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Variranje mase korijena, glave korijena i listova šećerne repe s obzirom na gustoću usjeva i proljetnu gnojidbu dušikom

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SUMMARY

This study analyzes the dynamics of sugar beet root, crown, and leaves fresh and dry matter (FM and DM, respectively) accumulation per plant and their mass ratio at different plant densities and nitrogen fertilization. The biennial field trials were set as four different planting densities (60,000, 80,000, 100,000 and 140,000 plants ha^{-1}) and three methods of nitrogen application in spring: control – without nitrogen fertilization (N0), presowing only (N1), and presowing with topdressing (N2). Close to the maturation, the mean DM of the whole root, crown, and leaves on September 20, 2014 amounted to 28.8, 7.3 and 4.0 t ha^{-1}, respectively, whereas it amounted to 20.7, 4.1 and 2.3 t ha^{-1} in 2015, respectively. Moreover, with regard to the plant densities, the highest root DM was at 140,000 and 100,000 (31.6 t ha^{-1} in 2014 and 22.4 t ha^{-1} in 2015), compared to the wider plant densities of 80,000 and 60,000 plants ha^{-1} (22.4 t ha^{-1} in 2014 and 18.1 t ha^{-1} in 2015). Nitrogen fertilization positively influenced on dry matter accumulation, but it was different within the years. On September 20, 2014, a presowing fertilization (N1) increased the root DM by 17%, compared to the control, whereas in 2015 the presowing with topdressing (N2) increased the root DM by 30%. The root-to-leaves FM ratio amounted to 1:3.9 on May 30, 2014, whereas it amounted to 1:0.1 on September 20, 2014. The leaves FM was at its largest on June 20, 2015, when the root-to-leaves ratio amounted to 1:1.1, and gradually decreased to 1:0.1 on September 20, 2015.

Keywords: sugar beet, fresh matter, dry matter, ratio, plant densities

INTRODUCTION

Sugar beet is a biennial plant of the *Chenopodiaceae* family that develops the thickened roots and leaves during the first year of vegetative growth. In the 2014-18 period, the world sugar beet production area averaged to 4,609,469 ha, of which more than 68% were located in Europe. In this period, the average root yield in the world and Europe was close to 60 t ha^{-1} (FAOStat, 2020). Even though there is an increased interest of sowing sugar beet as an autumnal crop, sugar beet in Europe is usually sown is early in spring (March – April) and harvested during autumn, from mid-September to mid-November (Hoffmann and Kluge-Severin, 2011; Schnepel and Hoffmann, 2016). Thus, sugar beets for sugar production have a vegetation length amounting from 150 to 200 days.

An adequate plant population establishment subsequent to the emergence is one of the most important

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factors that exert a direct influence on the final field crops' yield (Pospišil et al., 2006; Anđelić et al., 2018). In the European countries, sugar beets are mostly sown at a 50 cm row spacing, so the most common plant population for sugar beet as a vernal crop is around 90,000 and 110,000 plants ha^{-1} (Smit et al., 1996; Söğüt and Arioğlu, 2004; Hoffmann and Kluge-Severin, 2011; Varga et al., 2015; Wilczewski et al., 2018).

Nitrogen is probably the most studied nutrient in sugar beet production because N is the most limiting one in a direct relationship with the sugar beet yield and quality. Many researchers reported that nitrogen fertilization has a great impact on sugar beet root development and nitrogen uptake, but it also impacts the quality - the sugar content in the root, sugar utilization, and finally a refined sugar yield (Bentrup et al., 2001; Stevens et al., 2011; Barlog et al., 2013; Pospišil, 2016; Varga et al., 2017; Káš et al., 2019).

The dynamics of sugar beet formation is not harmonized, because the leaves are formed faster than the root is at the beginning of vegetation. Beside the genotype and agrotechnical measures, the dynamics of sugar beet growth depends on the weather conditions, especially on the temperature and the amount of rainfall during the growing season. The sugar beet root usually contains 20-25% of dry matter at the harvest (Starke and Hoffman, 2014; Sacała, et al., 2016).

