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The change of planting timing to sugar beet cultivars as an adaptation to climate change

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ABSTRACT— The production of agricultural crops depends on the optimization rate of plant genetic factors, climatic and soil factors and the level of agrochemicals. This factors are in constant dynamism and also is the production of agricultural plants. Changing in climatic conditions of the area will necessitate bring changes in the genetic resources of the plants that will be cultivated as well as in the technology of cultivation. Climate data of recent decades have shown steady rise in temperatures and significant changes in the amount of precipitation and its distribution. Experimenting in relation with the optimal timing of planting of different sugar beet cultivars, constitutes a necessity to adapt to climate change. The study was based on a multi-year analysis of climate indicators in the Korça region, analyzing the performance of morphological, physiological and productive indicators of sugar beet cultivars planted at different time periods. Experimental conclusions are based on the statistical analysis of factors variance two (sugar beet genotype x different planting time. The planting time, which is essentially determined by the optimum agronomic temperature, determines the entire biological cycle of the plant by directly influencing the morphologic and plant yield. Sustainable agricultural development determined by long-term climate change requires adaptation to these changes.

KEYWORDS: Planting time, Sugar beet, Climate, Cultivar.

1. INTRODUCTION

Sugar beet production is conditioned much more by climatic factors than some of agricultural plants. In last years, production has decreased significantly as a result of high temperatures and changes of the precipitation amount, so it is necessary to experiment to the impact minimize of climatic factors. Regardless of the degree of adaptation of agricultural plants to the climate and the level of technology used, the annual fluctuations of climatic elements determine the level of production achieved. On the other hand, agricultural plants have differentiated climatic requirements and extend their cycle of development at different times of the year, but not always, climatic conditions are appropriate [18]. Several studies reported that climate change will result in increased mean temperature and higher precipitation variability in many regions of the globe including Europe. The results indicate considerable near-surface warming already at the lower 1.5 °C of warming. [24], [6]. According to studies conducted (IPCC, 2007), Southern Europe, part of which is also Albania, is getting dryer and hotter with less precipitation. Agriculture and rural areas will be more affected by climate change and especially from the lack of rainfalls. A correlation with the Human Development Index suggests that in many less developed – and thus more sensitive and less adaptable – countries climate is expected to change more strongly than in more developed [1]. Current knowledge based on a large set of evidence shows that most of the agricultural lands analyzed have had a significant increase in minimum and maximum temperatures from the beginning of the twentieth century [4]. The area of the Korça field, is part of the southern Mediterranean pre-mountainous area of the Albanian territory, is the most productive agricultural areas. This area extends to the altitude of 850 m above sea level, in geographic width 400 and 36 'and geographical latitude 200 and 44'. The purpose of this study was to analyze the climatic performance of the Korça area, referring to the main indicators and their variations in time especially temperature changes in the

sugar beets planting times. Plant yield in agro-ecosystems varies from one year to the other, however the cultivation techniques are the same. From this point of view, we say that this variability comes as a result of the direct or indirect impact of climatic factors that are not depending the human being. [23]. Fluctuations of inter-annual climate elements directly affect the intensity of growth and production of agricultural plants. Definitions and concepts of production ecology are presented as a basis for development of alternative production technologie [30]. Field observation, experimental and modeling studies are needed to fill the current knowledge gaps on the economic impact [19]. There is much data on the impact of weather variables on the growth of sugar beet from studies conducted under controlled conditions or single field experiments, but these data are of only limited validity for other sites or larger areas [16]. Depending on genotype, sugar beet can differ considerably in yield and quality characteristics. These are additionally modified by environmental conditions with drought stress recently gaining in importance, restricting growth and altering the chemical composition of the beet.

