BioFlux ProEnvironment Original article
ProEnvironment 17/58 (2024) 86 - 89

Sugar Beet Yield in Different Varieties Function of Irrigation and Fertilization Strategy

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Received 20 April 2024; received and revised form 30 April 2024; accepted 7 May 2024; Available online 30 June 2024

Abstract

The characterization of sugar beet culture involves the analysis of aspects related to environmental requirements, cultivation technologies, disease and pest control, as well as its use. The aim of the research was to identify the impact of the agronomic inputs represented by fertilization and irrigation on sugar beet yeld, expressed in dry matter terms, of two sugar beet varieties, Gorilla, and Vanghelis, respectively. The trial was carried out in Tritenii de Jos commune. The Gorilla sugar beet cultivars and Vanghelis were studied, according to a bi-factor experiment (variety x agronomic inpunts). The Gorilla cultivar of sugar beet demonstrated the highest productivity of dry mass in the variant corresponding to the highest irrigation norms and intensive fertilization, with an average value of 11.57 t/ha and the lowest coefficient of variation (CV) of 11.61%. In the Vanghelis cultivar, demonstrated the highest productivity of dry mass in the variant corresponding to the highest irrigation norms and highest fertilization doses, with an average value of 14.90 t/ha and the lowest coefficient of variation (CV) of 7.58%.

Keywords: correlation, humidity temperature, precipitationswind velocity.

1. Introduction

Sugar beet needs certain soil conditions, climate and agricultural management techniques to reach its maximum production potential. The characterization of sugar beet culture involves the analysis of aspects related to environmental requirements, cultivation technologies, disease and pest control, as well as its use [1, 2].

Fertilization of sugar beet is an essential aspect for obtaining high yields and superior quality. To achieve this goal, several factors must be taken into account, such as the specific nutrient needs of the plant, the condition of the soil, the climatic conditions and the cultivation technology used [8].

Nitrogen (N) plays an essential role in vegetative growth, promoting the development of leaves, which are vital for the process of photosynthesis. The healthy, green leaves of the sugar beet capture sunlight and convert it into energy, thus supporting the entire growth of the plant. Depending on soil conditions and local climate, sugar beet requires between 100 and 180 kg of nitrogen per hectare [4]. To obtain an abundant and quality harvest, sugar beet requires a well-planned fertilization that covers the specific needs of the plant at different stages of growth and development. Nutritional balance is essential to support both vegetative growth and high sugar root formation [7]. Phosphorus (P) is another essential nutrient, necessary for the development of the root system and for the energy processes of the plant. Strong roots ensure efficient absorption of water and nutrients from the soil, the foundation of a healthy plant.

Phosphorus also contributes to metabolic energy, promoting robust development. Sugar beet needs between 50 and 80 kg of phosphorus per hectare, and its application is recommended before sowing, considering the reduced mobility of phosphorus in the soil [5]. Potassium (K), known as the "quality element", is vital for the plant's resistance to disease, drought and temperature variations. Potassium contributes to the development and consistency of the roots, positively influencing the quality of the sugar beet. The required amount of potassium varies between 150 and 250 kg per hectare. This element also improves the plant's ability to store sugar in the root and maintain an optimal water balance in the cells, which is essential for the plant's survival under stress conditions [3]. By regulating the osmotic balance and contributing to stomatal opening, potassium allows sugar beet to effectively manage water loss, making it more resistant to drought and extreme temperature variations [9].

The aim of the research was to identify the impact of the agronomic inputs represented by fertilization and irrigation on sugar beet yeld, expressed in dry matter terms, of two sugar beet varieties, Gorilla, and Vanghelis, respectively.

2. Material and Method

The trial was carried out in Tritenii de Jos commune. The Gorilla sugar beet cultivars [10] and Vanghelis [11] were studied, according to a bi-factor experiment (variety x agronomic inpunts). The agronoic inputs are fertilization and irrigation, with three and two grades, the fertilization grades were: no fertilization - b1, fertilization with the NPK complex in the ratio of 60-40-40 kg/ha – b2, and NPK in the ratio of 180-120-120 kg/ha – b3. The irrigation grades were. No irrigation – a1 (control), and irrigation with a watering rate of 600 m^3/ha per irrigation shift – a2, using 7 shifts over the entire period of vegetation. The basic statistics [6] was applied in order to calculate the averages and dispersion parameters for dry matter yields.

