Srđan Šeremešić, Maja Manojlović, Monika Tomšik, Nataša Vujić, Goran Jaćimović, Bojan Vojnov

University of Novi Sad, Faculty of Agriculture, Dositeja Obradovića 8, Novi Sad, Serbia
Greensoft ltd., Cara Dušana 49 Novi Sad, Serbia
Suncokret DOO, Hajdukovo, Serbia
Email: srdjan.seremesic@polj.uns.ac.rs
Organic agriculture in Serbia

• 0.4% of the total arable land under organic control and certification (cca 15,000 ha)
• Established institution (National association, legislation NAP, center for OA development, certification bodies etc....)
• Non GMO area, favorable pedoclimatic conditions
• Lower level of food processing
• Export oriented production
• Organic area will increase as EU requirement
Introduction

Buckwheat (Fagopyrum esculentum Moench) and Soybean (Glycine max (L.) Merr.) are regarded as multifunctional crops in organic agriculture and thus could be successfully alternate and combined.

Possibility of use:
- main (cash) crop,
- cover crop (undersown/intersown)
- stubble crop or green manure

weeds infestation,
water shortage,
uneven emergence
successive maturation
birds

Good preceding crop
Lower demand in nutrients
Can be easily combined and mixed
Short growing period
lesser infestation from diseases

relative air humidity,
slow initial growth/soil preparation
suppression from weed
uneven ripening

Possibility of use:
animal feed,
human food
and green manure
Using mulch in organic production

- Reduce weed seed germination
- Shade and physically hinder emerging weeds
- Enhance crop growth and competitiveness by conserving soil moisture and sometimes by modifying soil temperature
- After mineralization provide nutrients

- Require additional work and labor + cost
- Sporadically difficult to obtain mulch from organic farms
- After application may require special measures for crops protection
- May complicate harvest
Aim of the study

• Considering the multifunctionality of buckwheat and soybean in organic production increase area of those crop could enhance overall sustainability and integrity of organic farm.

• Combination of mulches and commercial fertilizers can eliminate some disadvantages in their production

• The aim of this study is to examine yield and morphological properties of buckwheat and soybean under different mulches and commercial fertilizers.
The experiment was established in semiarid conditions of Pannonian Basin in Center for organic production in Selenča, Vojvodina, Republic of Serbia.
The experiment was set up as 2-factorial experiment with 3 type of mulches:

Wood chips (W) 3 kg m²
Wheat Straw (S) 4 kg m²
Living mulch (L)

Matricaria chamomilla (Soybean)
Field pea (Buckwheat)

Control (CON)

Commercial fertilizers and soil enhancers:
organic NPK (5:3:8) fertilizer (Siforga), Si
Ascophyllum nodosum 2.3% N (Wuxal Ascofol) Wa
Microbiological stimulator (Natur Plasma) Np

Soybean cultivar NS Kaća
Buckwheat cultivar Novosadska

Preceding crop: maize
Seed bed preparation: 26. April
Sowing: 28. April
Inter row cultivation 04. Jun +17. Jun

HARVEST: 19.08 soybean / 16.08 buckwheat
Results and discussion
### Soil chemical properties

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) - Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma

<table>
<thead>
<tr>
<th>Nr</th>
<th>Treatments Soybaen</th>
<th>pH KCl</th>
<th>pH H₂O</th>
<th>CaCO₃ %</th>
<th>OM %</th>
<th>Total N %</th>
<th>AL-P₂O₅ mg/100g</th>
<th>AL-K₂O mg/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>7,32</td>
<td>8,31</td>
<td>5,10</td>
<td>2,49</td>
<td>0,185</td>
<td>12,0</td>
<td>24,5</td>
</tr>
<tr>
<td>2</td>
<td>LSi</td>
<td>7,48</td>
<td>8,35</td>
<td>2,95</td>
<td>2,70</td>
<td>0,13</td>
<td>10,13</td>
<td>23,19</td>
</tr>
<tr>
<td>3</td>
<td>LNp</td>
<td>7,37</td>
<td>8,06</td>
<td>3,37</td>
<td>2,51</td>
<td>0,12</td>
<td>8,98</td>
<td>23,36</td>
</tr>
<tr>
<td>4</td>
<td>LWa</td>
<td>7,09</td>
<td>8,13</td>
<td>3,79</td>
<td>2,50</td>
<td>0,12</td>
<td>8,54</td>
<td>20,79</td>
</tr>
<tr>
<td>5</td>
<td>SSi</td>
<td>7,11</td>
<td>8,14</td>
<td>3,79</td>
<td>2,43</td>
<td>0,12</td>
<td>8,34</td>
<td>21,09</td>
</tr>
<tr>
<td>6</td>
<td>SNP</td>
<td>7,40</td>
<td>8,18</td>
<td>2,95</td>
<td>2,47</td>
<td>0,12</td>
<td>7,23</td>
<td>20,92</td>
</tr>
<tr>
<td>7</td>
<td>SWa</td>
<td>7,40</td>
<td>8,21</td>
<td>3,37</td>
<td>2,43</td>
<td>0,12</td>
<td>8,54</td>
<td>21,09</td>
</tr>
<tr>
<td>8</td>
<td>WSi</td>
<td>7,20</td>
<td>8,25</td>
<td>5,06</td>
<td>2,42</td>
<td>0,17</td>
<td>8,28</td>
<td>21,89</td>
</tr>
<tr>
<td>9</td>
<td>WNp</td>
<td>7,44</td>
<td>8,30</td>
<td>3,37</td>
<td>2,55</td>
<td>0,13</td>
<td>9,54</td>
<td>21,42</td>
</tr>
<tr>
<td>10</td>
<td>WWa</td>
<td>7,31</td>
<td>8,30</td>
<td>3,79</td>
<td>2,78</td>
<td>0,14</td>
<td>7,32</td>
<td>19,57</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr</th>
<th>Treatments Buckwheat</th>
<th>pH KCl</th>
<th>pH H₂O</th>
<th>CaCO₃ %</th>
<th>OM %</th>
<th>Total N %</th>
<th>AL-P₂O₅ mg/100g</th>
<th>AL-K₂O mg/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>7,37</td>
<td>8,49</td>
<td>4,23</td>
<td>2,08</td>
<td>0,10</td>
<td>6,98</td>
<td>19,83</td>
</tr>
<tr>
<td>2</td>
<td>LSi</td>
<td>7,40</td>
<td>8,42</td>
<td>4,23</td>
<td>2,24</td>
<td>0,11</td>
<td>8,20</td>
<td>19,91</td>
</tr>
<tr>
<td>3</td>
<td>LNp</td>
<td>7,37</td>
<td>8,40</td>
<td>4,65</td>
<td>2,26</td>
<td>0,11</td>
<td>8,12</td>
<td>18,61</td>
</tr>
<tr>
<td>4</td>
<td>LWa</td>
<td>7,42</td>
<td>8,47</td>
<td>5,49</td>
<td>2,15</td>
<td>0,11</td>
<td>8,20</td>
<td>17,98</td>
</tr>
<tr>
<td>5</td>
<td>SSi</td>
<td>7,44</td>
<td>8,49</td>
<td>6,76</td>
<td>2,22</td>
<td>0,11</td>
<td>8,88</td>
<td>18,27</td>
</tr>
<tr>
<td>6</td>
<td>SNP</td>
<td>7,47</td>
<td>8,47</td>
<td>7,61</td>
<td>2,26</td>
<td>0,11</td>
<td>8,87</td>
<td>17,89</td>
</tr>
<tr>
<td>7</td>
<td>SWa</td>
<td>7,53</td>
<td>8,47</td>
<td>7,61</td>
<td>2,22</td>
<td>0,11</td>
<td>8,79</td>
<td>17,47</td>
</tr>
<tr>
<td>8</td>
<td>WSi</td>
<td>7,55</td>
<td>8,53</td>
<td>9,72</td>
<td>2,10</td>
<td>0,10</td>
<td>7,78</td>
<td>15,71</td>
</tr>
<tr>
<td>9</td>
<td>WNp</td>
<td>7,57</td>
<td>8,50</td>
<td>7,18</td>
<td>2,29</td>
<td>0,11</td>
<td>10,70</td>
<td>18,37</td>
</tr>
<tr>
<td>10</td>
<td>WWa</td>
<td>7,55</td>
<td>8,49</td>
<td>6,76</td>
<td>2,15</td>
<td>0,11</td>
<td>10,00</td>
<td>17,89</td>
</tr>
</tbody>
</table>
More N was found under the treatments with living mulch
Buckwheat has left more NO3 compared with the soybean
In treatment with woodchips N depression was observed
Soil Bulk density