Sugar beet growers have to optimize sowing dates and seedbed preparations to ensure successful crop establishment [14] There is much data on the impact of weather variables on the growth of sugar beet from studies conducted under controlled conditions or single field experiments, but these data are of only limited validity for other sites or larger areas [16]. The Sugar beet is considered a plant with average temperature requirements. The optimum temperature for its growth and development is 18-220C. The amount of active temperature in the conditions of the Korça region is 2500-28000C. The minimum biological temperature for germination is 3-40C and in this case the germination lasts for over 25-30 days while the optimal agronomic agricultural temperature for germination is 6-70C in which germination lasts for about 13-15 days with which the planting begins of sugar beet. Minimum harmful temperatures are -3-40C when these find the plant of just sprouted in the cotyledon phase and this happens not infrequently in practice, especially when we early planting. Environmental conditions namely temperature, solar radiation and sunshine hours etc. influence the plant growth and development. Crop emergence is a function of soil temperature. Sugar beets emerge the fastest when the air and soil temperature ranges between 15–25°C [17], [2]. After emergence, the growth and development activities are largely influenced by air temperature and crop nutrition. For proper growth of the plants and sugar accumulation, an average temperature of about 20-22°C is ideal. Temperatures above 30°C retard sugar accumulation. Sugar beet has no self-regulatory mechanisms to promote sucrose accumulation but is dependent upon external stimuli from the climatic factors such as light, temperature, moisture and day length which determine to a great extent, the type of growth and the amount of sugar that gets stored in the root [29], [25]. In sugar beet, there is a discrepancy between the greater intensity of sucrose accumulation and the increase in fruit root weight in terms of the optimal temperatures that, they require. Thus the greatest intensity of sugar accumulation is done at a temperature of about 200C (18-220C). At this temperature the accumulation of sugar increases intensively, but we have a relatively slower increase in fruit weight. Its most intense growth occurs at a temperature of 22-280C in which the intensity of sugar accumulation, decreases relatively. At temperatures above 300C both, the yield and the % of sugar, decrease, because the respiration is intensified by dissolving (burning) 30-50% of the photosynthesis products. It has been observed that a change, between day and night temperature of 23-250C, during the day and 13-150C at night, increases the accumulation of sugar in the fruit root, which occurs during the coolness of the night because the respiratory intensity decreases significantly in these conditions. The negative effect of high temperatures increases when they are accompanied by a lack of moisture in the soil which can come from a lack of rainfall or irrigation. In the pre-harvest period when there is abundant rainfall, especially when it comes after a period of drought, the plant forms new leaves which reduce the sugar content.

We pointed out all these elements to conclude that the time of planting in the sugar beet plant affects not only the rate of germination but also in the other stages of plant development. Thus agronomic practices thought

to great influence yield & quality and may need to be adjusted to provide suitable conditions for maximizing yield and quality of sugar beet [22]. Sugar beet belongs to the group of crops that are planted early in the spring. They should be carried out when the temperature at a depth of 4-5 cm is 6-70C. The traditional season of sugar beet planting for the Korça region is March 20-April 10. Utilizing of the optimal planting timing to sugar beets takes on special importance due to the fact of unstable weather and often unfavorable at this time. Planting within the optimal time, provides early germination, cortical formation is avoided (which prevents the full and regular germination of sugar beet plants), the risk avoided of touching by the flea (Chaetocnema concinna) and long-nosed (Bothynoderesres punctiventris), plants are more grown during their emergence). The plant grows older in the summer, abler to withstand drought, has more time for a full cycle and therefore, production, and significantly increases. During the vegetative period, referring to the climate in the region of Korça, sugar beet has need for 2600 - 2800ºC distributed:

- Planting - germination 120 - 150ºC
- Germination - the joining of leaves within a row of 600 - 700ºC
- Joining leaves within a row - joining leaves between rows 1100 - 1200ºC.
- Joining of leaves between rows - technical baking 950 - 1050ºC.

