PRODUCTION POTENTIAL OF FEED BARLEY VARIETY VESLETS, GROWN IN THE SOUTH DOBRUDZHA REGION OF BULGARIA

Albena Ivanova
Shumen University „Bishop Konstantin Preslavsky", College Dobrich, Bulgaria albena.ivanova@shu.bg
Magdalena Koleva
Shumen University „Bishop Konstantin Preslavsky", College Dobrich, Bulgaria
albena.ivanova@shu.bg

Abstract: The soil and climatic conditions of Dobrudzha region are favorable for the cultivation of cereal crops and the formation of higher yields compared to the other agro-ecological regions of Bulgaria. Barley is a traditional agricultural crop, ranks after wheat and maize and has an important role in the grain balance of our country. The proven stable and permanent barley yields ensure good harvest and make it a preferred crop with other cereals. Its productivity is determined by the genetic features of the variety and the growing conditions - meteorology and agro-technology. The production potential of the feed standard barley variety Veslets were investigated in an eight-year field experiment (2009-2016) carried out in the trial field of Dobrudzha Agricultural Institute-General Toshevo. The experiment was designed by the split plot method in 4 replications, the size of the trial plot being 12 m^2 after four predecessors: rape, peas, sunflower and grain maize. The study included three levels of fertilization. The mineral fertilization was applied according to the type of previous crop. Fertilization with phosphorus and potassium was background (P_6K_6) and nitrogen fertilizer tested at the following rates: N_6, N_{12} and N_{18} after rape, sunflower and grain maize (T), N_3, N_6 and N_9 after peas (T), the check variant being $N_0P_0K_0$ (O). The purpose of the research is to study the productivity of the feed standard barley variety Veslets over a longer period of time characterized by a variety of weather conditions at different fertilization rates. Meteorological conditions over the years have had a decisive impact on the productivity of feed barley. The long research period with the presence of a wide variety of weather conditions during the growing season of barley is a cause of formation of its different productivity. The most favorable combination of weather conditions during the 2013 season obtained the maximum yield of barley compared to other years. Mineral fertilization is a powerful factor that has a specific impact on the formation of feed barley. The effect of mineral fertilization on the productivity of barley is different and depends on its interaction with other agronomic factors and environmental conditions. Quite naturally, the lowest yields were obtained in control variants without fertilization (O). However, the effect of mineral fertilization in fertilizer variants (T) is different as a result of the interaction between the other agro-technical factors and the environment conditions. The effectiveness of mineral fertilization is most expressed during the 2015 season, when the increase in yields relative to control without fertilization is 52%.
Keywords: barley, yield, fertilization, years.

INTRODUCTION

In the last few years global climate changes has been affecting the most severe grade food crops because they occupy large areas. Improving crop yields are essential to meet the increasing pressure of global food demands [1] [2] [3] [4] [5].

Grain cereals are traditional for us and are the basis of world agriculture. Naturally wheat occupies a major share in world production. Unfortunately, the areas sown with barley have been progressively decreasing on the one hand due to the introduction of rapeseed in the country over the last ten years, on the other hand, due to a reduction in the livestock sector [6] [7] [8].

Barley continues to be a major field crops in Bulgaria. Barley is an economically important and traditional Bulgarian culture that takes its place in the feed grain production and brewing industry. However that amount of the sown areas over the years is unstable, this culture plays a significant role in the grain balance of our country. The yield of barley depends on the genetic features of the variety and the conditions of cultivation (meteorology and agro-technology). [9] [10] [11] [12] [13].

The purpose of the research is to study the productivity of the feed standard barley variety Veslets over a longer period of time characterized by a variety of weather conditions at different fertilization rates.

