THE EFFECT OF PLANTING DENSITY ON THE YIELD OF SWEET POTATO [*IPOMOEA BATATAS (L.) LAM.*] IN SOUTH-EAST HUNGARY IN 2017

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Abstract . *Sweet potato also called batata (*Ipomoea batatas *(L.) Lam) is a perennial food crop of the morning glory family (Convolvulaceae) and widely cultivated as an annual crop in the warmer temperate climates. In Hungary, all new experimental data elucidating various factors of production technology are essential to improve efficiency, especially yield stability. Optimal plant density of sweet potato was shown to be highly dependent on the genotype in previous international studies. Thus, it is important to determine it for the genotypes grown under dosmetic conditions. Our field experiment was conducted at Domaszék, South-East Hungary, on moderately alkaline sandy soil of medium humus, very good phosphorous and good potassium content. The experimental setup was Randomized Complete block design with four repetitions, during the main cropping season of 2017 with the objective of determining the effect of variety and plant spacing on the productivity of the crop. The experiment consisted of four planting spacing setups (80 cm x 20 cm, 80 cm x 30 cm, 100 cm x 20 cm, 100 cm x 30 cm) with the Hungarian certified sweet potato variety 'Ásotthalmi-12'. The planting was performed on 4th Juny 2017 without ridges and the crop was harvested on 15th October 2017. The highest yield per plant was obtained with the 100 cm x 30 cm setup (0,39 kg) that is the usually recommended density in technology guides. Then calculating the yield data for one hectare, we got different results. The highest storage root yield (13.93 t ha^{-1}) was recorded with the density of 80 cm x 20 cm. Increasing plant density from 3.33 plants m^{-2} (100 cm x 30 cm) to higher level of 6.25 plants m^{-2} (80 cm x 20 cm) increased the production of total storage root yield from 13.16 t ha^{-1} to 13.93 t ha^{-1}. In conclusion, the results of the study have revealed that the highest plant density of 6.25 plants m^{-2} (80 cm x 20 cm) – despite decreasing the yield per plant - resulted in the production of the highest storage root yields per hectar.*

Keywords: *sweet potato, batata, experiment, density, tuberous root*

INTRODUCTION

Sweet potato [*Ipomoea batatas* (L.) Lam.] is an important crop in many areas of the world, and today is cultivated in over 100 countries, and ranks among the five most important food crops in the tropical areas where a high population of the world's poorest people live [1, 2]. With the advantages of sweet potato cultivation and its high nutritive value, the sweet potato has been developed as an alternative crop to supply food. Both the root and the leaf parts of the plant can be used as food for humans and animals. Sweet potato is a dry-land crop that is tolerant of a wide range of edaphic and climatic conditions [3]. It is also more tolerant to cold than other tropical root and tuber crops and therefore can be grown at altitudes as high as 2500 meter above sea level. They grow best where the average temperature is 24°C. The crop has relatively few pests and diseases, and pesticides are rarely used. Sweet potato can be grown in poor soils with little fertilizers thus it is often considered as a crop associated with poor soils [4]. This is probably because it is well suited to sandy soils that are often infertile, and because storage root yields are sometimes depressed in very fertile or heavily fertilized soils. Nevertheless, good yields can be obtained only under conditions of high, but balanced nutrition [5]. At temperatures below 10 °C growth is severely retarded. The crop is damaged by frost,

and this restricts the cultivation of sweet potato in the temperate regions to areas with a minimum frost-free period of 4 to 6 months [6]. The potential yield of sweet potato in research goes up to 50 t ha^{-1} [7]. In some other countries like Israel yields as high as 80 t ha^{-1} at farm level have been reported [8]. In Hungary, the storage root yields range between 18 and 25 ha^{-1}, depending on the production site and the applied technology [9].

In Hungary, sweet potato is cultivated for more than thirty years [10, 11], but it became well-known in the last years only, thanks to the media. The row distance generally applied in sweet potato production is between 70 and 107 cm, the most preferred being 100 cm. The usual plant-to-plant distance is 17 to 30 cm, the 30 cm being most widely used [12, 13, 14]. Planting distance (row or in-row spacing) determines the number of plants per unit area. Each stem behaves as separate sweet potato plant since each has its own root and shoots system [15]. The yield of tubers per hectare was decreased with the increasing plant spacing [16]. Narrow spacing increased the hectare yield and decreased the yield per plant. However, increasing planting space increased the population of large-sized tubers. It was also reported that the maximum weight of tubers per hill was produced by the plant having the widest spacing and the highest yield of tubers was obtained from the closest spacing and the lowest was in the widest spacing [17]. The planting density in sweet potato affect some of the important plant traits such as total yield, tuber size distribution and tuber quality [18]. Increasing the density can increase the yield in three ways. First, the green leaves will cover the soil earlier and will absorb more sunlight and lead to more assimilation. Second, few lateral shoots will grow and the third is that the growth of tubers will start earlier [19]. A 33,333 up to 55,555 planting density is the recommended population for research purpose worldwide [20].

