RESULTS ON THE INFLUENCE SPACE NUTRITION ON GROWTH AND DEVELOPMENT OF SWEET POTATO PLANT UNDER SANDY SOILS IN SOUTHERN OLTENIA

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ABSTRACT

Microclimate created in the psamo-pelitic soils in southern Oltenia, offers great conditions for growth and development of sweet potato (Ipomoea batatas) which is a thermophilic plant specific tropical and subtropical areas. The results obtained during 2013-2015 from Dabuleni, Development Research Center for Plants Crops on Sands, emphasizes productions between 19221 -21634 kg / ha, depending on the size space nutrition and variety cultivated. Those two factors in the study have significantly influenced the conduct from plant physiological processes. The highest value from plant photosynthesis rate (28.81 micromoles CO_2 / m^2 / s) was recorded at 11 am, at a density of 40,000 plants / ha, when sweet potato plant has lost through sweating about 5.69 millimoles H_2O / m^2 / s.

INTRODUCTION

Sweet potato (Ipomoea batatas) is grown on large areas in China, India, Japan, Africa, USA, the Mediterranean areas of Europe, providing an important food in a healthy diet (Srisuwan, Saranya et al., 2006). The diversity of sweet potato varieties grown in Romania is quite limited and they are cultivated more experimental. Orange and yellow varieties have a high content of beta-carotene, the precursor of vitamin A. Therefore, it encourages the cultivation of these species in places like Africa where vitamin deficiency is causing severe health problems (Ladokum, O.A. et al., 2007, Wariboko C. and I. A. Ogidi, 2014). Research conducted in different areas of Kenya, recommends sweet potato culture (Ipomoea batatas) as an alternative to climate change, being resistant to drought and high temperatures (Kareem I., 2013). Sweet potato is a plant well adapted to tropical and subtropical climates, but can grow successfully in a wide range of climatic conditions, in which the cold season average to not more than 5 months. In South Africa, the sweet potato is a popular culture for agricultural farmers, so the selection of valuable varieties is very important for plant efficiency (Laurie, S.M. and Magoro, M.D. 2008). Sweet potato plant is quite drought tolerant, adaptable to sandy soils, which the can survive for longer periods of drought during the summer, but growth resumed when there is sufficient rainfall (Draghici Reta et al., 2013). Research conducted in Ethiopia shows the importance of nutrition space size, depending on the variety, highlighting in this respect the distances 20 cm x 80 cm (Teshome Abdissa et al., 2011). In Romania, the sweet potato is a relatively recent species known. Concerns for growing sweet potato in Romania took place at the University of Agricultural Sciences and Veterinary Medicine (Ciofu Ruxandra, 2005, Muşat Cosmin, 2010) and have been materialized by creating two varieties (Victoria IANB in 1991 and Crux in 1997), aimed at diversification assortment of plants eaten fresh or preserved, in order to ensure a good nutrition in point of view nutrients. Using seedlings of

the highest quality, using cut sprouts and planted immediately in the field is crucial to achieving a successful system in sweet potato production (Srisuwan, Saranya et al., 2006,Kenneth VA Richardson, 2010, Cioloca Mihaela et al., 2013). Determinations in a culture of sweet potato located in the sandy soils of southern Oltenia, reported the presence of 50 species or genera of arthropods (Iamandei Maria et al., 2014). To improve food security in areas affected by stress thermal-hydr in Romania, it is appropriate to identify new species of plants, less cultured, but the biological potential can best capitalize on the microclimate created in these areas. In this regard the climatic conditions recorded in the south of Romania, provide an optimal microclimate for growth and development of sweet potato (Ipomoea batatas) which is a thermophilic plant specific tropical and subtropical areas.

MATERIAL AND METHOD

Research for sweet potato crop were conducted during 2013-2015 in Development Research Center for Plants Crops on Sands, Dabuleni, located in southern Oltenia, Romania. They were carried out under the Bilateral Cooperation Protocol between Kyungpook National University (KNU) in South Korea and the Academy of Agricultural and Forestry Sciences "Gheorghe Ionescu Sisesti, Bucharest". The experiment was nestled on a psamo-pelitic soil with low natural fertility (0.39 to 0.92% humus) and pH (H_2O) = 5.9 to 6.9 and aimed behavior of two varieties Korean, Pumpkin (KSP1) and Chestnut (KSC1) by planting at three densities (30,000 plants / ha, 40,000 plants / ha and 50,000 plants / ha). The culture was established in the field by seedling produced in solar doubly protected. Planting sweet potato tubers in the solar, it was conducted in the last decade of March (20-25 March). At the age of 35-40 days vegetation sprouts were cut, keep 24 hours at room temperature and then the 2nd day, after 17 hours, were planted in the field in ground mulch foil PPE and irrigation dripping. Harvesting was carried out 120 days after planting. During the growing season, at the stage of root tubers was to determine the rate of photosynthesis and transpiration plant at the level of the leaf, with the device LCpro+ Portable Photosynthesis System, in 4 times of the day (Photo 1). At harvest, was determined in the field, the production of tubers and analyzed in terms of the number and the diameter of the tuber. In laboratory was determined the quality characteristics of tubers at harvest, as follows: Water content and total solids (%) by gravimetric method; Soluble solids content (%), by refractometry; Total carbohydrate content (%), by the method Fehling Soxhlet method; Vitamin C content (mg / 100g fresh substance) by iodometric method; Starch content (%) by gravimetric method.