MATERIAL AND METHODS

The investigation was carried out during 2009-2016 in the trial field of Dobrudzha Agricultural Institute – General Toshevo on slightly leached chernozem soil (Haplic Chernozems, FAO, 2002). The trial was designed by the split plot method in 4 replicates, the trial area being 12 m^2. During the years of the investigation variety Veslets was sown within the optimal term for this region with sowing norm 450 germinating seeds/m^2 after four previous crops – rape, peas, sunflower and grain maize. The study included three levels of fertilization. The mineral fertilization was applied according to the type of previous crop. Fertilization with phosphorus and potassium was background (P_6K_6) and nitrogen fertilizer tested at the following rates: N_6, N_{12} and N_{18} after rape, sunflower and grain maize, N_3, N_6 and N_9 after peas, the check variant being $N_0P_0K_0$.

Soil tillage included single disking (10-12 cm) after harvesting of previous crops, and double disking after main fertilization. Phosphorus and potassium was introduced before main soil tillage, and nitrogen – before the beginning of permanent spring vegetation. The fertilizers used were triple super phosphate (TSP), potassium chloride (KCl) and ammonium saltpeter niter (NH_4NO_3). Control of weeds, diseases and pests was done with appropriate pesticides in case of need in all variants of the trial.

The data were processed and analyzed with Excel 13. In this article, the yields of the various predecessors are averaged (previous crops are not considered separately). Also, the yields obtained from the different fertilization variants are also averaged and indicated by T. These results are compared with the yields obtained from the non-fertilized control variants labeled O.

RESULTS AND DISCUSSION

Feed barley varieties to which Veslets variety belongs are mainly multi-row. Multi-row barley combines cultural forms which have three normally developed fertile spikelets at each rachis node. They belong to subspecies Hordeum sativum ssp.vulgare L.polystichum, which is subdivided into two subgroups: Hexastichum L. and Tetrastichum. The first group includes the varieties: parallelym, pyramidatum and gracilium [14] [15].

The studied period is characterized by a variety of weather conditions (Table 1). During the years of the study, different amounts of precipitated rainfall and average temperatures during the vegetation period of barley. The meteorological conditions during the investigated years (2009-2016) are compared with the climatic norm for the Institute (1952-2016). With regard to the falling rainfall, vegetation period of the barley is divided into autumn-winter (months X-III) and spring (months IV-V). The deviations between the rainfall rate (1952-2016) and the average amount of precipitated rainfall for each of the studied years are calculated. The autumn-winter supply of moisture in the soil is of great importance for the formation of barley productivity. Just over two years (2008-2009 and 2010-2011) autumn-winter stock is lower than the rainfall rate and during 2008-2009 deviation is larger (61,6 mm). They are distinguished for 2009-2010, when the amount of precipitation fallen during autumn-winter period exceeds the rainfall rate by 178 mm and 2014-2015 by 134,7 mm. The amount of fallen rainfall during the spring critical period is also of great importance for the formation of high productivity (months IV-V). Then proceed phases of stem elongation and grain formation of barley. During this period only the average amount of precipitation in the three years (2008-2009, 2012-2013 and 2014-2015) is lower than the rainfall rate. The average daily temperature is calculated for the whole vegetation period and is compared with the climatic norm. In terms of temperature regime research period is warmer, as 2010-2011 and 2011-2012 are closest to the calculated norm. The years 2012-2013 and 2015-2016 are very different, during which the measured average temperatures are almost two degrees above the climatic norm. This diversity in weather conditions is a prerequisite for the formation of different productivity in feed barley.

Table 1. Meteorological conditions during the years of research and for a multiannual period.

