A NEW MUTANT SPRING FORAGE VETCH LINE (\textit{Vicia sativa ssp. sativa L.})
WITH INCREASED POD NUMBER PER FERTILE NODE

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Aksenia ALEKSIEVA, Galina NAIDEVOVA

Experimental station of soybean, 5200 Pavlikeni, Rousky 61, Bulgaria,
E-mail: aaleksieva@abv.bg

\textbf{Abstract:} A new mutant spring forage vetch line with increased pod number (3–4) per fertile node, obtained by applying of chemical mutagenesis in variety Obrazetz 666, was studied. For estimate the degree of heritability of the mutation was determined the genotypic variance (S\textsuperscript{2}g) according to the traits number of pods per plant, mean number of pods per fertile node and number of seeds per plant between the mutant and the initial genotype of mean sample of 10 plants by ANOVA model 3. Significant genotypic difference between the mutant line and the initial variety with regard to the traits mean number of pods per fertile node, number of pods and number of seeds per plant was established. A very high coefficient of heritability (H\textsuperscript{2} = 99\%) was observed for the trait mean number of pods per fertile node and was reason to be considered that its phenotypic performance in the mutant line was entirely genetically determined. The genotypic variance for the traits number of pods and seeds per plant was significantly superior to the ecological one and can be considered that in the newly-selected line will be actual increase in the grain yield because of the higher values of these elements structuring it. The introduction into practice of this line, which has higher propagating coefficient, respectively higher seed yield, can contribute to the wider use of forage vetch as crop for green manure and cover crop.

\textbf{Key words:} Vicia sativa (L.), heritability in broad sense, grain yield, mutant line, increased (3–4) pod number per fertile node

\textbf{Introduction}

Spring vetch (\textit{Vicia sativa L.}) is one of the most widespread annual legumes in the Mediterranean and West Asia \cite{YOLCU2010}. Except as pasture crop and for production of green forage, hay and silage, the seeds obtained from it are widely used in animal nutrition (mainly lambs), because of the high nutritional value of its seeds \cite{ACIKGOZ1988}.

Therefore one of the main objectives of breeding of spring vetch is to develop varieties with increased yield of grain.

The yields of grain obtained from the contemporary Bulgarian varieties spring vetch, compared with those obtained in Western Europe, were very low and depending on the meteorological conditions during the growing year, varied from 101 to 114.6 kg/da \cite{AGROSTATISTICS2010, AGROSTATISTICS2011}.

It was found that there were high and significant correlation coefficients between grain yield on the one hand and biological yield, straw yield, number of secondary branches per plant and the number of pods per plant.

According to \cite{SAOUB2012} the selection according to these traits would help to develop lines and varieties with improved yield potential of grain.

Many authors indicated that some traits, such as number of pods and seeds per plant which were directly related to grain yield, were characterized by moderate to high heritability and therefore can be used as reliable criteria for the selection in the early stages of breeding in annual legumes in the direction of grain yield.

According to Kumar and Turk \cite{KUMAR2001, TURK2007} heritability of these traits was from 0.45 to 0.61\% and \cite{MILCZAK2001, WALCZAK2004} reported even higher values—from 0.72 to 0.93\%.

The objective of this study was to determine heritability in M4–6 generations of morphological mutation characterized.
by an increased pod number (3–4) per fertile node and the possibilities for developing high-yielding forage vetch line for grain and seeds, suitable for direct use in practice.

**Material and methods**

The investigation was conducted in ESS in Pavlikeni during the period 2010–2012.

Morphological mutation with increased pod number (to 3–4) per fertile node, by applying of chemical mutagenesis in variety Obrazetz 666, was studied.

The mutation was obtained and selected in \( M_2 \) generation in our previous investigations [ALEKSEIEVA, 2009].

In \( M_3 \) generation the mutation was differentiated as mutant line recorded as №1 and tested in the following generations (\( M_4 - M_6 \)) together with the initial variety Obrazetz 666, which at the same time is standard for the country.

For estimate the degree of heritability of the mutation was determined the genotypic variance (\( S^2_g \)) according to the traits number of pods per plant, mean number of pods per fertile node and number of seeds per plant between the mutant and the initial genotype of mean sample of 10 plants by ANOVA model 3.

Additionally, in \( M_6 \) generation were studied the productive capacities in line №1 and the standard variety Obrazetz 666 in preliminary test.