The uneven field germination and improper agrotechnics exert an enormous influence on the plant population of sugar beet per unit area. Since there are only foreign sugar beet hybrids in Croatia, mostly from Germany and Denmark, it is venerable to find out their growth dynamics and behavior in our environmental conditions. The aim of this study was to analyze the dynamics of fresh and dry matter accumulation of sugar beet root, crown, and leaves (t ha^{-1}) in the field conditions and their relationship to the root diameter increment, depending on different plant densities and spring nitrogen fertilization in a biennial period in Eastern Croatia.

MATERIAL AND METHODS

Field trials

A field trial was set up in Eastern Croatia in 2014 and in 2015, respectively. In both years, the previous crop was that of a winter wheat. The hybrid Serenade, KWS, was sown in the scheme of a randomized block design. Sowing was performed on March 18, 2014 and on March 25, 2015 at an inter-row spacing amounting to 50 cm and at four different sizes of intra-row spacing: 13, 15, 17 and 19 cm. Each plot was 20 m x 3.0 m wide and consisted of six rows, out of which the plant samples were collected from the four central rows during vegetation. A plant population correction was made in the stage of two to four true leaves; therefore, four different planting densities were formed, as follows: 60,000 (*P1*), 80,000 (*P2*), 100,000 (*P3*) and 140,000 (*P4*) plants ha^{-1}.

The autumnal fertilization was performed as follows: 0, 70 and 105 kg ha^{-1} of N, P and K in 2013 and 69, 100, 150 kg ha^{-1} of N, P and K in 2014. There were three different nitrogen fertilization treatments applied in spring: at the control (*N0*), with no fertilizer applied, at the *N1* treatment, when nitrogen was applied while presowing 45 kg ha^{-1} of N, and at the *N2* treatment, when it was applied in two terms, in the presowing and in the topdressing at a two- to four-leaf stage (54 kg ha^{-1} N in 2014 and 40.5 kg ha^{-1} N in 2015). There was a smaller amount of N applied with the topdressing in 2015, since the amount of the Nmin in the soil was higher (Table 1).

Table 1. The amount of N min (kg ha^{-1}) of the field trails in 2014 and in 2015

Tablica 1. Zaliha mineralnoga dušika (kg ha^{-1}) pokusnih površina u 2014. i 2015. godini

	Soil depth / *Dubina tla*			
	0–30 cm		30–60 cm	
	$N–NH_4$	$N–NO_3$	$N–NH_4$	$N–NO_3$
2014	8.45	26.23	1.91	38.80
2015	14.66	32.10	6.75	28.14

In both years, the herbicides were applied subsequent to the germination of sugar beet (split method) in three terms, and there was no pest attack. A plant protection against *Cercospora beticola* Sacc. was applied in both years (four times in 2014 and three times in 2015).

Weather conditions

The total rainfall in the 2014 air was by 31.4% higher than the long-term mean (LTM), but the mean temperature was not very different when compared to the LTM (Table 2). In May 2014, there extremely rainy conditions, reaching 167% of the LTM. Contrarily, in 2015, the sugar beet vegetation (March to October), the LTM rainfall was by 13.6% lesser. The estival months, especially July 2015, were lacking the rainfall and having the high air temperatures.

Table 2. Weather conditions during the sugar beet vegetation in 2014 and 2015 (March to October) and the long-term mean (LTM) from 1981 to 2010 at the Gradište Climatological Station (Croatian Meteorological and Hydrological Service, 2016)

Tablica 2. Vremenske prilike tijekom vegetacije šećerne repe 2014. i 2015. godine (od ožujka do listopada) i višegodišnji prosjek (1981. – 2010.) Klimatološke postaje Gradište (Državni hidrometeorološki zavod, 2016.)

Month *Mjesec*	Air temperature (°C) *Temperatura zraka (°C)*			Rainfall (mm) *Oborine (mm)*		
	2014	2015	LTM (1981-2010)	2014	2015	LTM (1981-2010)
March	10.6	7.8	7.1	39.0	45.9	48.4
April	13.3	12.7	12.1	87.8	24.3	54.7
May	16.8	18.2	17.2	165.0	98.7	61.7
June	20.8	21.1	20.1	46.2	25.8	85.1
July	22.8	24.9	21.9	83.3	9.5	85.1
August	21.6	24.0	21.4	94.2	48.7	58.1
September	16.8	18.2	16.8	96.2	102.7	62.6
October	13.8	11.5	11.8	65.1	89.9	59.3
Mean / Sum. (Mar. – Oct.)	17.1	17.3	16.1	676.8	445.5	515.0

Plant sampling and growth analysis

The plants were manually harvested in a 10-day interval from the end of May to September 20. Thus, there was a total of 12 sampling dates during a vegetative sugar beet growth. On each harvest date, five representative plants per plot were taken for further analysis (720 individual plants in each year).