3. Results and Discusions

For the Gorilla sugar beet cultivar, irrigation in combination with moderate fertilization (NPK 60-40-40 kg/ha) corresponding to the a2b2 variant, led to the highest productivity of 11.57 t/ha and the lowest data variability, indicating an efficient optimization of productivity. In the absence of fertilization, irrigation alone did not have a major effect on increasing productivity. Also, intensive fertilization (NPK 180-120-120 kg/ha), either with or without irrigation, led to a high productivity equal to 8.59 t/ha, but not as significant as the moderate combination of fertilization and irrigation.

These data emphasize the importance of a balance between irrigation and fertilization to achieve optimal productivity in the Gorilla sugar beet crop (Table 1).

Table 1. The basic statistics for the yield of Gorilla sugar beet, dry matter (t/ha), in Tritenii de Jos area, in 2021

Experimental variant	N	X	Minim	Maxim	s	CV%
a_1b_1	31	7.28a	7.25	7.31	1.12	15.38
a_1b_2	31	8.11b	8.18	8.11	1.11	13.71
a_1b_3	31	8.76b	8.71	8.86	1.16	13.24
a_2b_1	31	7.37a	7.34	7.38	1.12	15.21
a_2b_2	31	11.57b	11.54	11.59	1.12	11.61
a_2b_3	31	8.59b	8.56	8.63	1.13	13.15

1 – martor, fără irigare (a_1), fără fertilizare(b_1)/no irrigation (a_1), no fertilization (b_1); 2 – fără irigare (a_1), NPK 60-40-40 kg/ha (b_2)/no irrigation (a_1), NPK 60-40-40 kg/ha (b_2); 3 – fără irigare (a_1), NPK 180-120-120 kg/ha (b_3)/no irrigation (a_3), NPK 180-120-120 kg/ha (b_3); 4 – irigare (a_2), fără fertilizare(b_1)/irrigation (a_2), no fertilization (b_1); 5 – irigare (a_2), NPK 60-40-40 kg/ha (b_2)/ irrigation (a_2), NPK 60-40-40 kg/ha (b_2); 6 – irigare (a_2), NPK 180-120-120 kg/ha (b_3)/no irrigation (a_2)- NPK 180-120-120 kg/ha (b_3).

The control variant a1b1 had an average productivity of 7.28 t/ha, with values between 7.25 and 7.31 t/ha. The average productivity increased to 8.11 t/ha, in the a1b2 variant with a variation between 8.11 and 8.18 t/ha. The coefficient of variation decreased to 13.71%, suggesting an improvement in productivity uniformity due to moderate fertilization, even under conditions of lack of irrigation. The a1b3 variant recorded a higher average productivity of 8.76 t/ha, with values varying between 8.71 and 8.86 t/ha. The CV% was 13.24%, showing slightly increased productivity uniformity compared to the a1b2 variant, suggesting that more intensive fertilization further improves productivity. The average productivity of the a2b1a variant was

7.37 t/ha, with a variation between 7.34 and 7.38 t/ha. The coefficient of variation was 15.21%, similar to that of the variant without irrigation and without fertilization, indicating that irrigation alone does not bring a significant improvement in the absence of fertilization (Table 1).

In the Vanghelis cultivar, in the year 2021, moderate fertilization (a1b2) and intense fertilization (a1b3) corresponding to productivity equal to 12.82 t/ha and 14.15 t/ha, also led to significant improvements in productivity compared to the control variant (a1b1) which recorded an average productivity of dry biomass equal to 11.13 t/ha, even in the absence of irrigation, emphasizing the importance of fertilization to obtain higher productivity. Irrigation alone (a2b1) for which average productivity equal to 14.41 t/ha was obtained, with values varying between 14.38 and 14.42 t/ha, improved stability and productivity in the absence of fertilization, but its combination with fertilization (a2b2, a2b3) led to better productivity and less variability.