The split plot method was used, the number of replications was 4 and the area of the plot was 5 m\(^2\).

The obtained results were statistically processed using ANOVA.

**Results and discussion**

Spring vetch *Vicia sativa*, ssp. sativa, to which also belongs the initial variety Obrazetz 666, usually forms flowers in a raceme, one or two in the axils of each leaf (Figure 1) from which develop 1–2 pods [HAMAL, SHARMA, 2012].

The studied mutant line differed from the initial variety in the trait number of pods per fertile node, which were three or four (Figure 2 and 3).

It was significantly superior to the initial genotype regarding the mean values of the trait number of pods per fertile node (Table 1).

These values of the trait were not negatively related to the number of fertile nodes and as result had formation of more pods and seeds per plant.

By analysis of the variance was established significant genotypic difference between the new line and the initial variety with regard to the mentioned
traits. For the trait mean number of pods per fertile node was observed very high coefficient of heritability ($H^2 = 99\%$) and this was reason to be considered that its phenotypic performance in the mutant line was entirely genetically determined.

**Table 1. Statistical analysis of the variance components and broad-sense heritability ($H^2$) for some grain yield components in mutant line No1 and initial variety Obrazetz 666**

<table>
<thead>
<tr>
<th>Grain yield components</th>
<th>No of pods per plant</th>
<th>Mean No of pods per fertile node</th>
<th>No of seeds per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obrazetz 666</td>
<td>Line No1</td>
<td>Obrazetz 666</td>
</tr>
<tr>
<td>Mean values</td>
<td>8.83±0.5</td>
<td>14.73±1.1</td>
<td>1.7 ± 0.06</td>
</tr>
<tr>
<td>VC %</td>
<td>29.1</td>
<td>41.5</td>
<td>18.6</td>
</tr>
<tr>
<td>MS for Genotype</td>
<td>282.3***</td>
<td>0.947167***</td>
<td>2656.6***</td>
</tr>
</tbody>
</table>

**Estimates of Variance components**

| $S^2_{\text{ph}}$ | 17.41 | 0.39 | 656.4 |
| $S^2_{\text{e}}$  | 8.56  | 0.13 | 275.7 |
| $S^2_{\text{gy}}$ | 11.54 | 0.001 | 536.8 |
| $S^2_{\text{g}}$  | 13.27 | 0.38 | 468.3 |
| $H^2$ %            | 77    | 99   | 72    |

*** significant at $P \leq 0.001$

The interaction between genotype and the conditions of the year (GxY) was not significant which showed that the performance of the new trait did not need specific conditions for performance.

The mutant line was with stable genotype characteristic and after preliminary test can be realized as new variety.

*Figure 2. Mutant line No1 with increased number of pods (3) per fertile node*
The higher values of the traits number of pods and seeds per plant in the new line were result of the stable phenotypic performance of the trait increased pod number per fertile node. The genotypic variance for the two traits was significantly superior to the ecological one and can be considered that in the newly–selected line will be actual increase in the grain yield because of the higher values of these elements structuring it.

**Figure 3.** A plant of mutant line No1 with increased number of pods (4) per fertile

As a proof of this were the obtained results in 2012 in the preliminary test of the line. It was significantly (P<0.001) superior to the initial variety with 54% (Figure 4) regarding the grain yield.

![Bar chart](image)

**Figure 4.** Preliminary test–2012

Vetch is most widely used crop for green manure and cover crop. Its low seed yield and as consequence of this, higher cost of seeds significantly limits its use. The introduction in practice of the new line, which is characterized with higher propagating coefficient, and respectively higher seed yield, can contribute to use it in this direction.

**Conclusion**

Significant genotypic difference between the mutant line and the initial
variety with regard to the traits increased pod number per fertile node, number of pods and number of seeds per plant was established.

For the trait mean number of pods per fertile node was observed a very high coefficient of heritability ($H^2=99\%$) and this was reason to be considered that the phenotypic performance of this trait in the mutant line was entirely genetically determined.

The genotypic variance for the traits number of pods and seeds per plant was significantly superior to the ecological one and can be considered that in the newly–selected line will be actual increase in the grain yield because of the higher values of these elements structuring it.

The introduction into practice of this line, which has higher propagating coefficient, respectively higher seed yield, can contribute to the wider use of forage vetch as crop for green manure and cover crop.

References

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