Grassland management for high forage yield and quality in the Western Balkans

Novi Sad, 21 September 2016

Maja Manojlović and Branko Ćupina
University of Novi Sad
Faculty of Agriculture
Novi Sad, Serbia
Project partners:

– The Norwegian Institute for Agricultural and Environmental Research – Bioforsk
– Department of Plant and Environmental Sciences, Norwegian University of Life Sciences (UMB)
– The Faculty of Agriculture, University of Banja Luka
– The Faculty of Agriculture and Veterinary in Prishtina
– The Faculty of Agriculture, University of Novi Sad

Project leader: Peder Lombnaes
Aims and objectives:

• **Capacity building** of Balkan institutions through targeted activities for scientific staff and students at master and PhD levels

• **Inventarisation of the current situation of grassland management** (e.g. botanical composition, fertilisation practice, cutting/grazing regimes)

• **Conduct field experiments** to assess the effect on grass yield and quality (protein and mineral composition) and soil carbon sequestration as affected by: 
  i) **botanical compositions**,  
  ii) **cutting/grazing regimes**,  
  iii) **different fertilisation practices**
Aims and objectives:

• **Economical evaluation** of cost/benefit analysis for different grassland management strategies (i.e. cutting regimes, fertilizer input, botanical composition)

• **Transfer new knowledge** on innovative solutions and new research findings for improved grassland management through participating in national and international seminars/workshops and joint meetings between scientists from Norway and Balkan countries, and development of educational materials
Working packages:

- 4 work packages
- WP1 Inventerisation and phytocenosis
- WP2 Legumes / grass mixtures and cutting regimes
- WP3 Fertilisation practise
- WP 4 Economical analysis and transfer of knowledge
1. GROWING LEGUME/GRASS MIXTURES IN TEMPERATE REGION

LEGUME/GRASS MIXTURES IMPROVES GRASSES QUALITY BY N FIXATION

<table>
<thead>
<tr>
<th></th>
<th>1st cut</th>
<th>Alfalfa+ Orchard</th>
<th>Alfalfa+ Fescue</th>
<th>Alfalfa</th>
<th>Orchard</th>
<th>Fescue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>14.98</td>
<td>14.63</td>
<td>14.63</td>
<td>8.1</td>
<td>7.75</td>
<td></td>
</tr>
<tr>
<td>Crude fiber</td>
<td>35.71</td>
<td>34.36</td>
<td>35.8</td>
<td>35.18</td>
<td>33.03</td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td>9.72</td>
<td>9.95</td>
<td>9.64</td>
<td>9.05</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>NDF</td>
<td>53.52</td>
<td>48.53</td>
<td>46.55 (aver. 53)</td>
<td>59.13</td>
<td>60.25</td>
<td></td>
</tr>
<tr>
<td>ADF</td>
<td>39.89</td>
<td>36.67</td>
<td>40.13 (aver. 41)</td>
<td>38.5</td>
<td>35.92</td>
<td></td>
</tr>
<tr>
<td>Lignin</td>
<td>8.28</td>
<td>7.92</td>
<td>9.62</td>
<td>5.22</td>
<td>5.59</td>
<td></td>
</tr>
</tbody>
</table>

WEATHER CONDITIONS ARE IMPORTANT FACTOR IN GRASS PRODUCTION IN TEMPERATE REGION (EARLY AUTUMN, SUMMER)

SELECTION OF SPECIES IN THE MIXTURE
2. PERMANENT GRASSLAND IN TEMPERATE REGION

CRUDE PROTEINS (AVERAGE 2012-2015)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>CP (%) in I cut average for 2012-2014*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without harrowing</td>
<td>12.67 A</td>
</tr>
<tr>
<td>With harrowing</td>
<td>12.80 A</td>
</tr>
<tr>
<td>Ø</td>
<td>12.90 b</td>
</tr>
<tr>
<td>PK + N1</td>
<td>13.75 b</td>
</tr>
<tr>
<td>PK + N2</td>
<td>14.74 a</td>
</tr>
<tr>
<td>One week earlier</td>
<td>16.5 a</td>
</tr>
<tr>
<td>Regular</td>
<td>14.7 b</td>
</tr>
<tr>
<td>One week later</td>
<td>13.8 b</td>
</tr>
</tbody>
</table>

FERTILIZATION PRACTICE AND CUTTING REGIME ARE IMPORTANT FACTORS IN GRASS PRODUCTION IN TEMPERATE REGION

Field experiment

N fertilization can improve quality and yield of natural grassland
IMPACT OF MANAGEMENT PRACTICE ON
YIELD OF DRY MASS OF NATURAL GRASSLAND (AVERAGE 2012-2015)

1st cut

<table>
<thead>
<tr>
<th>Yield of dry mass (kg/ha)</th>
<th>With</th>
<th>Without</th>
<th>Ø</th>
<th>PK + N1</th>
<th>PK + N2</th>
<th>One week earlier</th>
<th>Normal</th>
<th>One week later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrowing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fertilization

Cutting regime

Total yield

<table>
<thead>
<tr>
<th>Yield of dry mass (kg/ha)</th>
<th>With</th>
<th>Without</th>
<th>Ø</th>
<th>PK + N1</th>
<th>PK + N2</th>
<th>One week earlier</th>
<th>Normal</th>
<th>One week later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrowing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fertilization

Cutting regime
Diverse vegetation of natural grassland

- More grasses, higher yield
- More legumes, better quality
- Less weeds (due to higher yield of grass)
The soils were well provided with the studied elements, but the analyzed fodder crops could not secure sufficient amounts of Cu, Zn and Se.

