This manual is part of:

Ecological Recycling Agriculture
Vol. I Farming Guidelines
ISBN 978-3-00-042440-3

ERA Software Tools

LEGUME ESTIMATION TRAINER

A learning tool for a better estimation of the legume proportion in forages

Moritz Reckling, Karin Stein-Bachinger and Johann Bachinger

THE TOOL IS AVAILABLE AT: WWW. BERAS. EU

Why it matters 116
How it works 117
How to use the tool 118
How to estimate in the field (after the training) 119
Samples of arable forage 120
Samples of permanent grassland 121

The software is also available at:
Why it matters

Forage legumes (e.g. clovers and alfalfa cultivated on arable fields and grasslands) build up soil fertility and therefore play a key role in crop rotations of ERA farms. Among other benefits legumes fix nitrogen (N) from the atmosphere which is available to current and subsequent crops. Moreover they provide a highly nutritious fodder for ruminants which, when their manure is recycled, also enriches the soil.

How it works

The Legume estimation trainer contains two sets of pictures to choose from – one of arable forage and one of permanent grassland. They show various legume-grass mixtures at different stages of maturity and the corresponding legume percentages. The data accompanying each photo are based on the results from scientific field experiments and nutrient analysis.

The computer based tool generates pictures randomly and allows the user to estimate the legume percentage of the dry matter yield by choosing one of the classes of percentages.

User interface

The user interface in the web-browser shows the legume-grass picture and options to estimate the legume percentage and additional information.

Estimate the legume proportion (%) in the mixture

<table>
<thead>
<tr>
<th>Legume Percentage</th>
<th>Dry Matter Yield (t/ha)</th>
<th>Fresh Matter Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>3.1</td>
<td>5.2</td>
</tr>
<tr>
<td>2.2</td>
<td>4.1</td>
<td>6.4</td>
</tr>
<tr>
<td>3.3</td>
<td>5.1</td>
<td>7.3</td>
</tr>
<tr>
<td>4.4</td>
<td>6.1</td>
<td>8.4</td>
</tr>
<tr>
<td>5.5</td>
<td>7.1</td>
<td>9.5</td>
</tr>
</tbody>
</table>
How to use the tool

The Legume estimation trainer can be used with all standard web-browsers and can be started without any prior software skills or installations.

Web-browser e.g. Mozilla Firefox, Windows Internet Explorer

Practice your legume estimation skills in 5 steps

- Open the file ‘start’ (it will appear in your web-browser)
- Choose between ‘arable forage’ and ‘permanent grassland’ and the training will start
- Study the first picture on your screen and read the information on yield below
- Estimate the legume percentage by pressing one of the buttons showing percentages
- If your estimation was correct, the exact percentage will be shown and you can press “next picture”; if not please estimate again.

Your estimation skills will improve with practice, so train regularly and monitor your rate of success. Enjoy the training!

- Estimate 100 pictures and note the no. of errors.
- Repeat this three times and compare the results to check your progress.
- Train until you have less than 20 errors – if you like!

Application of your estimation skills

After the training, your estimation skills will be good enough to estimate the legume percentage in the field. To get a very rough estimation, you can estimate from the tractor or harvester at the time of harvesting. If time allows, a more precise estimation, at least on a few fields, is recommended. This can be done by a quick transect walk through the field.

How to estimate in the field (after the training)

- Use a record book for documenting all data during the field walk
- Walk diagonally through the field (transect)
- Take one sample every 50-100 m (avoid field margins)
- 5 samples for fields with little variation in legume percentage
- 10 samples for fields with high variation in legume percentage
- Estimate one square meter per sample (use a frame or sticks to mark the borders)
- Write the percentage for each sample in the record book and calculate the average
- Estimation should be repeated throughout each season since the percentage may vary between fields and cuts and from year to year

Average legume percentage in the field

<table>
<thead>
<tr>
<th>Sample</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>Average</td>
<td>38</td>
</tr>
</tbody>
</table>

Estimation of the legume percentage from the tractor (rough estimation)

Equipment: 0.5 m² frame made of sticks and a kitchen scale
- Note your estimation on paper and cut the samples (0.5 m²)
- Sort the shoots into legumes and non-legumes
- Weigh the legume shoots and all shoots; and calculate:
  \[ \text{Legume percentage} \% = \frac{\text{legume shoots (g)} \times 100}{\text{all shoots (g)}} \]

