Performance of legume-based annual forage crops in Mediterranean environment

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Annual cereal-legume mixtures are considered a good option to enhance and complement forage resources (hay), but few mixtures options are traditionally exploited in Mediterranean environments.

Common vetch-oat
Objectives

comparing the **agronomic performances** of annual legume-based mixtures in a drought-prone Mediterranean environment as a function of the associated cereal and the legume species

farmers were involved in the evaluation of crops (**visual assessment**)
**Experimental site**

**Sassari (Italy) (40°84’N 8°82’E) 24 m a.s.l.
Sandy-loam alluvial calcareous soil, pH 7.8
Soil depth: >1.20 m**

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<tbody>
<tr>
<td><strong>Cumulated rainfall (mm) Sep-Aug</strong></td>
<td>550</td>
<td>641</td>
<td>470</td>
<td>418</td>
</tr>
<tr>
<td><strong>Rainfall (mm) – Nov-Feb</strong></td>
<td>254</td>
<td>346</td>
<td>322</td>
<td>188</td>
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<tr>
<td><strong>Rainfall (mm) – Mar-Apr</strong></td>
<td>94</td>
<td>100</td>
<td>105</td>
<td>67</td>
</tr>
<tr>
<td><strong>Avg daily mean temp. Nov-Feb (°C)</strong></td>
<td>11.0</td>
<td>10.2</td>
<td>10.9</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>Avg daily mean temp. Mar-Apr (°C)</strong></td>
<td>12.3</td>
<td>12.1</td>
<td>11.8</td>
<td>12.2</td>
</tr>
<tr>
<td><strong>Avg daily max temp. Mar-Apr (°C)</strong></td>
<td>16.9</td>
<td>18.6</td>
<td>18.3</td>
<td>19.3</td>
</tr>
</tbody>
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Materials and methods

PLANT MATERIAL

**Pea: semileafless type**
- Semi-tall forage pea Kaspa (P1)
- Tall forage pea line 2/37b (P2)

**Vetch**
- Common vetch Barril (V1)
- Narbon bean Bozdag (V2)

**Cereal**
- Oat Genziana (O)
- Triticale Amarillo (T)

16 Treatments
- 6 pure stands
- 8 binary mixtures
- 2 four-component mixtures
**EXPERIMENTAL PROTOCOL**

**Fertilization:** 45 kg P$_2$O$_5$ ha$^{-1}$ (all plots) - 30 kg N (cereal pure stands)

**Plot dimension:** 4 x 3 m

**CRB design** with 4 replications

Annual rotation with wheat

**Germinating seeds m$^{-2}$:** 70 (P1,P2,V2), 140 (V1), 280 (O, T)

- $\frac{1}{2}$ in binary mixtures
- $\frac{1}{4}$ in 4-component mixtures

**Seeding date:** November 2013, 2014 and 2015

**Harvests:** mid April 2014, 2015 and 2016 (late heading stage of cereals)

**VISUAL ASSESSMENT**

100 farmers involved in 2014 and 2015

**Traits**

DMY

Forage quality

Interest as a crop

Interest as feed

Crop global value

**Score ranking**

1= very poor/low

2= poor/low

3= sufficient

4= high/good

5= very high/very good

**MEASURED TRAITS**

Sown DMY

Legume and weed rate
\textbf{Results}

\textbf{Monocultures (avg 3 years)}
\begin{itemize}
  \item T, O: 7.6 and 7.2 t ha\textsuperscript{-1}
  \item P2 = 6.3 t ha\textsuperscript{-1}
  \item V1, P1 = 5.6 t ha\textsuperscript{-1}
  \item V2 = 1.7 t ha\textsuperscript{-1}
\end{itemize}

\textbf{Mixtures}
\begin{itemize}
  \item V1-, P2-based mix: 7.4 t ha\textsuperscript{-1}
  \item P1-based mix: 6.7 t ha\textsuperscript{-1}
  \item V2-based mix: 5.5 t ha\textsuperscript{-1}
\end{itemize}

No differences induced by cereal species

\textbf{Mixtures vs monocultures}
Mix > pure stands but no statistical differences, except for V2-mixtures vs V2 (5.6 vs 1.7 t ha\textsuperscript{-1})

\textbf{4-component vs binary mixtures}
No statistical differences

\textbf{Abbreviations:}
P1 = semi-tall pea
P2 = tall pea
V1 = common vetch
V2 = Narbon bean
O = oat
T = triticale

\textbf{Graph:}
- Sown DMY (t ha\textsuperscript{-1})
- 2014, 2015, 2016
- LSD 2014 = 2.03
- LSD 2015 = 2.09
- LSD 2016 = 3.86
Increase of unsown species from 2014 to 2016 in legume pure stands

**Best crops** in controlling weeds T, O, V1 and its binary mixtures
Pea-based oat mixtures

- P1 = semi-tall pea
- P2 = tall pea
- V1 = common vetch
- V2 = Narbon bean
- O = oat
- T = triticale

Lsd 2014 = 0.235
Lsd 2015 = 0.193
Lsd 2016 = 0.241
Legume percentage differed significantly among years in mixtures.

Highest legume ratio in V1T, P2T and P1T, followed by complex mixtures.

- P1 = semi-tall pea
- P2 = tall pea
- V1 = common vetch
- V2 = Narbon bean
- O = oat
- T = triticale

Lsd 2014 = 0.235
Lsd 2015 = 0.340
Lsd 2016 = 0.097
The most appreciated traits in the evaluation of the crops were high DMY and easiness of harvesting.

P1 monocultures and mixtures were well appreciated mostly as grain rather than forage crops.

P2 and its mixtures, despite their high DMY, were penalised because they were considered difficult to harvest.

Visual score

P1 = semi-tall pea
P2 = tall pea
V1 = common vetch
V2 = Naboron bean
O = oat
T = triticale

Lsd = 0.74
Conclusions

Both binary and 4-component mixtures ensured higher levels of forage production than legume pure stands across years, especially P2-O

The main disadvantage of pea-based crops is their lower ability to control weeds compared to common vetch

Stakeholders involvement showed to be very useful to address both selection programmes and the proposal of new agronomic solutions
Thanks for your attention

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http://reforma.entecra.it/