STUDY OF THE POSSIBILITY FOR TWOFOLD HARVESTING OF ANNUAL WINTER CEREAL AND LEGUME CROPS AND MIXTURES IN THE REGION OF THE CENTRAL BALKAN MOUNTAINS

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Abstract


Bulg. J. Agric. Sci., 16: 687-691

During the 2007-2009 periods in the Institute of Mountain Stockbreeding and Agriculture Troyan a study was conducted on the possibility for twofold harvesting of annual winter cereal and legume crops and mixtures for production of green forage. Three pure stands of one cereal and two legume crops and 2 mixtures between them were tested in the following variants: 1. Wintering pea; 2. Winter vetch (Control); 3. Winter barley; 4. Winter barley + Wintering pea; 5. Winter barley + Winter vetch.

It was found that under initial harvesting at the stage of “early flowering” (1st stage) the mixture of winter barley + wintering pea was distinguished for the maximum productivity of dry mass, and among the pure stands wintering pea. At seed formation in the lower pods of pea (2nd stage) the mixture of winter barley + winter vetch was the most productive, and among the pure stands wintering pea.

Irrespective of the stage of initial harvesting and nature of the stands (pure or mixed), the sown cereal and legume forage crops occupied the greatest relative portion in the areas.

Key words: winter cereal and legume crops, mixtures, twofold harvesting, yields, weed infestation

Introduction

Lately, the studies for improvement of elements of the technologies for growing of some wintering legume crops occupy an important place in the researches in the field of forage production. Their twofold harvesting in one calendar year is a prerequisite for increase of plant productivity and for rising of quality of the obtained forage.

This problem was studied abroad (Jimenez, 1999; Schultz et al., 2000), as well as in our country (Éártikov, 2002a; Éártikov, 2002b; Éártikov, 2003). All studies show that when observing certain cultural conditions there are real possibilities for twofold harvesting of some of the wintering legume forage crops (pea, vetch), which increases the forage yields per unit area.

Such studies have not been conducted till now for the conditions of the foremountain regions of the Central Balkan Mountains.
The objective of this study was to investigate the possibility for twofold harvesting of some annual winter cereal and legume crops and mixtures between them grown in the soil and climatic conditions of the Central Balkan Mountains (Troyan region).

Material and Methods

The experiment was laid out during 3 years every year in autumn (first half of October) in the experimental field of IMSA, Troyan on light grey (pseudopodzolic) soil. The block method was used with 4 replications and a 5 m² area of the harvest plot. An object of the study was 3 pure stands of one cereal and two legume crops and 2 mixtures between them, investigating the following variants: 1. Wintering pea; 2. Winter vetch (Control); 3. Winter barley; 4. Winter barley + Wintering pea; 5. Winter barley + Winter vetch.

Before sowing, necessary tillage was conducted (shallow ploughing, disk ing, rotary tillage) until obtaining of a garden status of soil.

The sowing rates of the different crops were the following: for wintering pea 120 germinable seeds/m², for winter vetch 260 germinable seeds/m², for winter barley 450 germinable seeds/m². The weight ratio of cereal to legume components in the mixtures was 1:3. The sowing of the pure and mixed stands was at interrow spacing of 12 cm and depth of 5-7 cm, the experimental area being rolled before and after it.

The area of every harvest plot was divided into two equal parts. The trial plots were harvested at two stages - in their one half the first cut of the pure stands (var. 1 and 2) was harvested at the stage of “early flowering” of pea and vetch (1st stage) and in the other one at seed formation in lower pods of pea and at full flowering of vetch (2nd stage). The pure stand of winter barley (var. 3) was mowed at occurrence of full flowering. The mixtures (var. 4 and 5) were harvested depending on reaching the mentioned phenological stages for legume crops. The harvesting of 2nd cut from the trial areas was conducted at full flowering of pea and vetch (for var. 1 and 2 and for var. 4 and 5) and at earring of barley (var. 3). Every year two mowing of the stands were performed every year.

The characteristics of “dry mass productivity” in kg/da and “weed infestation of stands” in % were recorded. Yielding capacity was determined by cuts, years and on average for the experimental period. It was determined by the cut method with subsequent drying of average samples (200 g each) of fresh mass to constant weight at 105°C and on the basis of % dry matter in them it was recalculated for 1 da. The weed infestation of stands was determined by weight from fresh average samples for every replication and variant, establishing % participation of the different sown cereal and legume crops and weeds (as a total).