Based on assessments of air temperature performance and precipitation in some of the meteorological locations of the Korça field of the National Meteorological Monitoring System for March and April of the last decade and especially for the experimental years 2016-2018 Metrology Bulletins Institute of Geosciences, Energy, Water & Environment are achieved some conclusions. Temperatures measured after March 1 are always above the biological minimum required by the of sugar beet. Based on the temperature data for the months of March - April and compared with the climatic data (referring to the period 1961-1990), generally maintained in most meteorological stations temperatures of about 0.5ºC to 2.5ºC higher than normal, due to the presence of warm air and an atmospheric stability with a longer duration, whereas in March 2017 temperatures of about 2ºC to 4ºC were higher than normal. (Institute of Geosciences, Energy, Water & Environment Bulletin March 2017) The weather during March 2018 was characterized by temperatures of around + 1.3ºC above norm values (Institute of Geosciences, Energy and Water & Environment Bulletin March 2018).

The aim of this study was to:

1. detect the interactions between planting date and cultivar
2. recommend sugar beet cultivar with the best performance for the specific vegetation period as useful tool for increasing the sugar yield; and
3. to determine the effect of environmental variables on sugar yield.

2. MATERIALS AND METHODS

The study was conducted during the years 2016 - 2018 in the EDE area of the "Fan S. Noli" University, Korça with mechanical SAM. The study was performed according to the randomized 4-block scheme. The study included the 3 main cultivars that are planted in the area of Korça. (Table 1) Soil characteristics presented in the Table (Table2) The surface of each variant was 20 m2 with dimensions 10 x 2 m. In each variant, 4 rows were placed. Rows 10 m long and row spacing 0.5 m. The planting took place on March 1 – 10, March 11 – 20, March 21 – 31, April 1- 10.

Table 1 Sugar beet cultivars

Kodi SSSE	Name	Ploidy	Germitet	Selector and responsibility	Registry	Registry
0405	Korça 2	Poly	plurigerm	ESKo	1988	1994
0406	H 137	Poly	plurigerm	ESKo	1986	1994
0407	Korça Mono 1	Poly	plurigerm	ESKo	1990	1994

Explanations:
SSSE-State Seed and Seedling Entity ESKo-Experimental Station of Korça H-137, hybrid

Table 2 Soil characteristics in 2016, 2017 and 2018.

Year	Humus (%)	N2(%)	pH	P_2O_5 (mg/100g)	K_2O (mg/100g)
			H_2O		
2016	1.92	0.125	7.42	32,1	34,3
2017	1.85	0.121	7.35	23.5	27.4
2018	1.98	0.127	7.4	26,8	32,4

After the development of the second pair of leaves, the seedlings were singled out to a final, recommended crop density of 110,000 plants/ha. Standard agricultural practices for sugar beet growing were applied during the vegetation period. Roots were harvested manually. The root yield (P) was determined by measuring the weight of roots from two middle rows and recalculating it as t/ha. Root samples were analyzed in the laboratory of the Faculty of Agriculture at the University of Korça. Sugar content (S) was measured according to polarimetry method. Sugar yield (RS) was calculated following the equitation: RS = P × S. During the study where taken, measurements, counts, weights, observations for the transition of plant development phases, dynamics of their growth, contact with diseases, characteristics and production qualities, etc. Climate indicators data were taken from the meteorological monitoring system of Korça National Meteorological Monitoring System. (Published in the Metrology Newsletter at the Institute of Geosciences, Energy and Water & Environment). Temperature data was analyzed by making comparisons with temperature data in the previous 30 and 10- year-olds. The analysis focused on the period from March 1 to October 15 because it is related to the period of sugar beet cultivation. The number of days (Nd1) planting to Germination The number of days (Nd2) was calculated from planting to harvest date. Thermal time (growing degree-days, GDD) was calculated by summing the daily values of mean temperatures minus the threshold value of 3°C (Milford et

al., 1985), from the planting to the harvest date. In 2016, the amount of precipitation and its distribution during the summer season has been positive quite for the development of sugar beet. In 2017, severe summer droughts and high temperatures had a major negative impact on sugar beet culture. In 2018 there have had moderate climatic developments.

