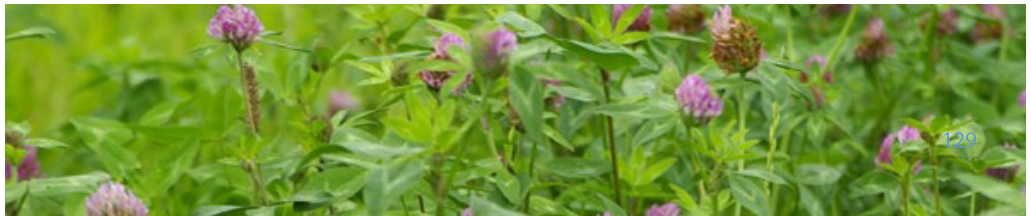
Crop rotation:
Legume-grass (mulching) – winter rye – winter rye –lupin – oat

Option A: Undersowing of legume-grass in oats
Mean legume percentage set to 50 % in the legume-grass sward

Crop	Yield	N_2-fixation	N-leaching	N-balance	Weed infestation risk (- reduces, + increases)			Humus reproduction
	[t/ha]	[kg N/ha]			peren.	spring	autumn	%
Legume-grass (50 % leg.)	24	124	3	105	0	-1	-1	
Winter rye	2.6	0	20	-57	-1	-1	3	
Winter rye	2.1	0	14	-44	-1	-1	3	
Lupin	1.5	76	26	-3	0	3	-1	
Oat + leg.-grass undersown	1.6	0	33	-54	0	1	-1	
Mean of crop rotation		**40**	**20**	**-11**	**-0.2**	**0.2**	**0.6**	**108**

Option B: Inclusion of a catch crop (turnip rape) before oat
Increased legume percentage set to 70 % in the legume-grass sward
→ the changes in option B are marked in green

Crop	Yield	N_2-fixation	N-leaching	N-balance	Weed infestation risk (- reduces, + increases)			Humus reproduction
	[t/ha]	[kg N/ha]			peren.	spring	autumn	%
Legume-grass (70 % leg.)	24	167	12	139	0	-1	-1	
Winter rye	2.6	0	20	-57	-1	-1	3	
Winter rye	2.1	0	14	-44	-1	-1	3	
Lupin	1.5	76	26	-3	1	3	-1	
Oat + catch crop + leg.-grass undersown	2.0	0	13	-42	-1	1	-2	
Mean of crop rotation		49	17	-1	- 0.4	0.2	0.4	117



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The Leibniz Centre for Agricultural Landscape Research (ZALF) in Germany explores ecosystems in agricultural landscapes and develops ecologically and economically tenable land use systems while taking into account societal demands. The Institute of Land Use Systems focuses on the assessment and further development of sustainable farming systems, including organic farming.
www.zalf.de

Södertörn University in Sweden is lead partner of the EU project BERAS Implementation. The University conducts education and research to develop and disseminate knowledge on how human activities affect the natural world, as well as how to create the right conditions for environmental, social and economic sustainable development.

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Photographers

PURPOSE

The environment of the Baltic Sea is endangered. Input of plant nutrients from highly intensive and specialized agriculture are a main source. BERAS Implementation can solve this problem through a systemic shift to Ecological Recycling Agriculture in association with the whole food chain from farmer to consumer.

WHO CAN USE THE GUIDELINES?

The guidelines will help farmers and advisers to practice and develop Ecological Recycling Agriculture. This type of agriculture will improve the environmental conditions of the Baltic Sea. They can be equally used for educational purposes, by decision makers and by politicians.

CONTENTS

The guidelines consist of four books that cover the following topics:

The Farming Guidelines give basic practical recommendations for implementing ERA and present proven agronomic measures and optimization strategies for effective nutrient recycling within the farm and between different farm types during and after conversion. Included are Software Tools that help to assess and improve sustainable crop rotation planning and nitrogen fluxes on a farm level.

The Economic Guidelines give advice and support to farmers how to plan the conversion process and highlight how the changes to ERA farming will affect farm economy.

In the Marketing Guidelines farmers can find support and ideas on how to more effectively promote and sell organic and ERA products.

The Farm Examples provide a personal presentation of different farms around the Baltic Sea, mainly farms in conversion to ERA, their challenges and future plans.

The books are available at www.beras.eu in digital form.

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