Mathematical processing of data on dry mass productivity was performed by the method of variance analysis (Shanin, 1977).

Results and Discussion

Data on the obtained yields of dry mass by years and on average for the 3-year period at 1st stage of initial harvesting (at “early flowering” of pea and vetch) is given in Table 1. It is evident that in 2007 the maximum productivity was recorded in the mixed stands (var. 4 and 5) - 727.39 and 582.31 kg/da, respectively, exceeding the control (winter vetch) by 237.43 and 170.12%, respectively. The pure stands of wintering pea (var. 1) and winter barley (var. 3) were superior to it by 89.66 and 132.16%, respectively.

In 2008, the maximum productivity was recorded also in the mixed stands (var. 4 and 5) - 817.58 and 697.27 kg/da, respectively. The pure stands of wintering pea (var. 1) and winter barley (var. 3) were superior to it by 27.33 and 91.77%, respectively.

It is evident from the same table that in third harvest year (2009) the mixed stands were again higher-yielding than the pure stands. The yields from the mixtures amounted to 697.33 kg/da (var. 4) and 544.00 kg/da (var. 5). The pure stands (var. 1 and 3) exceeded the control stand of wintering vetch by 113.46 and 127.56%, respectively.

On average for the 3-year period of harvesting, as
compared to the pure stands, the cereal-legume mixtures yielded the greatest quantity of dry mass. The mixture of winter barley + wintering pea was distinguished for the maximum productivity (747.43 kg/da). The recorded dry mass quantity in Wintering vetch (Control) was 238.79% smaller. The other two pure stands (Wintering pea var. 1 and winter barley var. 3) were also superior to it in yielding capacity by 74.70 and 135.04%, respectively.

Figure 1 presents the data on weed infestation of the pure and mixed stands during the three years of initial harvesting at 1st stage. It is evident that in the first harvest year (2007) the sown forage crops predominated, varying from 82.66% (var. 1) to 95.14% (var. 3) in the pure stands and from 89.96% (var. 5) to 94.01% (var. 4) in the mixtures. The lowest weed infestation (4.86%) was found in winter barley and in the mixture of winter barley + wintering pea 5.99% and the highest one in the pure stand of pea 17.34%.

In 2009, the forage crops from the pure stands and the mixtures occupied the greatest relative portion in the sown areas, varying from 93.18% (for winter vetch) to 96.51% (for winter barley) and from 88.84% (var. 4) to 94.82% (var. 5), respectively. The lowest weed infestation was found in winter barley 3.49% and in the mixture of winter barley + wintering pea 4.16%, and the highest one in the pure stand of pea - 14.26%.

Fig. 1. Weed infestation of stands in % by years at 1st stage of initial harvesting
Data on obtained dry mass yields by years and on average for 3-year period at 2nd stage of initial harvesting (at seed formation in lower pods of pea and at full flowering of vetch) is presented in Table 2. It is evident that in 2007 the maximum productivity (687.33 and 706.67 kg/da) was recorded in the mixed stands (var. 4 and 5), which was 48.77 and 52.96% higher respectively than that obtained from the control stand with forage vetch. The pure stands of wintering pea (var. 1) and winter barley (var. 3) were superior to it by 37.37 and 19.91%, respectively.

In 2008, the maximum productivity (648.00 and 490.67 kg/da) was recorded also in the mixed stands (var. 4 and 5), being superior to forage vetch by 40.87 and 50.14%, respectively. The pure stands of wintering pea (var. 1) and winter barley (var. 3) exceeded the control by 29.28 and 5.80%, respectively.

It is evident from the same table that in the third harvest year (2009) the mixed stands (var. 4 and 5) were again the highest-yielding and their increase as compared to the control stand of wintering vetch was 72.08 and 66.38%, respectively, whereas in the pure stands it was smaller - 38.46 and 61.54%.