Years	Rainfall, mm				Average temperature, ^{0}C	
	Periods					
	Months X – III	Deviation +/-	Months IV – V	Deviation +/-	Vegetation period	Deviation +/-
2008-2009	176,6	– 61,6	69,4	– 26,6	8,5	+0,9
2009-2010	416,2	+178,0	141,7	+45,7	8,4	+0,8
2010-2011	206,4	– 31,8	129,6	+33,6	7,8	+0,2
2011-2012	283,0	+44,8	159,0	+63,0	7,7	+0,1
2012-2013	250,8	+12,6	58,7	– 37,3	9,5	+1,9

2013-2014	320,5	+82,3	107,8	+11,8	8,9	+1,3
2014-2015	372,9	+134,7	59,2	– 36,8	8,2	+0,6
2015-2016	313,5	+75,3	137,9	+41,9	9,5	+1,9
1952-2016	**238,2**		**96,0**		**7,6**	

High cultivation technologies of feed barley are directly dependent on the weather conditions during its vegetation. The average yields obtained from the Veslets variety in years are shown in Figure 1. The environment conditions were most favorable during the 2013 harvest when the Veslets variety formed a maximum yield of 9,79 t/ha. In five years studied (2010, 2011, 2012, 2014, 2015) the average yields obtained were very close in the range of 6,05-6,33 t/ha. The most unfavorable were the weather conditions during the harvest 2016 when the feed barley had the lowest productivity of 4,88 t/ha.

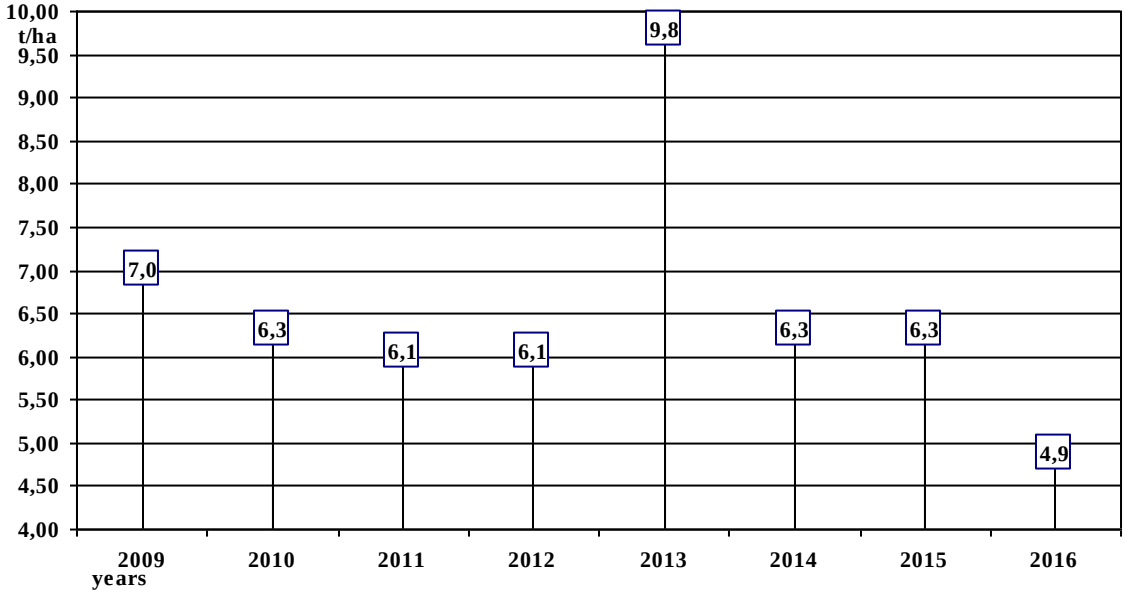

Figure 1. Yield of barley variety Veslets by year.