For a2b2, the average productivity is equal to 13.53 t/ha, with a small range of variation between 13.51 and 13.55 t/ha, and the CV% of 8.28% suggests good productivity uniformity. For a2b3, the average productivity is equal to 14.91 t/ha, with a range of variation between 14.87 and 14.94 t/ha.

The CV% of 7.58% is the lowest of all variants, indicating the highest productivity stability. Overall, the results indicate that an integrated irrigation and fertilization strategy is essential to optimize Vanghelis sugar beet productivity in the Tritenii de Jos area (Table 2).

Table 2. The basic statistics for the yield of Vanghelis sugar beet, dry matter (t/ha), in Tritenii de Jos area, in 2021

Experimental variant	N	X	Minim	Maxim	s	CV%
a_1b_1	31	11.13a	9.99	11.18	1.14	11.37
a_1b_2	31	12.82a	12.78	12.85	1.13	8.81
a_1b_3	31	14.15b	14.11	14.19	1.14	8.16
a_2b_1	31	14.41b	14.38	14.42	1.12	7.78
a_2b_2	31	13.53ab	13.51	13.55	1.12	8.28
a_2b_3	31	14.91b	14.87	14.94	1.13	7.58

1 – martor, fără irigare (a_1), fără fertilizare(b_1)/no irrigation (a_1), no fertilization (b_1); 2 – fără irigare (a_1), NPK 60-40-40 kg/ha (b_2)/no irrigation (a_1), NPK 60-40-40 kg/ha (b_2); 3 – fără irigare (a_1), NPK 180-120-120 kg/ha (b_3)/no irrigation (a_3), NPK 180-120-120 kg/ha (b_3); 4 – irigare (a_2), fără fertilizare(b_1)/irrigation (a_2), no fertilization (b_1); 5 – irigare (a_2), NPK 60-40-40 kg/ha (b_2)/ irrigation (a_2), NPK 60-40-40 kg/ha (b_2); 6 – irigare (a_2), NPK 180-120-120 kg/ha (b_3)/no irrigation (a_2)- NPK 180-120-120 kg/ha (b_3).

4. Conclusions

The study of the productive characteristics of sugar beet cultivars (Vanghelis and Gorilla) in the area of Tritenii de Jos, during the years 2021-2022, highlighted the trends regarding the impact of irrigation and fertilization inputs. These crops are analyzed according to both dry matter and fresh matter productivity (t/ha), in different experimental variants that include and exclude the use of irrigation and different fertilization doses (NPK 60-40-40 kg/ha and NPK 180-120-120 kg/ha).

The Gorilla cultivar of sugar beet demonstrated the highest productivity of dry mass in the a2b23 variant, corresponding to the highest irrigation norms and intensive fertilization, with an average value of 11.57 t/ha and the lowest coefficient of variation (CV) of 11.61%. This result emphasizes the importance of intensive fertilization in combination with irrigation to maximize productivity. In contrast, irrigation alone without fertilization (a2b1) did not have a significant impact on improving productivity compared to the control variant (a1b1), indicating that irrigation without fertilization is not sufficient for significant increases in productivity. Moderate and intensive fertilization without irrigation (a1b2 and a1b3) improved productivity compared to the control variant, but not as effectively as when combined with irrigation. The presence of high productivity variability in most of the experimental variants suggests the need for precise water and fertilization management to ensure stability and uniformity of sugar beet productivity in the Gorilla cultivar in the Tritenii de Jos area.

In the Vanghelis cultivar, during the experimental period, the a2b3 variant (irrigation and intensive fertilization) proved to be the most effective for maximizing the productivity and productivity uniformity of the Vanghelis sugar beet cultivar (X = 14.91 t/ha and CV = 7.58%). For best results, combining irrigation with heavy fertilization is essential. These findings highlight the importance of an integrated water and fertilization management approach to maximize productivity and its uniformity in the Vanghelis sugar beet cultivar.

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