The plants were washed to remove the dirt and soil and then divided into leaves, crowns, and roots. At the cross-section of the widest root part (about 1 cm below the dried leaves' scars), the fresh root diameter was measured (in cm). The root diameter represents an average of two perpendicular measurements. It was possible to separate the crowns from the root from July 20, 2014 and from July 10, 2015. To determine the fresh mass (FM), the plants were put into a plastic bag immediately subsequent to the collection. On each sampling date, the plants were necessarily washed to remove the dirt and soil (especially on the rainy sampling dates). Subsequent to drying the plants with the wet wipes, the FM was determined while using the Kern (Germany) precision laboratory balance and then put into a paper bag and oven-dried at 105°C for 48 hrs to determine the dry mass (DM). The crowns and roots were also weighted for the FM and oven-dried at 105°C for 48 and 96 hrs, respectively, for the sake of a DM determination. The root FM and DM represent the root mass with the crowns. The mass of the plant parts was determined as a g per plant and then calculated as t ha^{-1}.

Statistics

In order to determine a relationship between the plant growth parameters, a simple linear regression analysis was performed using the SAS Enterprise Guide 7.1 (SAS Institute Inc., USA). This program was also applied to the determination of significance coefficient (*R*) in a simple linear regression.

RESULTS AND DISCUSSION

In general, the plants developed in the plant densities of 60,000 and 80,000 plants ha^{-1} and, in this study, had a higher mass than the beets of 100,000 and 140,000 plants ha^{-1}. Even though the plants had a higher root mass, the root mass and the sugar beet root quality are negatively correlated (Kristek and Liović, 1988; Tsialtas and Maslaris, 2010). According to this study's results, the highest mean accumulation of leaves' DM during vegetation for the first growth phase was determined from June 30, 2014 to July 10, 2014 (0.14 t ha^{-1} daily) and later in the vegetation period in the third August decade, when it amounted to 0.16 t ha^{-1} daily, while it increased to 6.4 t ha^{-1} (Fig. 1) on August 30.