MATERIAL AND METHODS

The experiment was conducted at Domaszék, South-East Hungary, on moderately alkaline sandy soil of medium humus, very good phosphorous and good potassium content (Table 1.). The experimental setup was Randomised Complete Block Design (RCBD) with four repetitions, during the main cropping season of 2017 with the objective of determining the effect of variety and plant spacing on the productivity of the crop. The experiment consisted of four plant spacing setups (row distance x plant-to-plant distance: 80 cm x 20 cm, 80 cm x 30 cm, 100 cm x 20 cm, 100 cm x 30 cm). The genotype involved was ‘Ásotthalmi-12’, a Hungarian certified sweet potato variety. The cuttings were derived from the Bivalyos Tanya Family Farm and planted on 4th Juny 2017, altogether ca. 450 pieces on the whole experimental area of 150 m^2. Spring tillage was followed by soil disinfection one time (Bora). The cuttings were planted manually with a dibble. For nutrient supply, the fertilizer Volldünger® Linz Classic (14-7-21) was applied. The equivalent numbers of plants per m^2 and per ha for each spacing are shown in Table 2.

Table 1.

Results of soil analysis

pH-KCl	Total salt	Soil plasticity	$CaCO_3$	Humus	P_2O_5	K_2O	Na	Mg
	m/m %	KA	m/m %	m/m %	mg/kg			
7.70	0.04	46	3.46	0.94	824	145	15.6	55

Table 2.

Plant population density

Spacing (cm)	Plants/m2	Plants/ha
80 cm x 20 cm	6,25	62500
80 cm x 30 cm	4,16	41600
100 cm x 20 cm	5,00	50000
100 cm x 30 cm	3,33	33333

RESULTS AND DICUSSIONS

Figure 1 shows that the highest yield per plant was achieved with the 100 cm x 30 cm setup (0,39 kg) and lowest yield per plant was obtained with the 80 cm x 20 cm setup (0,22 kg). Our perception is that closer plant density decreased the yield per plant.

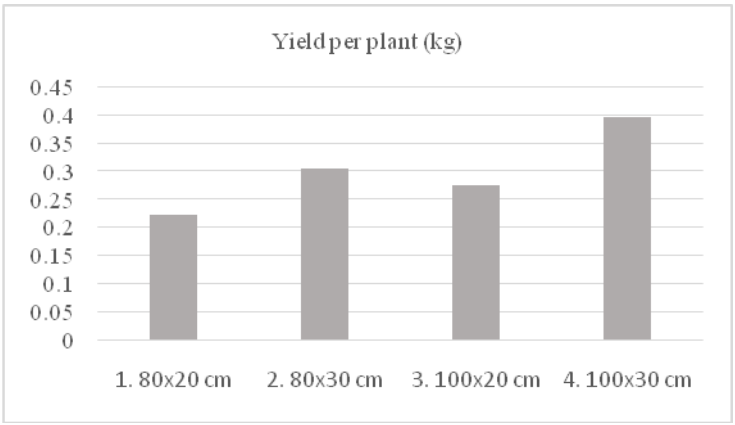

Figure 1: The average yield of one sweet potato plant with four different inter and intra-row spacing

The distance between plants in any crop is a factor which can affect yields, however in the case of sweet potato no significant responses have been obtained with the different distanced studied. The effect of planting distance between plants (20 to 30 cm) and between rows (80 to 100 cm) under irrigation were studied. The best results (13.93 t/ha) were obtained with planting at 80 cm x 20 cm. Increasing plant density from 3.33 Plants m^{-2} (100 cm x 30 cm) to higher levels of 6.25 Plants m^{-2} (80 cm x 20 cm) increased production of total storage root yields from 13.16 t ha^{-1} to 13.93 t ha^{-1}. However, a significantly higher response of marketable storage root yield (13.93 t ha^{-1}) was obtained at the plant density of 6.25 plant m^{-2} (80 cm x 20 cm).

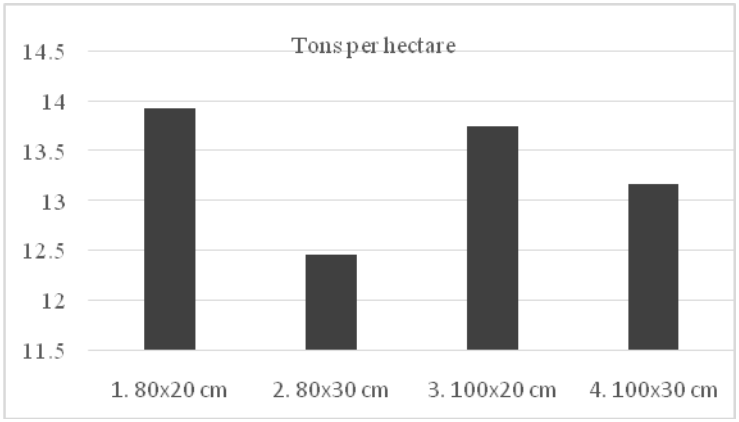

Figure 2: The average sweet potato yield of tons per hectare with four different inter- and intra-row spacings

CONCLUSIONS

The results of the study have revealed highly significant differences among the results achieved with different plant densities. It was shown that the highest plant density 6.25 Plants m^{-2} (80 cm x 20 cm) resulted in the production of the highest storage root yields among the setups applied. Closer plant densities decreased the yield per plant but increased the total yield per hectar. Plant density could be used as means to reduce weed infestation. Generally, the results obtained in this study are concordant with the findings of [21] reporting that closer spacing of 80 cm × 20 cm producing the highest yield of sweet potato could be recommended for sweet potato cultivation and closer spacing is generally recommended to achieve maximum yield. Maximum yields are obtained at a closer spacing [22]. Our results suggest that plant density can have a considerable impact on the production of sweet potato. The experiment in the future should be carried out to develop appropriate technologies in collaboration with producers and farmers.

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