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma

- Control plots were higher in BD more compacted
- In general applied treatments were able to decrease BD and decrease compaction
- Lower value was obtained in LWa and Ssi in soybean
- Buckwheat was higher compared to soybean
Total soil porosity

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma

- In soybean higher values in L and SNp
- For buck wheat higher values were observed with woodchips application
- In average lower higher values was found after soybean
• Significantly higher height was observed in woodchips compared to other treatments

• Mulches and commercial fertilizer out performed control

• Woodchips+natur plasma has higher effects of buckwheat plant height

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
• Woodchips increase soybean height compared to living mulch and straw

• Addition of mulch material was more pronounced in soybean compared to buckwheat

• Single higher values was woodchips and natur plasma

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
• Mulches increase TGW compared to control
• Wheat straw and Siforga produced higher value of TGW
• This trait is specific to variety and average values are 23-25g

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
Soybean Thousand Grain Weight

- NS Kaća variety is 000 maturity group short vegetation and for human consumption
- Mulch treatment were significantly higher
- Siforga has also produced significant effect on TGW
- Higher value in LSi
- Np has lower effects on this trait

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
Bukwheat plant dry mass

- Mulches affected plant dry mass compared to control
- Wheat straw and Siforga produce higher plant dry mass
- Siforga has better contributed as application was not foliar

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
Soybean plant dry mass

- In soybean living mulch has affected performance of soybean dry mass also Siforga
- Single higher PDM was in LSi

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
Higher grain mass per plant was observed with woodchips.

Siforga has also significantly affected grain mass per plant.

Straw and woodchips +Si were higher in increasing the grain mass per plant.

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) - Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma.
Seed mass per plant in soybean

- Higher seed mass was obtained with addition of woodchips and living mulch
- Single higher seed mass was attained in combination of LWa, WWa and Wsi
- Seed mass in control plants was 2-3 lower

(W) - Wood chips, (S) - Wheat Straw, (L) - Living mulch, (CON) - Control, (Si) – Siforga, (Wa) - Wuxal ascofol, (Np) - Natur plasma
Grain yield of buckwheat and soybean

Seed yield kg ha\(^{-1}\)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>A</th>
<th>B</th>
<th>AB</th>
<th>a</th>
<th>a</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Si</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Np</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grain yield kg ha\(^{-1}\)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>A</th>
<th>B</th>
<th>AB</th>
<th>a</th>
<th>a</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Si</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Np</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Living mulch has affected yield for soybean and buckwheat
- In soybean Wa and for buckwheat Si show better result for yield

PCA study reveals that yield change is well explained. The first PC1, accounts for 90% of the total data variance. For soybean there is a strong relation with woodchip application and for buckwheat with living mulches.
CONCLUSIONS

- Soil chemical properties slightly change more evident in buckwheat compared to soybean
- More residual N was found after buckwheat (living mulch)
- Soil bulk density higher after buckwheat while total porosity increases after soybean
- Woodchips affected plant height
- TGW increases after mulch application
- Siforga has marked effect on plant dry mass in soybean also living mulch
- Grain mass per plant increases after woodchip application and siforga while in soybean woodchip and living mulch has noticeable effects
- Yield of both, soybean and buckwheat increases with living mulch undersown
Thank you for your attention