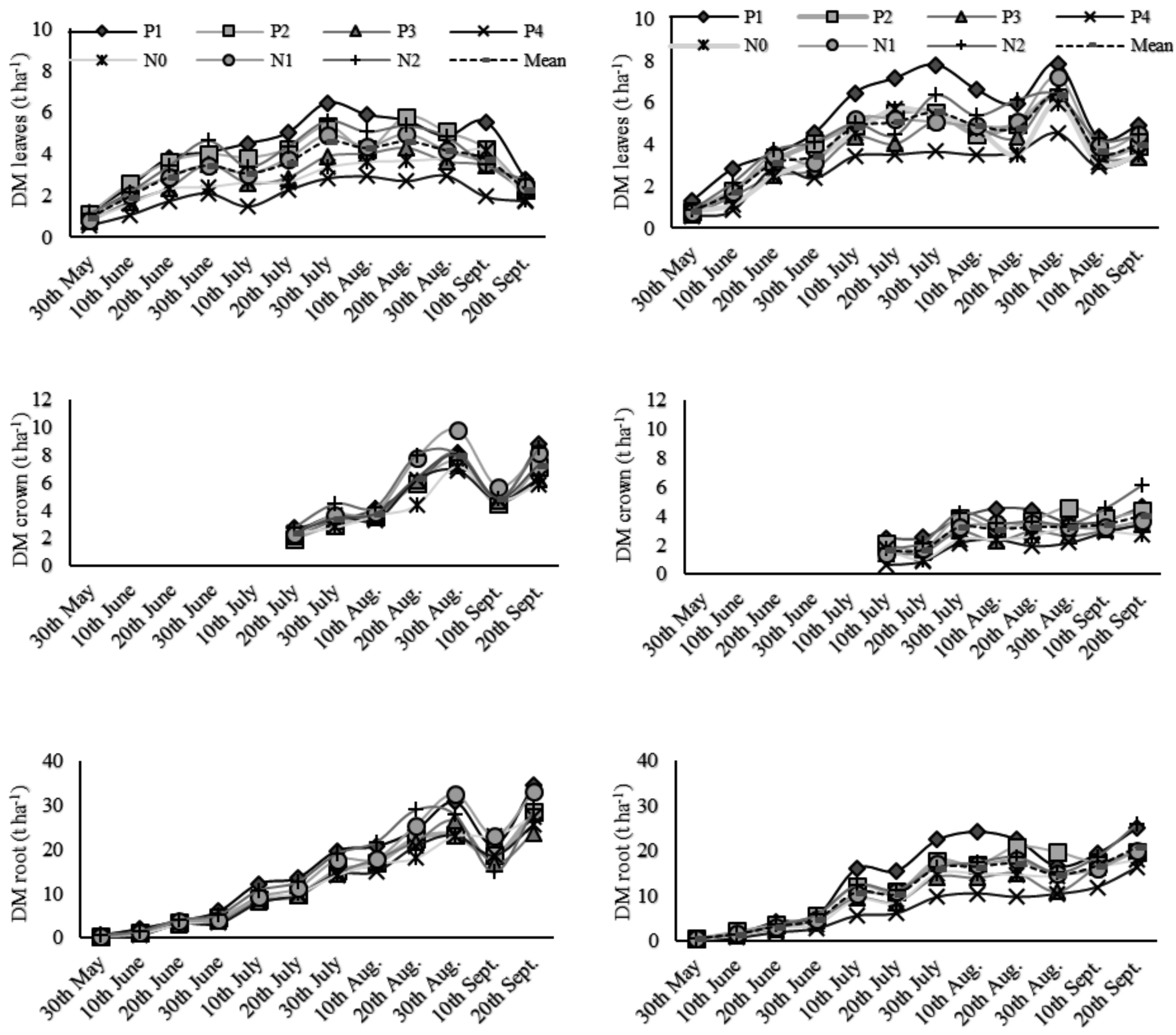

Figure 1. The dynamics of sugar beet leaves, crowns, and the whole root dry matter (DM) accumulation in 2014 *(on the right)* and in 2015 *(one the left)* in different plant densities and spring nitrogen fertilization

Slika 1. Porast mase suhe tvari lisne rozete, glave korijena i cijeloga korijena šećerne repe tijekom 2014. (lijevo) i 2015. (desno) godine ovisno o broju biljaka po jedinici površine i proljetnoj gnojidbi dušikom

This late leaf mass increment proximate to the harvest usually exerts a negative influence on the sugar beet root quality, since the newly developed leaves decrease the FM, DM, and the sucrose content in the root. There was an immense problem in Republic of Croatia in the sugar beet production pertaining to the *Cercospora beticola* Sacc. disease in the periods coinciding with this experiment. In the Republic of Croatia, the mean root yield in 2014 amounted to 69.2 t ha^{-1}, with a sucrose content amounting to 13.27% (Internal Sugar Beet Factories' Data, 2016). Thus, even though the plant protection against the fungi in 2014 and 2015 was performed three to four times during the vegetation, the treatments had no effect. This was probably due to a loss of Strobilurin efficiency and the low effectiveness of a cyproconazole treatment (Kristek et al., 2015). This caused a leaf destruction. Since the plants enjoyed sufficient rainfall in 2014 (Table 2), they formed the larger leaves, and thus the 2014 root DM decreased in the first decade of September by 0.7 t ha^{-1} daily, up to 19.4 t ha^{-1}, which was determined on September 10.