2.1 Field observations in the trail

To explain more objectively the impact of the factor, planting time in plant development and their yield should be field observations and to maintain the phenological phases and biometric measurements of the plants. These phonological phases were analyzed:

1. Planting date
2. Germination date (start and end)
3. Number of days (Nd1) planting to Germination
4. Number of days (Nd2) germination - joining of leaves within the row
5. Number of days (Nd3) joining leaves within a row - joining leaves between rows
6. Number of days (Nd4) joining leaves between rows - technical maturity (harvesting plants)
7. Number of days (Nd5) planting to harvest date (Table 3) Defining the phenological phase is done by eye and counting.

The starting phase will be considered when 10% of the plants have entered that stage, and complete when 75% of the plants are in phase. Biometric measurements are made before harvesting (in full ripening) in the set for taking the phases and at the end are taken these indicators:

1. Planting season of cultivars
2. Plant growth dynamic.
3. Morphological characteristics of cultivars.
4. Disease infection rate.
5. Production of cultivars under different planting times

- Single root weight (kg)
- Root yield (t/ha)
- Leaf yield (t/ha)
- Root /Leaf ratio
- total sugar (%)
- Sugar yield (t/ha)

Table 3. Summary of environmental variables for trial environments

Nr	Variants	GDD (°C)	Insolation (h)	Precipitation (mm
1-	Korça 2 1-10 March	2,709.7	2003	397
2-	Korça 2 11-20 March	2,694.3	1981	385
3-	Korça 2 21-31 March	2,685.4	1970	367
4-	Korça 2 1-10 April	2,681.1	1948	367

5-	Korça 1 1-10 March	2,665.2	1941	356
6-	Korça 1 11-20 March	2,555.4	1928	344
7-	Korça 1 21-31 March	2,547.6	1918	344
8-	Korça 1 1-10 April	2,538.5	1912	344
9-	H 137 1-10 March	2,732.8	2012	412
10-	H 137 11-20 March	2,714.1	1990	385
11-	H 137 21-31 March	2,696.3	1965	367
12-	H 137 1-10 April	2,681.2	1934	367

3. RESULTS

Based of field observations, resulted these experimental data (3-year averages 2016 - 2018): The cultivation period of cultivars is reflected in the Table 4.

1. Planting date
2. Germination date (start and end)
3. Number of days (Nd1) planting to Germination
4. Number of days (Nd2) germination - joining of leaves within the row
5. Number of days (Nd3) joining leaves within a row - joining leaves between rows
6. Number of days (Nd4) joining leaves between rows - technical maturity (harvesting plants)
7. Number of days (Nd5) planting to harvest date (Table 4)

Based of field observations, resulted these experimental data (3-year averages 2016 - 2018): The cultivation period of cultivars is reflected in the Table 5. Production of cultivars under different planting times Single root weight (kg), Root yield (t/ha), Leaf yield (t/ha), Root /Leaf ratio, total sugar (%) Sugar yield (t/ha). Production of sugar beet cultivars in different sowing times. Harvesting of the experiment production was carried out on the technical ripening time. Harvesting and collection is done separately for each variant of repetition. Based on the production and the harvested surface area is calculated the yield (average 3-year converted yield per 1 ha), which is presented in Table The collected data are subject of the two factor variance analysis. The two factorial analysis of the variance is presented in Table 6, 7 and 8.

Table 4. Summary of environmental variables for trial environments

Nr	Variants	Planting	Nd1	Nd2	Nd3	Nd4	Nd5
1-	Korça 2 1-10 March	1-10 March	24	54	63	70	187
2-	Korça 2 11-20 March	11-20 March	21	53	62	70	185

3-	Korça 2 21-31 March	21-31 March	19	52	61	69	184
4-	Korça 2 1-10 April	1-10 April	18	52	62	69	183
5-	Korça 1 1-10 March	1-10 March	23	58	61	62	181
6-	Korça 1 11-20 March	11-20 March	20	57	58	61	176
7-	Korça 1 21-31 March	21-31 March	19	56	58	61	175
8-	Korça 1 1-10 April	1-10 April	18	56	57	61	174
9-	H 137 1-10 March	1-10 March	22	54	68	67	189
10-	H 137 11-20 March	11-20 March	18	52	65	68	185
11-	H 137 21-31 March	21-31 March	17	52	64	66	182
12-	H 137 1-10 April	1-10 April	16	50	64	66	180

Table 5. Production of sugar beet cultivars in different sowing times.