- Two field experiment were set up on private family dairy farm
- Milk production 3,000 l per day, about 1,000,000 l per year
- About 140 lactating cows, total 550
- Farmer cultivates more than 500 ha of land
**Treatments**

1. Control
2. Se 5 g ha\(^{-1}\) (Na\(_2\)SeO\(_4\))
3. Se 10 g ha\(^{-1}\) (Na\(_2\)SeO\(_4\))
4. Zn 0,5 kg ha\(^{-1}\) (ZnSO\(_4\))
5. Zn 1 kg ha\(^{-1}\) (ZnSO\(_4\))
6. 2% Cu (Cu SO\(_4\))
7. Zn 0,5 kg ha\(^{-1}\) + Se 10 g ha\(^{-1}\)

**ALFALFA**

**SILAGE CORN**

**FACTOR A: Nitrogen fertilization**
1. control Ø
2. 120 kg N/ha
3. 180 kg N/ha
4. 240 kg N/ha

**FACTOR B: Microelement fertilization**
1. control Ø
2. Se 10 g/ha
3. Zn 1,5 kg/ha
4. UREA 7% + Zn 1,5 kg/ha

---

**Se content in alfalfa**

- control
- Se 5 g/ha
- Se 10 g/ha
- Zn 0,5 kg/ha
- Zn 1 kg/ha
- Cu 2%
- Zn 0,5 kg/ha + Se 10 g/ha

**Se content in silage corn - whole plant**

- control
- Se 10 g/ha
- Zn 1,5 kg/ha
- Urea + Zn 1,5 kg/ha
- 120 kg N/ha
- 180 kg N/ha
- 240 kg N/ha
PROJECT OUTCOMES

Importance for the Universities

- Collaboration of different working groups at the UNS
- Knowledge transfer (PhD students from UNS attend statistical course at the NMBU and worked in NMBU laboratory)
- Improved teaching activities and quality
- Improved research approach

Preparation and analyses of soil and plant samples

PhD students from UNS attend the course STAT200 Regression Analysis
Long-term Effects of Crop Rotation and Different Fertilization Systems on Soil Fertility and Productivity

Maja Cuvardic,1*, Steinar Tveitnes,2 Tore Krogstad2 and Peder Lomhnes2

1Faculty of Agriculture, University of Novi Sad, Trg Dr. Obradorica 8, SCG-21000 Novi Sad, Serbia and Montenegro and 2Department of Plant and Environmental Sciences, Agricultural University of Norway, P.O. Box 5003, NO-1432 As, Norway

The effects of crop rotation and fertilization systems on yield and soil fertility parameters have been investigated in a long-term field trial established in southeast Norway in 1953. The results indicate the small
Project: Mineral improved food and feed crops for human and animal health

Analytical course under Balkan - Herd project at IPM (UMB)
(21th May to 15th June 2012)

Participants:
- Darko Kerovec, FA Osijek, Croatia
- Ranko Čabilovski, FA, Novi Sad, Serbia
- Jasmin Grahić, FA, Sarajevo B&H
- Aleksandar Kralj, FA, Banja Luka, B&H
- Muhamet Zohaj, FA, Pristina, Kosovo
Procedures and analysis

Norwegian University of Life Science
Laboratory of the Department of Plant
and Environmental Sciences
May 21 – June 15, 2012
As, Norway

Soil sampling, preparation of soil and plant samples and soil dry matter determination

Basic laboratory procedures

Preparation and digestion plant and soil samples for total element analysis

Cation exchange capacity (CEC), total exchangeable basis and AL-P extraction

Determination of total nitrogen and nitrates in water and soil samples by FIA

Total C and organic C content in soil

Maja Manojlovic,
Novi Sad, 3rd October 2012
Procedures and analysis

Norwegian University of Life Science
Laboratory of the Department of Plant
and Environmental Sciences
May 21 – June 15, 2012
As, Norway

Soil sampling, preparation of soil and plant samples and soil dry matter determination

Basic laboratory procedures

Preparation and digestion plant and soil samples for total element analysis

Cation exchange capacity (CEC), total exchangeable basis and AL-P extraction

Determination of total nitrogen and nitrates in water and soil samples by FIA

Total C and organic C content in soil

Maja Manojlovic,
Novi Sad, 3rd October 2012
Long-term Effects of Crop Rotation and Different Fertilization Systems on Soil Fertility and Productivity


The effects of crop rotation and fertilization systems on yield and soil fertility parameters have been investigated in a long-term field trial established in southeast Norway in 1953. The results indicate the small

Maja Manojlović, Novi Sad, 3rd October 2012
PROJECT OUTCOMES

Importance for the

Agriculture and business

• On-farm trials and results were available for farmers
  - higher yield and quality of forage crops and grasslands with applied treatments
  - improved soil properties

• Higher forage crops yield led to development of the livestock production
  - development of other agricultural sectors

Social sector

• Improved economic budget ensures better social status and number of rural population
  - one of the key problems in WBC
• Higher awareness of climate and climate changes importance
Novi Sad, Serbia

Thank you!
Thank you!