This can be a group exercise with farmers facilitated by the advisor

How to carry out a transect walk?
Samples of arable forage
(Photos: ZALF)

Classification

1-20 %

11% Legumes / 4.2 t/ha DM / 51 cm

4% Legumes / 4.4 t/ha DM / 47 cm

21-40 %

37% Legumes / 2.6 t/ha DM / 37 cm

22% Legumes / 3.8 t/ha DM / 53 cm

41-60 %

59% Legumes / 3.1 t/ha DM / 51 cm

48% Legumes / 3.7 t/ha DM / 42 cm

61-80 %

78% Legumes / 2.7 t/ha DM / 42.6 cm

73% Legumes / 3 t/ha DM / 46.4 cm

> 81 %

94% Legumes / 2.1 t/ha DM / 24 cm

80% Legumes / 2 t/ha DM / 39 cm

Samples of permanent grassland
(Photos: ZALF and Engel, Aulendorf)

Classification

< 6 %

4 % Legumes / 4.2 t/ha DM / 30 cm

5 % Legumes / 2.8 t/ha DM / 45 cm

6-20 %

11 % Legumes / 2.2 t/ha DM / 37 cm

18 % Legumes / 3 t/ha DM / 27 cm

21-40 %

25 % Legumes / 1.7 t/ha DM / 33 cm

35 % Legumes / 2.9 t/ha DM / 29 cm

> 40%

45% Legumes / 3.6 t/ha DM / 60 cm

51 % Legumes / 2.1 t/ha DM / 25 cm
We thank Prof. Dr. Martin Eisele and Sylvia Engel from the Agricultural Centre Baden-Wuerttemberg, Department of Grassland Management and Forage Production (LAZBW Aulendorf) for most of the images and samples of permanent grassland. At the Leibniz Centre for Agricultural Landscape Research (ZALF) in Müncheberg, we thank Gerlinde Stange and the staff at the Institute of Land Use Systems and the ZALF Research Station in Müncheberg for their help and assistance with sample and data processing.

Addresses of editors and authors

Editors

Dr. Karin Stein-Bachinger, Moritz Reckling and
Johannes Hufnagel
Leibniz Centre for Agricultural Landscape
Research (ZALF) e.V.
Institute of Land Use Systems
Eberswalder Str. 84, 13374 Müncheberg, Germany
kstein@zalf.de
moritz.reckling@zalf.de
j.hufnagel@zalf.de

Associate Professor Dr. Artur Granstedt
Södertörn University, 141 89 Stockholm
and Biodynamic Research Institute
153 91 Järna, Sweden
artur.granstedt@beras.eu

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.

The Biodynamic Research Institute in Sweden works with long term on-farm studies to develop ecological and biodynamic agriculture for Nordic conditions with a focus on soil fertility, the environment and food quality.

Corresponding authors

Gustav Alvermann
Ackerbauberatung, Scharberg 1a
23847 Werther, Germany
Gustav.Alvermann@t-online.de

Prof. Dr. Artur Granstedt
Kulturcentrum 13, 15391 Järna,
Schweden
artur.granstedt@beras.eu

Prof. Dr. Stefan Kühne
Federal Research Centre for Cultivated Plants
Julius Kühn-Institut (JKI)
Stahnsdorfer Damm 81
14532 Kleinmachnow, Germany
Stefan.kuehne@jki.bund.de

Moritz Reckling
ZALF e.V., Institute of Land Use Systems
Eberswalder Str. 84,
13374 Müncheberg
E-mail: moritz.reckling@zalf.de

Katarina Rehnström
Gamla Rustvägen 254 B
10 600 Ekenäs, Finland
kata@bene.fi

Dr. Karin Stein-Bachinger
ZALF e.V., Institute of Land Use Systems
Eberswalder Str. 84, 13374 Müncheberg
E-mail: kstein@zalf.de

Photographers

© Johann Bachinger, Moritz Reckling, Karin Stein-Bachinger, Åsa Odelos, Katarina Rehnström, Stefan Kühne, Carlo Horn, Gustav Alvermann, Johannes Hufnagel, Gerlinde Stange, Frank Gottwald, Klaus-Peter Wiloos (p 48 left), Martin Ehléter (p 59 right below, p 68), Nikola Acuti
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.