Nr	Variants	Single root weight (kg)	Root yield (t/ha)	Leaf yield (t/ha)	Root /Leaf ratio	total sugar (%)	total Sugar yield (t/ha)
1-	Korça 2 1-10 March	0.498	54.8	24.3	2,26	18	9.86
2-	Korça 2 11-20 March	0.595	65.5	25.4	2,58	18,3	12
3-	Korça 2 21-31 March	0.565	62.1	26.1	2,38	18,4	11.4
4-	Korça 2 1-10 April	0.514	56.5	24.9	2,27	18,4	10.1
5-	Korça 1 1-10 March	0.422	46.4	21.7	2,14	17,6	8.17
6-	Korça 1 11-20 March	0.522	57.4	24.4	2,35	17,8	10.22
7-	Korça 1 21-31 March	0.490	53.9	23.8	2,26	17,9	9.65
8-	Korça 1 1-10 April	0.445	48.9	24.1	2,03	17,9	8.75
9-	H 137 1-10 March	0.662	72.8	25.9	2,8	19,6	14.27
10-	H 137 11-20 March	0.755	83.1	26.8	3,1	19,7	16.37

11-	H 137 21-31 March	0.688	75.7	26.5	2,86	19,8	14.99
12-	H 137 1-10 April	0.641	70.5	26.3	2,68	19,9	14.03

Table 6. Production of sugar beet cultivars in different sowing times. Root yield (t/ha)

Nr	Variants	Repeating I	Repeating II	Repeating III	Repeating IV	Σv Sum of variants	Root yield (t/ha)
1	Korça 2 1-10 March	54.7	55.6	53.8	55.1	219.2	54.8
2	Korça 2 11-20 March	65.6	64.8	66.4	65.2	262	65.5
3	Korça 2 21-31 March	62.4	63.3	61.5	61.2	248.4	62.1
4	Korça 2 1-10 April	56.5	56.6	57.2	55.7	226	56.5
5	Korça 1 1-10 March	46.3	47.1	45.5	46.7	185.6	46.4
6	Korça 1 11-20 March	58.6	56.1	55.8	59.1	229.6	57.4
7	Korça 1 21-31 March	54.7	53.9	53.2	53.8	215.6	53.9
8	Korça 1 1-10 April	49.8	49.1	48.6	48.1	195.6	48.9
9	H 137 1-10 March	73.8	71.9	72.3	73.2	291.2	72.8
10	H 137 11-20 March	82.4	84.6	81.8	83.6	332.4	83.1
11	H 137 21-31 March	75.6	76.8	74.5	75.9	302.8	75.7
12	H 137 1-10 April	71.3	71.8	69.6	69.3	282	70.5
	Repetitions Sum	751.7	751,6	740.2	746.9	2,990.4	62.3

Table 7. The amount (total) of sugar beet cultivar test x sowing time

Planting time (factor A)	Sugar beet cultivar (factors B)			Sum	Average production Root yield (t/ha)
	Korça 2	Korça 1	H 137		
1 – 10 March	219.2	185.6	291.2	696	58
11 – 20 March	262	229.6	332.4	824	68.7
21 – 31 March	248.4	215.6	302.8	766.8	63.9
1 - 10 April	226	195.6	282	703.6	58.6
Sum	955.6	826.4	1208.4	2,990.4	62.3

Average production Root yield (t/ha)	59.73	51.65	75.53	62.3	

Table 8. Statistical analysis of the variance of the production of sugar beet cultivars planted in different period of time.

