EFFECTS OF DIFFERENT TYPES FERTILIZERS ON GRAIN YIELD IN DIFFERENT SORTS OF FLAX

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Abstract

A few years ago began the re-cultivation of flax in the area of the northwestern part of Bosnia and Herzegovina with the ultimate aim of producing seeds and fibers. Flax seed contains about 57 % alpha linolenic acid known by multiple medical effects as the guardian of cardiovascular health, and which the current way of nutrition we take into the organism in about ten times smaller quantity than those recommended by the World Health Organization. In addition to the seed of the flax are obtained with high quality fibers that are environmentally acceptable and for which there is a great need in the area of the European Union. In order to achieve higher yields have been conducted research on the effects of fertilization on seed yield. For this purpose, the experiment was conducted under field conditions at two locations (Cojluk and Ostruznica) in a split-plot design. In the research were used three varieties (Mikael, Belstar and variety X) with five fertilization treatments: T1 - control, T2 - mineral fertilizers T3 - organic fertilization, T4 - bacterial fertilizer (Azoter) and T5 - bacterial+organic fertilizer. Based on the obtained results, the two-year investigation of morphological and phenological traits was found that there were differences between the studied varieties and fertilizer on the basis of treatment. Statistical significance of highest yield at both locations was obtained by variety Belstar with fertilization treatment T5 (1600 kg/ha Ostruznica and 1900 kg/ha Cojluk). With the aid of the Kruskal-Wallis test revealed significant differences in fertilization treatments, which had an impact on all the characteristics of the flax plant, the statistical differences between the varieties studied traits less significant. After the research, as the best variety for cultivation, and on the basis of the yield level, recommended varieties Belstar with the aforementioned method of fertilization (T5).

Keywords: flax, omega 3 fatty acids, fertilization, yield.

1. Introduction

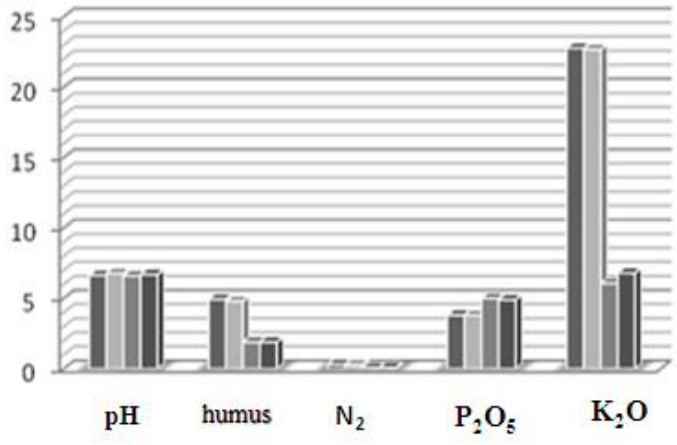
Flax cultivation in Bosnia and Herzegovina is unjustified neglected, and in recent years has started cultivation again, because every day the growing demand for flax, both on domestic and on the foreign markets (Šimetić, 2008). To satisfy the market need for seed of these culture it is necessary to increase the yield of flax, which can be achieved by sowing high yielding varieties and optimizing agricultural activities (Khourang et al. 2012). Flax is a culture that is relatively small/symbolic grown in the area of the northwestern part of Bosnia and Herzegovina, and therefore the results will form the basis for its further cultivation, as well as key plants that the physico-chemical characteristics, has a great impact on human health, and as such should is an indispensable food and nutrition an integral part of every inhabitant. The aim of the research is to determine the level of influence of different types of fertilizers (organic, bacterial, organic-bacterial, mineral and cultivation without fertilizers) on grain yield of different varieties of flax.

2. Materials and Methods

At the locality Cojluk, and the locality Ostruznica, Bosanska Krupa in 2012 and 2013, has been set an experiment with three varieties of flax: Mikael, Belstar and variety X. The experiments were set by scheme randomized block design with four replications, and five variants of fertilization: T1 - control (without fertilizer application), T2 - T3 and mineral fertilizers - organic fertilization (bovine manure), T4 - bacterial fertilizer (Azoter) and T5 - organic + bacterial fertilizer. Size plot was 10 m^2, and the sowing is done in the third week of April on the basis of 1200 germinable seeds per m^2. A common technology of growing flax is applied. Analysis of soil substrate was performed by standard methods that are applied in scientific institutions (AOAC, 1995). Measurements of quantitative traits and qualitative traits were performed in the laboratory of Biotechnical Faculty, University of Bihac, and the results were analyzed by using statistical software PAST (2013) and XL STAT (2011). During the growing season are followed morphological and phenological properties: time of germination, increase flax during the growing season, beginning of flowering and full maturity, number of capsules per plant and number of seeds in the capsule.

3. Results and Discussion

Before setting the experiment for the vegetation period in 2012 and the 2013th year was made the control of soil fertility. The results are shown in graph 1.



Graph 1. Results of soil fertility control in the studied locations

Results of the analysis indicate that investigated soil of location Cojluk has a very high content of humus, very good presence of nitrogen, but extremely weak content of potassium and phosphorus, and in addition to other treatments applied fertilizer NPK fertilizer formulation (5:10:20), while the plot on the location Ostruznica significantly poorer quality when it comes to the content of humus, potassium and nitrogen, and a little higher percentage of phosphorus (NPK = 20:10:20). Previous studies (Butorac et al. 2006a & 2006b; Easson & Long, 1992; Padlock, 1994; Zedan et al. 1999) indicate that large amounts of nitrogen affecting the formation of finer flax fiber, less hardness, but lead to increased risk of lodging, and thus to a loss in yield. There have been many significant research on the effects of fertilization on the quality of the fiber, but not on the quality and yield of seeds, and the results will be of great importance to future farmers of this culture.