Table 3. Sugar beet root- and leaves- ratio of fresh matter in different plant densities and spring nitrogen fertilization during the 2014 and 2015 vegetations

Tablica 3. Variranje odnosa svježe mase korijena i lisne rozete šećerne repe tijekom vegetacije ovisno o broju biljaka po jedinici površine i proljetnoj gnojidbi dušikom u 2014. i 2015. godini

		Sampling date / *Datum uzorkovanja*											
		May 30 *30. svibnja*	June 10 *10. lipnja*	June 20 *20. lipnja*	June 30 *30. lipnja*	July 10 *10. srpnja*	July 20 *20. srpnja*	30 July *30. srpnja*	August 10 *10. kolovoza*	August 20 *10. kolovoza*	August 30 *30. kolovoza*	September 10 *10. rujna*	September 20 *10. rujna*
2014	**P1**	1:3.3	1:2.0	1:1.4	1:1.2	1:1.0	1:0.9	1:0.9	1:0.5	1:0.6	1:0.4	1:0.3	1:0.2
	P2	1:4.1	1:2.1	1:1.4	1:1.5	1:1.1	1:0.9	1:0.6	1:0.7	1:0.5	1:0.5	1:0.3	1:0.1
	P3	1:4.0	1:2.0	1:1.4	1:1.3	1:0.9	1:0.8	1:0.7	1:0.7	1:0.5	1:0.4	1:0.3	1:0.2
	P4	1:4.4	1:1.8	1:1.3	1:1.2	1:0.8	1:0.7	1:0.5	1:0.6	1:0.4	1:0.2	1:0.1	1:0.1
	N0	1:2.8	1:1.8	1:1.3	1:1.3	1:0.9	1:0.9	1:0.7	1:0.6	1:0.5	1:0.3	1:0.3	1:0.2
	N1	1:4.4	1:2.2	1:1.5	1:1.3	1:1.0	1:0.9	1:0.6	1:0.7	1:0.5	1:0.4	1:0.3	1:0.2
	N2	1:4.6	1:2.0	1:1.4	1:1.3	1:1.0	1:0.8	1:0.7	1:0.6	1:0.5	1:0.4	1:0.2	1:0.2
	Mean	**1:3.9**	**1:2.0**	**1:1.4**	**1:1.3**	**1:0.9**	**1:0.8**	**1:0.7**	**1:0.7**	**1:0.5**	**1:0.4**	**1:0.3**	**1:0.1**
2015	**P1**	1:1.0	1:1.0	1:1.2	1:1.0	1:0.8	1:0.5	1:0.4	1:0.3	1:0.3	1:0.3	1:0.2	1:0.1
	P2	1:1.0	1:1.0	1:1.2	1:1.0	1:0.9	1:0.6	1:0.3	1:0.2	1:0.4	1:0.2	1:0.2	1:0.1
	P3	1:1.0	1:1.0	1:1.1	1:1.1	1:0.7	1:0.5	1:0.4	1:0.3	1:0.3	1:0.3	1:0.2	1:0.1
	P4	1:1.0	1:1.0	1:1.1	1:1.0	1:0.8	1:0.5	1:0.4	1:0.4	1:0.3	1:0.2	1:0.2	1:0.1
	N0	1:1.0	1:1.0	1:1.1	1:0.9	1:0.7	1:0.5	1:0.3	1:0.3	1:0.3	1:0.3	1:0.2	1:0.1
	N1	1:1.0	1:1.0	1:1.1	1:1.0	1:0.8	1:0.5	1:0.4	1:0.3	1:0.3	1:0.2	1:0.2	1:0.1
	N2	1:1.0	1:1.0	1:1.2	1:1.2	1:0.9	1:0.6	1:0.4	1:0.4	1:0.4	1:0.3	1:0.2	1:0.1
	Mean	**1:1.0**	**1:1.0**	**1:1.1**	**1:1.0**	**1:0.8**	**1:0.5**	**1:0.4**	**1:0.3**	**1:0.3**	**1:0.2**	**1:0.2**	**1:0.1**

At the last sampling of 2014, the mean root DM amounted to 28.8 t ha^{-1} (Fig. 1). The highest DM with regard to the plant density had the roots at 140,000 plants ha^{-1} (33.5 t ha^{-1}).

On May 30, 2014, the average FM of a root-to-leaf ratio amounted to 1:3.9 and gradually decreased to 1:0.1 on September 20 (Table 3). Depending on the sowing density, Jelić et al. (2015) pointed out that the difference in the fresh mass leaf and root ratio was the largest in mid-September of 2014 and averaged 1:7.06 at 70,000 – 110,000 plants ha^{-1}, while at 30,000 and 50,000 plants ha^{-1} the ratio averaged to 1:9.58. Stanaćev (1979) demonstrated that an increase in the mass of sugar beet root was at its greatest in the period from July to mid-August, so a root-to-leaves mass ratio was most proximate in mid-August (1:1.2 and 1:0.92). Pospišil (2013) stated that that the sugar beet leaf mass in Croatia decreased up to the harvest season, and that the ratio of root-to-leaves mass at harvest amounted to 1:0.4–0.6.