Source of change	Degrees of Freedom	Quadratic sums	Quadratic averages	Calculated F	Table F	
					95%	99%
Total	47	5701.06				
Repetitions	3	7.34	2,45	3,02*	2,89	4,44
A	3	900.38	300,13	370,5**	2,89	4,44
B	2	4719.26	2359.63	2913,1**	3,28	5,32
AB	6	47.46	7,91	9,77**	2,39	3,41
Mistake	33	26,62	0,81			

Based on the analysis of variance, it is concluded that the factors taken into in the study (sugar beet genotype, planting at different times and sugar beet genotype x planting at different times) given statistically proven changes (Xhuveli and Salillari, 1984). 3-year average of root and sugar production, compared to D.M.V (minimum proven difference). This indicator after the calculation resulted as follows:

D.M.V* (A) = 1.93 (t/ha) D.M. V** (A) = 2.58 (t/ha)
D.M.V* (B) = 2.12 (t/ha) D.M. V** (B) = 2.86 (t/ha)
* - with 95% probability
** - with 99% probability

4. DISCUSSION

In the study, performance of sugar beet cultivars through vegetation periods of different duration (different planting dates), were investigated, using the root yield and sugar yield as the indicator main. Regarding the time of planting, the experiment was carried out based on the traditional time of sugar beet planting in the region of Korça and the analysis of changes in zonal climate indicators for long periods of time. Other authors point out that clear conclusions can only be achieved by experimenting on the basis of many years' local analysis of climate indicators. To predict accurately the sowing time, soil temperature and humidity balance need to be computed using a physical model forced by local historical weather data. A less demanding approach, more in tune with the available data and the aims of this study, is to use statistical techniques to relate observed climate and sowing times (Kaukoranta and Hakala, 2008). Planting dates has a vital role for germination, growth, yield and root quality of sugarbeet plants. The regarding of the planting time factor, taking the multi-year analysis of climatic, the current tradition of the sugar beet planting period took into account:

1. Elimination of frost risk. Other authors emphasize that Planting should be done when soil temperature is higher than 4 °C and the risks of frost is nil. (Terry, 1968; Milford and Riley, 1980).
2. Late planting in April brings problems related to high temperatures and drought not only at the time of germination of plants but also in other vegetative stages. Especially high temperatures above 30ºC, negatively affect in plant growth and sugar content.

Among processes consuming O2 photorespiration increased at 30-35 °C, while processes non-consuming O2 were non-affected (D'ambrosio et al., 2006). An important factor in this regard is the risk of flea infestation (Chaetocnema concinna) and long-nosed (Bothynoderes punctiventris). Their negative impact has been present in the varieties planted in April. Influence of different planting time was with highly influential in