Mineral fertilization is an essential and dynamic part of growing technology. It is a powerful factor that has its specific impact on the formation of feed barley productivity. The average yields obtained from the Veslets variety are presented in years depending on the fertilization in Figure 2. The differences between control variants without fertilization (O) and fertilization variants (T) clearly show the effectiveness of mineral fertilization. Quite naturally, the lowest yields were obtained in control variants without fertilization (O). However, the effect of mineral fertilization in fertilizer variants is different as a result of the interaction between the other agro-technical factors and the environment conditions. Depending on the effect studied years can be divided into three groups. In the first group, the efficiency of the applied mineral fertilization is the highest and here can be attributed the 2009 and 2015 harvest years. During these years, the increase compared to control variants was 30% and 52%, respectively. In 2015, in the non-fertilizer variants, the productivity of feed barley is the lowest (4,53 t/ha). The application of mineral fertilizers has led to twice as high yields (6,91 t/ha). In 2009, in the variants without fertilization, 5,72 t/ha were obtained and 7,43 t/ha of the fertilizers. The second group can be attributed to the 2011, 2012 and 2014 harvest years. During these years, the increase compared to control variants is also large and is in the range of 19-25%. During these years the yields obtained from the control variants are close to the values (from 5,12 t/ha to 5,33 t/ha). In the fertilization variants the yields obtained from the Veslets variety are also small differences (from 6,31 t/ha to 6,35 t/ha). The third group can be assigned the 2010, 2013 and 2016 harvest years. During these years the efficiency of mineral fertilization is the lowest and is in the range of 6-10%. Interesting results were obtained in 2013, when a feed barley produced the highest yields of both the non-fertilizer plot (9,37 t/ha) and the fertilizer section (9,93 t/ha). However, the effect of applied mineral fertilization is only 6%. The 2016 harvest year was also recorded, when the lowest yields (4,59 t/ha in the non-fertilizer variants and 4,97 t/ha in the fertilizer variants) of the Veslets variety were obtained. The effect of the applied mineral fertilization is also low - 8%.

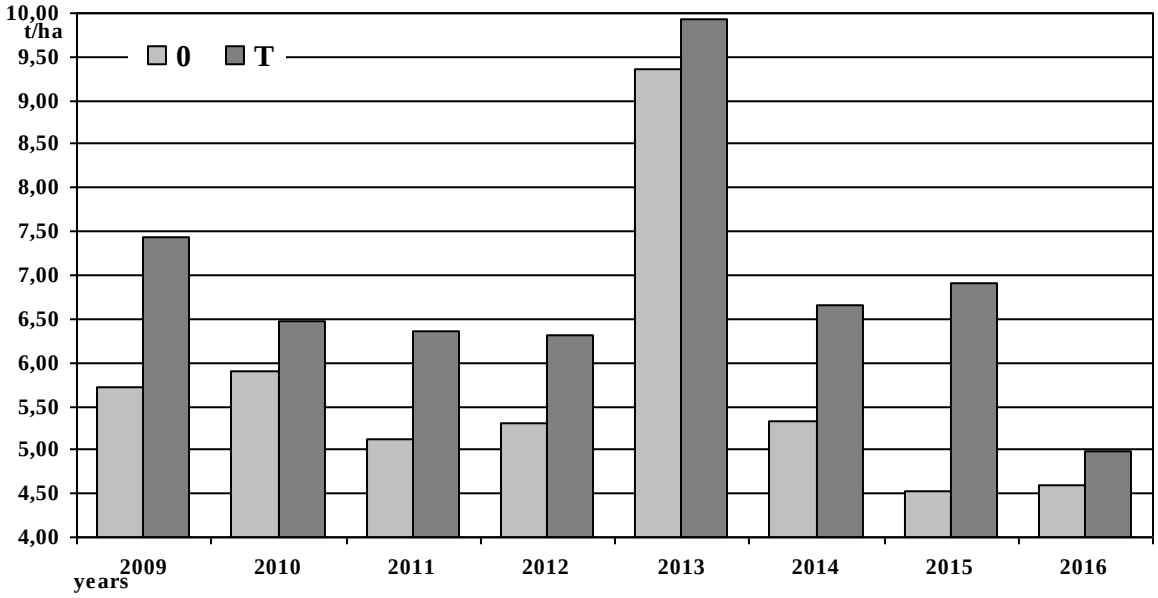

Figure 2. Yields of barley variety Veslets per year depending on fertilization (O-control variant without fertilization, T-variants with fertilization).

CONCLUSIONS

The long research period with the presence of a wide variety of weather conditions during the growing season of barley is a cause of formation of its different productivity.