In 2015, there were no such high differences in the root-to-leaves ratio (Table 3) due to a lack of rainfall for the canopy development. Generally, this 2015 lack of rainfall (Table 2) was reflected on the average root yield in the Republic of Croatia, which amounted to 54.6 t ha^{-1} according to the Internal Sugar Beet Factory data (2016), while the sucrose content amounted to 15.00%. In our study, the maximum mean leaf DM of 4.6 t ha^{-1} was determined on August 20 (Fig. 1), when it varied in the plant densities from 2.7 t ha^{-1} (60,000 plants ha^{-1}) to 5.8 t ha^{-1} (100,000 plants ha^{-1}), with regard to the N fertilization from 3.7 t ha^{-1} (*N0*) to 5.4 t ha^{-1} (*N2*). The mean root DM increased up to 20.7 t ha^{-1} on September 20, 2015 (Fig. 1). With regard to the plant density, the root DM in 2015 varied from 16.2 t ha^{-1} (60,000 plants ha^{-1}) to 25.1 t ha^{-1} (140,000 plants ha^{-1}).

With regard to the fertilization (Fig. 1), the highest root DM on September 20, 2014 (33.0 t ha^{-1}) was recorded by the plants being subject to a presowing by a nitrogen application (*N1*), which was by 5.6 t ha^{-1} (or about 17%) higher than a control fertilization (*N0*). The nitrogen fertilization also positively influenced the 2015 DM accumulation, but on the last sampling date the whole root DM upon a *N2* treatment reached 25.9 t ha^{-1}, which was about 30% higher than the control (*N0*). This was probably due to the favorable weather conditions in 2014. As there was a sufficient rainfall, the soil mineralization released sufficient N for the plant growth. The differences of the 2014 whole root DM between the nitrogen fertilization variants amounted to 4 t ha^{-1}. Malnou et al. (2007) reported that the root dry weights increased significantly ($p<0.01$) compared to the control ones, but that there were no differences between 80 and 160 kg ha^{-1} N in the early and late summer.

There was a difference in the crown DM within the years and treatments. In both years, the nitrogen fertilization had a positive influence on the crown mass. Greater variations for crown DM were detected for the nitrogen, as compared to the plant density. Thus, on September 20, 2014, the crown DM varied from 6.2 t ha^{-1} (80,000 plants ha^{-1}) to 8.8 t ha^{-1} (140,000 plants ha^{-1}), while in the fertilization treatments it varied from 5.9 t ha^{-1} (*N0*) to 8.5 t ha^{-1} (*N2*). In 2015, the mean crown DM on September 20 varied from 2.7 t ha^{-1} without fertilization (*N0*) up to 6.1 t ha^{-1} with a presowing and topdressing treatment (*N2*), whereas it varied from 3.4 t ha^{-1} (60,000 plants ha^{-1}) to 4.6 (140,000 plants ha^{-1}) for the plant densities.

Similar results were obtained by Jaćimović et al. (2007), who found that, in a year with a lack of rainfall (2003), the highest accumulation of leaf and root crown FM was from June 15 (14.59 t ha^{-1}) to July 15 (31.12 t ha^{-1}), and it was not significantly altered up to the harvest, at the beginning of November (32.42 t ha^{-1}). According to a triennial study, Starke and Hoffmann (2014) demonstrated that a sugar beet dry matter content root averaged to 22.8%, while that of the leaves with crowns averaged to 14.6%. In the study of De Koeijer and van der Werf (1999), 125 days subsequent to the sowing the dry matter of sugar beet at 75 000 plants ha^{-1} amounted to 19.2 t ha^{-1}, of which 11.6 t ha^{-1} was the root mass. On the contrary, at a larger density amounting to 118 000 plants ha^{-1} plants. A dry matter was smaller, 16.5 t ha^{-1}, of which a root dry matter amounted to 9.9 t ha^{-1}. According to the study on different sowing distances, Çakmakçi and Oral (2002) stated that the root crown leaf yield increases from 23.97 t ha^{-1} to 38.57 t ha^{-1} due to an increase in the distance between plants.