Table 1. Variance analysis of investigated morphological characteristics of flax

St. anal	Plant height		Length branching		Number of seeds	
Cojluk	Sum of squares **1293,600** F **10,078 ***	Mean squares **128,869** Pr > F **0,002**	Sum of squares **2683,240** F **37,180**	Mean squares **70,96** Pr > F **0,1726**	Sum of squares **102,010** F **47,463***	Mean **2,149** Pr > F **0,0366**
Ostruznica	Sum of squares **14777,600** F **65,026 ***	Mean squares **3694,40** Pr > F **00,00185**	Sum of squares **1968,480** F **24,617 ***	Mean squares **420,120** Pr > F **0,016**	Sum of squares **750,720** F **41,345 ***	Mean **187,687** Pr > F **0,01309**

* Significant at the level of 0.05%

Table 1 shows the statistical analysis of observed traits of flax monitored during the experiment, which significantly affect on seed yield. After processing the data collected for both the test locations, there was a statistically significant difference between the samples of plants on the basis of fertilization treatments and examined varieties, where as the best way of fertilization, with all three varieties, location Cojluk showed T5 (a combination of bacterial and organic fertilizers).

Analysis of variance showed a statistically significant difference ($P < 0.05$) on the basis of plant height where the tallest stalks of flax varieties Mikael recorded at 89 cm, and the lowest in the stems of the variety X, the same treatment fertilization, height 71 cm. By statistical analysis the significance of the results it can be concluded that the differences in plant height caused by variety, but the method of fertilization, where the lowest stems measured at variety X, T1 = 47 cm, then sort Belstar, T1 = 53 cm and a variety Mikael T1 = 68 cm. On the location of Ostružnica, due to significantly lower soil quality were achieved significant differences measured value, but as best variety, when a measurement of the height of the plants, showed Mikael variety, fertilization treatment T5 = 79 cm, as the worst sort X, T3 = 45 cm, while the fertilization treatment T5 achieved height was 65 cm. Further measurements were found statistical differences in other traits investigated. After established the presence of a statistical difference, with the help of the Kruskal-Wallis test was determined statistical significance of differences in both locations (Table 2).

Table 2. Kruskal - Wallis test

Cojluk	T1	T2	T3	T4	T5
Height	NS	×	×	×	×
Number of seeds	×	×	×	×	×
Branching	NS	×	×	×	×
Ostruznica	T1	T2	T3	T4	T5
Height	NS	×	NS	×	×
Number of seeds	×	×	×	×	×
Branching	NS	×	NS	NS	×

Note: NS = nonsignificant difference, × = significant difference.

With the help of the Kruskal-Wallis test (Table 2) revealed significant differences in fertilization treatments, which had an impact on all the features of the flax plant, which is the height, number of seeds and branching, while the statistical differences between the varieties studied traits less significant. The harvest of flax was performed in the first week of August when the flax was on the turn from yellow to full maturity, the leaves are down, stalk got dark color, and the capsules began to shoot. After separating the seeds from the remains of plants was determined the height of yield on the basis of the test varieties and fertilizer treatments.

Table 3. Variance analysis of seed yield the examined flax varieties

St. anal	Yield			
Cojluk	Sum of squares	Mean squares	Fisher's t	P>F
	1742233,333	435583	4,659*	0,0022
Ostruznica	Sum of squares	Mean squares	Fisher's t	P>F
	2095506,667	523886,667	5,866 *	0,011

From Table 3 are visible statistical differences in both studied locations. After analysis of variance was done using Kruskal-Wallis test which showed us (Table 4) that are statistically significant differences in the yields using a different fertilization treatments, while statistical differences in the yields of those varieties are not considered so significant.

Table 4. Kruskal-Wallis test

Table of groups:	Sum of ranks	Groups	
Ostruznica	15	A	
Cojluk	30		B
	Cojluk	Ostruznica	
sort	NS	NS	
treatments	×	×	

Note: NS = nonsignificant difference, × = significant difference.

Pospišil and colleagues (2010) performed the research seed yield in eight varieties of flax oil (Atlanta, Flanders, Biltstar, Altess, Mikael, Princess, Niagara, Eole), and the results showed that the highest yield was sort Altess (1644 kg/ha). Comparing their results and yield varieties Belstar the location Cojluk, with organic fertilizer + bacterial treatment more than good (1900 kg/ha). In contrast to locations Cojluk, and due to much lower soil quality, conditioned significantly lower percentage of humus and microelements, there has been a lower yield that was statistically significantly different at different fertilization treatments, so for example the

variety Belstar was: control (300 kg/ha), mineral fertilizers (900 kg/ha), organic manure (1200 kg/ha), bacterial fertilizer (950 kg/ha) and the highest yield with organic + bacterial fertilizer treatment (1600 kg/ha).

4. Conclusion

On the basis of the study of morphological and phenological characteristics of flax at two locations, it can be concluded the following:

- All varieties are grown consistently to the end of vegetation.
- The results show that there are no statistically significant differences between the varieties in terms of seed yield.
- There are statistically significant differences in seed yield based on the fertilization treatments.
- The highest yield was achieved at fertilization treatment T5 (organic+bacterial fertilizer) in all tested cultivars in both locations.
- According to the results, we can conclude that it is the best Belstar variety for growing flax and because achieves the highest seed yield.

The area of the Unsko-Sanski Canton is relatively underdeveloped area, when in is the question mentioned farming culture. The development of farming and cultivation of flax, as a branch of agriculture, until now was not followed by scientific research and achievements. Therefore it can be concluded that this work is a contribution to science.

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