On average for the period of harvesting, as compared to the pure stands, the greatest dry mass quantity was obtained from the cereal-legume mixtures. The mixture of winter barley + wintering pea was distinguished for the maximum productivity 725.34 kg/da. In the yield recorded for Wintering vetch (Control) was 56.55% lower. The other two pure stands (Wintering pea var. 1 and Winter barley var. 3) was also superior to it in yielding capacity by 35.06 and 29.26%, respectively.

Figure 2 presents data on weed infestation of the pure and mixed stands during the three years of initial

Table 2
Yields of dry mass in kg/ha by years and on average for the 2007-2009 period at 2nd stage of initial harvesting

<table>
<thead>
<tr>
<th>Variant</th>
<th>2007</th>
<th></th>
<th>2008</th>
<th></th>
<th>2009</th>
<th></th>
<th>Average</th>
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<tbody>
<tr>
<td></td>
<td>kg/da</td>
<td>%</td>
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<td>kg/da</td>
<td>%</td>
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<tr>
<td>1. Wintering pea</td>
<td>634.66</td>
<td>137.37</td>
<td>594.67</td>
<td>129.28</td>
<td>648</td>
<td>138.46</td>
<td>625.78</td>
<td>135.06</td>
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<td>2. Winter vetch (C)</td>
<td>462</td>
<td>100</td>
<td>460</td>
<td>100</td>
<td>468</td>
<td>100</td>
<td>463.33</td>
<td>100</td>
</tr>
<tr>
<td>3. Winter barley</td>
<td>554</td>
<td>119.91</td>
<td>486.67</td>
<td>105.8</td>
<td>756</td>
<td>161.54</td>
<td>598.89</td>
<td>129.26</td>
</tr>
<tr>
<td>4. Winter barley + Wintering pea</td>
<td>687.33</td>
<td>148.77</td>
<td>648</td>
<td>140.87</td>
<td>805.33</td>
<td>172.08</td>
<td>713.55</td>
<td>154</td>
</tr>
<tr>
<td>5. Winter barley + Winter vetch</td>
<td>706.67</td>
<td>152.96</td>
<td>690.67</td>
<td>150.14</td>
<td>778.67</td>
<td>166.38</td>
<td>725.34</td>
<td>156.55</td>
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<td>GD 5%</td>
<td>22.15</td>
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<tr>
<td>GD 1%</td>
<td>26.83</td>
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<tr>
<td>GD 0.1%</td>
<td>40.65</td>
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</tbody>
</table>

Fig. 2. Weed infestation of stands in % by years at 2nd stage of initial harvesting
harvesting at 2nd stage. It is evident that in the first harvest year (2007) the sown forage crops predominated, varying from 86.30% (var. 2-C) to 94.35% (var. 3) in the pure stands and from 93.30% (var. 4) to 96.79% (var. 5) in the mixtures, where lower weed infestation was also found - 6.70 and 3.21%, respectively. The highest weed infestation was recorded in the pure stands with wintering pea and winter vetch (Control) - 12.40 and 13.70%.

In the second harvest year (2008) the sown forage crops also predominated in the stands, reaching 80.90% (var. 2-C) to 94.74% (var. 3) in the pure stands and 95.23% (var. 5) to 98.41% (var. 4) in the mixtures, where the lowest weed infestation was also found 1.59 and 4.77%, respectively. The highest weed infestation was recorded in the pure stands with wintering pea and winter vetch (Control) - 16.22 and 19.10%.

In 2009, the sown forage crops occupied the greatest relative portion in the pure stands, varying from 87.80% for winter vetch to 98.11% for winter barley. Their relative portion in the mixtures amounted to 96.71% (var. 5) and 98.21% (var. 4). The highest weed infestation was observed in winter vetch and wintering pea 12.20 and 11.89%, respectively.

Conclusions

The study of the possibility for twofold harvesting of some annual winter cereal and legume crops and mixtures between them for production of green forage showed that under initial harvesting at the stage of “early flowering” (1st stage) the mixture of winter barley + wintering pea was distinguished for the maximum productivity of dry mass (747.43 kg/da), and among the pure stands wintering pea (625.78 kg/da).

Irrespective of the stage of initial harvesting and nature of the stands (pure or mixed), the sown cereal and legume forage crops occupied the greatest relative portion in the areas.

References


Received February, 2, 2010; accepted for printing September, 23, 2010.