The mean root diameter, the number of cambium rings, and the root mass increased with the plant maturation. Based on the regression equations, there was a positive linear relationship pertaining to the root diameter increment and the FM or DM increment in both years. So, as a study average, it was calculated that the plant FM increased by approximately 76 g plant^{-1}, the root increased by 93 g plant^{-1}, and the leaves increased by 11 g plant^{-1}, while the root crown increased by approximately 31 g plant^{-1} for every centimeter of sugar beet root diameter's increment (Fig. 2 *on the left*).

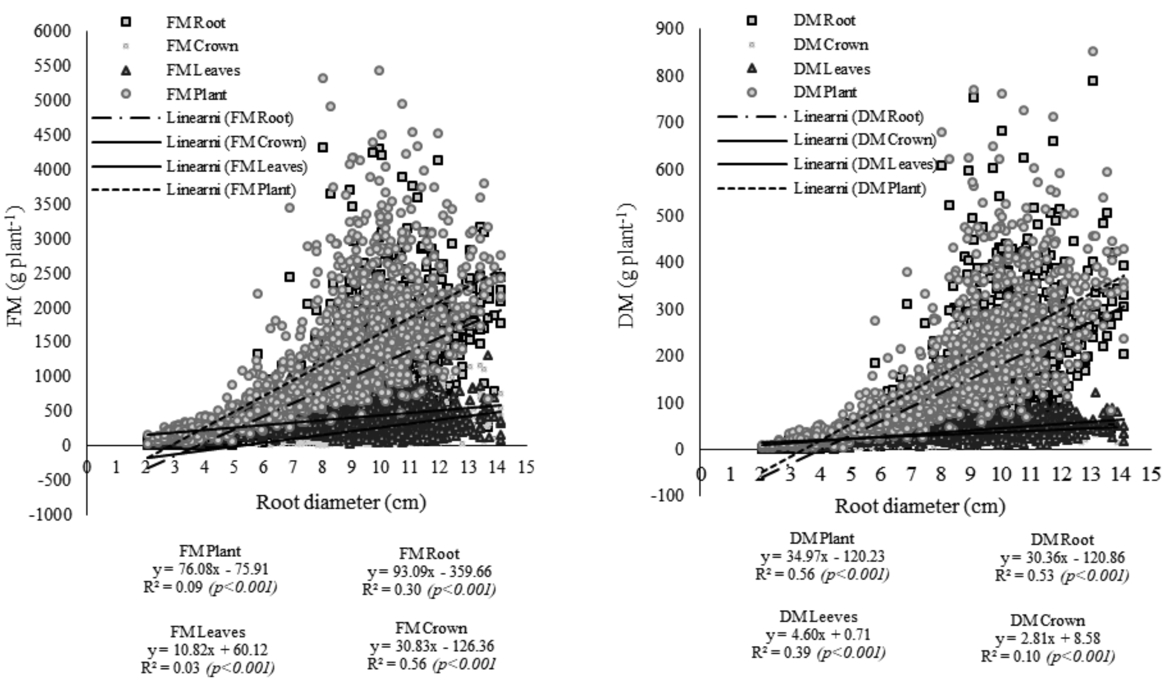

Figure 2. A scatter plot diagram for the fresh matter (on the left) and for the dry matter (on the right) pertaining to an incremental relationship between the fresh mass of sugar beet leaves, roots, crowns and plants, as well as to the root diameters of individual plants in 2014 and 2015, as a mean in all treatments (N=1440)

Slika 2. Dijagram rasipanja porasta svježe mase (lijevo) i mase suhe tvari (desno) lisne rozete, korijena, glave korijena te biljke i promjera korijena po biljci prosječno za sve tretmane u 2014. i 2015. godini (N=1440)