terms of germination time and the passage of subsequent vegetative phases. Similarly, other authors refer to: Progressively more yield was lost by delaying sowing throughout April (Jaggard et al., 2009) Different cultivars (genotype factor) had different performance during germination, the passage of vegetative phases and productivity. Hybrid H 137 showed superiority in all researched indicators. By six weeks the plant has 8-10 leaves but the storage portion of the root is just enlarging. From this stage onwards, growth of leaves and storage portion of root occur simultaneously with the root making up an increasing proportion of total plant dry weight (FAO 2012). The yield of sugar beet is conditioned much more by climatic factors than some of agricultural plants. The formation of sugar and its accumulation in the roots of beets are problems that have not yet found interpretation accepted by all. This is due to the fact that we often do not have a full compliance for some given climatic factors, that to influence equally positively both the intensity of tuber growth and the intensive accumulation of sugar in it. The amount of sugar that is formed is in direct proportion to the dry matter content (Fitoteknia, 1987: Publication of Tirana Agriculture University) Elongation of the growing season, by means of early sowing, would increase yield by decreasing average temperatures (Tmean, Tmax) over the growing season in locations with the highest recorded temperatures (Tsialtas and Maslaris, 2014). During the experiment, was identified the progress of the leaf system, which determines the formation of assimilates. It was observed that at first the leaves emerge two by two to the fourth pair and then one by one in a spiral shape over the head of the fruit root. At the beginning every 3-4 days a leaf emerges then the intensity increases of their emergence every 1-2 days and from the end of the vegetation their growth decrease again. This intensity is maintained in normal conditions, during which about 40-50 leaves are formed, but in years and special conditions, 30-80 leaves are formed. Of particular importance is the longevity of the leaves, which depending on climatic conditions but also agro technical interventions, especially through irrigation. The longevity of the leaves lasts 25-70 days. Longevity maintaining has great importance, because in case than they dry and earlier damage, then more plants to balance spoiled establish, will discover new leaves reducing % of sugar. We noticed that sugar beet productivity had changes on the 3 years of the study and this was related not only to temperature and humidity but also to the amount of hours of lighting. These are also reflected by the authors (Scott et al., 1973) who emphasize: Yields of crops sown and harvested on different dates were closely correlated with the amount of solar radiation intercepted by the leaf canopy. In terms of the impact of planting time on sugar content in the roots are not statistically proven and we cannot reach clear conclusions. And other authors have different views. On average, sowing date had negligible effect on sugar percentage at harvest (Hull and Webb, 1970). The impact of the cultivar on the sugar content in the roots is statistically proven and has a clear impact. The increase in the length of the vegetative period (as a result of planting at different times and climate change from year to year) led to an increase in root and sugar production. Such conclusions have been reflected by the authors: (Draycott., 1973) Increasing the length of the growing period increased sugar yield greatly.

5. CONCLUSIONS

From the processing of experimental data (Table 8) results:

1- Factor A - Planting time brings statistically proven differences with certainty 99% (Calculated F 370,5** > Table F 4.44 with 99% probability) The best time for sugar beet planting in the area of Korça is March 11 - 20. As a result of climate change, sugar beet planting should take place about ten days before the usual planting. Average production root yield 68.7 t/ha. Based on D.M.V this variant reflected significant difference with all other variants

The highest productivity of sugar beet planted on March 11 - 20 is explained by the following facts:

- The crop cycle (planting - ripening) of sugar beet cultivars planted on 11 - 20 March is longer than the same crops planted at later times. There is a positive correlation between crop cycle length and plant production.

- Early planting cultivars show lower levels of diseases infection during vegetation.
- The longevity of the leaves is longer

The earliest planting time, March 1 - 10, gave the lowest yield. Average production root yield 58 t/ha. This is explained by the relatively low temperatures in this period which prolong the germination period and form more delicate plants.

The later planting time, April 1 – 10, gave a low yield, almost similar to the March 1 - 10 variant, and this is explained by the increase of temperatures, both during germination and during vegetative development.

2- Factor B – Sugar beet cultivar brings statistically proven variations with 99% confidence in plant productivity. These changes are reflected in growth indicators as well as plant resistance against disease. (F calculated 2913,1**> 5.32 F table with certainty 99%). Hybrid H 137 showed superiority in all researched indicators. On the basis of D.M.V this variant reflected significant differences with all other variants. Different cultivars (genotype factor) had different performance during germination, stages vegetative transition and productivity.

3- Factor AB - Planting time x Sugar beet cultivar brings statistically proven variations with 99% confidence (calculated F 9,77**> 3.41 F tabular with 99% confidence). The best variant was sugar beet planted on March 11 - 20 x Hybrid H 137. On the basis of D.M.V this variant reflected significant differences with all other variants.

4- The same statistically confirmed conclusions were observed on regarding with the amount of sugar per ha.

5- The influence of the cultivar on the sugar content in the roots is statistically proven and has been clearly conveyed.

6- The impact of planting time on the sugar content in the roots is not statistically proven and we cannot reach clear conclusions.

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