The most favourable combination of weather conditions during the 2013 season obtained the maximum yield of barley compared to other years.

The effect of mineral fertilization on the productivity of barley is different and depends on its interaction with other agronomic factors and environmental conditions.

The effectiveness of mineral fertilization is most expressed during the 2015 season, when the increase in yields relative to control without fertilization is 52%.

REFERENCES

[1] Hellin, J., B. Shiferaw, J. E. Cairns, M. Reynolds, I. Ortiz-Monasterio, M. Banziger, K. Sonder, R. La Rovere, Climate Change and Food Security in the Developing World: Potential of Maize and Wheat Research to Expand Options for Adaptation and Mitigation, Journal of Development and Agricultural Economics, vol. 4, pp. 311–321, 2012.

[2] Semenov, M.A., P. Stratonovitch, F. Alghabari, M.J. Gooding, Adapting wheat in Europe for climate change, Journal of Cereal Science, vol. 59, pp. 245–256, 2014.

[3] Chapagain, T., A. Good, Yield and production gaps in rainfed wheat, barley and canola in Alberta, Front Plant Sci., vol. 6, pp. 990, 2015.

[4] Chamurliyski, P., D. Atanasova, E. Penchev. Productivity of foreign common winter wheat cultivars (*Triticum aestivum* L.) under the conditions of Dobrudzha region, Agriculture & Forestry, vol. 61, №1, pp. 77-83, Podgorica, 2015.

[5] Chamurliyski, P., E. Penchev, N. Tsenov. Productivity and stability of the yield from common winter wheat cultivars developed at IPGR Sadovo under the conditions of Dobrudzha region, Agricultural Science and Technology, vol. 7, № 1, pp 19 - 24, 2015.

[6] Mihova, G., Agrocompas, Barley and triticale-attractive cereals on the Bulgarian fields, 2014 *(in Bul).*

[7] Tsenov, N., Agronom, Current state of cereal crops in the country, 2014 *(in Bul).*

[8] Dyulgerova, B., D. Dimova, D. Valcheva, D. Vulchev, T. Popova, M. Gocheva, Grain yield of winter feed barley varieties, Agricultural Science and Technology, vol. 5, № 1, pp. 25-28, 2013.

[9] Koteva, V., B. Zarkov, D. Atanasova, V. Maneva, Sustainable cultivation of barley in water deficit, Field crops studies, vol. VI-1, pp. 67-78, 2010 *(in Bul)*.
[10] Bazitov, R., B. Bazitov, Productive possibilities of feed barley under influence of some agrotechnical factors, International Science Online Journal of Science and Technology, Union of Scientists, St. Zagora, vol. 1, No. 6, pp. 180-184, 2011 *(in Bul)*.
[11] Koteva, V., M. Marcheva, Productivity of barley, cultivar Vesletz, cultivated under reduced mineral fertilization, Agricultural Science, vol. IV, № 11, pp. 7-11, 2012 *(in Bul)*.
[12] Koteva, V., Mineral fertilization effect's on winter barley, cultivated in favorable and risky climate conditions, Soil, Science, Agrochemistry and Ecology, vol. XLVII, №3, pp. 32-38, 2013 *(in Bul)*.
[13] Koteva, V., V. Bazitov, Effect of nitrogen fertilization on the productivity of feed barley, variety Veslets, Science&Technologies, vol. IV, №6, pp. 241-245, 2014 *(in Bul)*.
[14] Mihova, G., D. Dimova, Yield components characterization of various feed barley forms, Field Crops Studies, vol. 8, № 1, pp. 23-36, 2012 *(in Bul)*.
[15] Dimova, D., D. Valcheva, B. Dyulgerova, Study Of Several Traits Related To Productivity In Lines Of Winter Feed Barley (var. Pallidum and var. Parallelum), Turkish Journal of Agricultural and Natural Sciences Special Issue: 1, pp. 1294-1298, 2014.