For the DM, it was determined that by 1 cm of the root diameter increment, the plant DM increased by approximately 35 g plant^{-1}, they root by 30 g plant^{-1}, the leaves by 5 g plant^{-1}, and the root crown by almost 3 g plant^{-1} (Fig. 2 *on the right*). Hoffman (2017) found an increasing mass gain from 130 g plant^{-1} to 230 g plant^{-1}, while the root diameter increased by 1 cm (in the range 10-15 cm of diameter). Furthermore, the author reported that nowadays the sugar beet genotypes experience a mass increase by 1 cm in diameter, up to more than 200 g, which is much higher than 100 g, as it was reported in the past. Comparing the field- and the pot-grown sugar beet plants, the author also stated that the field-grown sugar beet seems to reach its yield increase through the expansion of diameter, when the yield is above 25 t ha^{-1}, while the root length remains rather constant. Jelić et al. (2019) found that the highest root diameter was on September 17, having varied from 12.7 cm (110,000 plants ha^{-1}) to 14.6 cm (50,000 plants ha^{-1}). In a pot experiment, Schnepel and Hoffmann (2015) found that the maximum sugar root diameter amounted to 15 cm, with a root length amounting to approximately 45 cm.

CONCLUSION

In general, the plants having higher crop densities produced a higher DM, compared to a sugar beet grown at lower densities. There were also differences recorded among the years pertaining to the weather conditions. So, in 2014, with a higher rainfall, the plants formed a more voluminous root and leaf FM, with a wider ratio in late spring (1:3.9 on May 30, 2014) when compared to 2015 (1:1.0 on May 30, 2015). Nitrogen fertilization exerted a positive influence on a dry matter accumulation, so in the year with a higher rainfall the presowing fertilization resulted in the highest root DM, whereas in the year with a lack of rainfall the highest root DM was with a presowing and with an additional topdressing application. On the basis of this study, the DM accumulation was larger in higher densities, so it is recommended for the producers to apply more seeds during the sowing season, so that a final plant density is not lower than 100,000 plants ha^{-1}, which will then result in a higher root DM and probably in a better quality.

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VARIRANJE MASE KORIJENA, GLAVE KORIJENA I LISTOVA ŠEĆERNE REPE S OBZIROM NA GUSTOĆU USJEVA I PROLJETNU GNOJIDBU DUŠIKOM

SAŽETAK

U ovome je istraživanju kroz dvije godine analizirana dinamika porasta svježe mase (FM) i mase suhe tvari (DM) cijeloga korijena, glave korijena i listova šećerne repe te njihov omjer masa ovisno o broju biljaka po jedinici površine (60.000, 80.000, 100.000 i 140.000 biljaka ha^{-1}) i gnojidbi dušikom u proljeće: kontrola (N0), samo predsjetva (N1) te predsjetva gnojidba s prihranom (N2). Pri sazrijevanju, 20. rujna, prosječna masa suhe tvari cijeloga korijena, glave korijena i lisne rozete šećerne repe u 2014. godini iznosila je 28,8, 7,3 i 4,0 t ha^{-1}, dok je u 2015. bila manja i iznosila je prosječno 20,7, 4,1 i 2,3 t ha^{-1}. Štoviše, u odnosu na gustoću sjetve, prosječno veća masa suhe tvari cijeloga korijena izmjerena je pri 140.000 i 100.000 (31,6 t ha^{-1} u 2014. i 22,4 t ha^{-1} u 2015.), i to u odnosu na sklop od 80.000 i 60.000 biljaka ha^{-1} (22,4 t ha^{-1} u 2014. i 18,1 t ha^{-1} u 2015.). Gnojidba dušikom pozitivno je utjecala na akumuliranje suhe tvari, ali je utjecaj gnojidbe bio različit ovisno o godini istraživanja. Tako je 20. rujna 2014. predsjetvena gnojidba (N1) povećala masu suhe tvari cijeloga korijena za 17% u usporedbi s kontrolom, dok je u 2015. predsjetva gnojidba i prihrana (N2) rezultirala povećanjem mase suhe tvari cijeloga korijena za 30% u odnosu na kontrolu. U 2014. je omjer svježe mase korijena i lisne rozete 30. svibnja bio 1: 3,9, a 20. rujna 1: 0,1. U 2015. godini omjer mase cijeloga korijena i lisne rozete bio je najširi 20. lipnja (1:1,1), a postupno se masa lisne rozete sazrijevanjem korijena smanjivala, tako da je 20. rujna omjer iznosio 1:0,1.

Ključne riječi: šećerna repa, svježa masa, masa suhe tvari, omjer, broj biljaka

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