RESULTS AND DISCUSSIONS

In the period from May to September 2013-2015 (calendar period of ongoing cycle of vegetation sweet potato) were registered an average air temperature of 21.25 ^{0}C, with 0.92 ^{0}C more than the annual average (Table 1). The amount of degrees of temperature recorded in the air during the growing of the plant was in the range of 3133.44 to 3332.34 ^{o}C, allowing the normal development of the processes of growth and development of sweet potato plant. In terms of ensuring thermal requirements for growing sweet potato, 2015 was the most favorable for the plant, followed by 2013 and then 2014. The average air temperature, during the growing season (May-September), ranged from 20.48 to 21.78 0C, with the lowest value in 2014, when there was a large amount of rainfall (516.9 mm). Compared to the multiannual average, when during the from May to September were registered 269.38 mm, rainfall during the study period from 2013 to 2015 they totaled 372.3 mm, exceeding the 38.2% the multiannual average. Year 2014 was unfavorable for

sweet potato as a result of rainfall during the maturing of tubers, preventing the accumulation of dry matter and increased weight of tubers per plant.

Table 1

Climate characterization of sweet potato vegetation period (2013-2015 Dabuleni)

Climatic element	2013 Year	2014 Year	2015 Year	Average 2013-2015 Period	Multiannual average (1956-2015)
Air temperature average during the growing sweet potato 01.05– 30.09 (^{0}C)	21.5	20.48	21.78	21.25	20.33
$\sum$ ^{0}C in air during the growing sweet potato 01.05– 30.09	3292.6	3133.44	3332.34	3252.79	3110.49
Rainfall average during the growing sweet potato 01.05– 30.09 (mm)	269.2	516.9	330.8	372.3	269.38
Relative humidity average during the growing sweet potato 01.05– 30.09 (%)	72.4	77.12	71,04	73.52	-

In the competition plants for vegetation factors, competition for sunlight plays an important and has direct implications for the accumulation of dry matter through photosynthesis process. Measurements of plant physiology studies in sweet potato (rate of photosynthesis and plant transpiration rate) are designed to control stress thermal-hydric by establishing of technological parameters, depending on weather conditions. The results obtained in phase of root tubers, show a diurnal variation in the physiological processes of sweet potato, according the temperature of surface leaf and active photosynthetic radiation registered with the device LCpro+ Portable Photosynthesis System, at the time of determination (Table 2). The rate of photosynthesis in the sweet potato used varies depending on the density of planting and the time of day (Figure 1). The maximum photosynthesis was recorded at a density of 40,000 plants / ha at 11th o'clock (28.81 micromols CO_2/ m^2/s, and the minimum was recorded at 15th o'clock, the same density planting. For storing this amount of CO_2 the plant sweet potato loses 5.69 mmol H_2O /m^2/s (Figure 2). Accentuation thermal stress by increasing the photosynthetic active radiation and temperature on the leaf surface, reduces the intensity of photosynthesis, so starting at 13, it recorded a decline compared to values at 11 o'clock. At 15th o'clock, when it recorded a maximum temperature of 43.10 C, the best behaved sweet potato at a density of 30,000 pl / ha. The increase in temperature and photosynthetic active radiation led to increased intensity of plant transpiration process. Sweet potato loses through perspiration between 2.73 -10.03 milimols H_2O/ m^2 /s, depending on planting density and climatic conditions on the leaf surface. To ensure planting densities of 40,000 plants / ha, sweet potato has used efficiently water lost through perspiration, accumulating a greater amount of CO_2.

Table 2

Values in photosynthetic active radiation (PAR) and temperature registered in the device's camera Lcpro+ Portable Photosynthesis System

Time	PAR (micromoles /m^2/s)		Temperature (^{0}C)	
	Minimum	Maximum	Minimum	Maximum
9th o'clock	1067	1467	30.6	34.5
11th o'clock	1378	1622	33.6	40.7
13th o'clock	1405	1707	40.1	42.1
15th o'clock	1362	1723	40.5	43.1

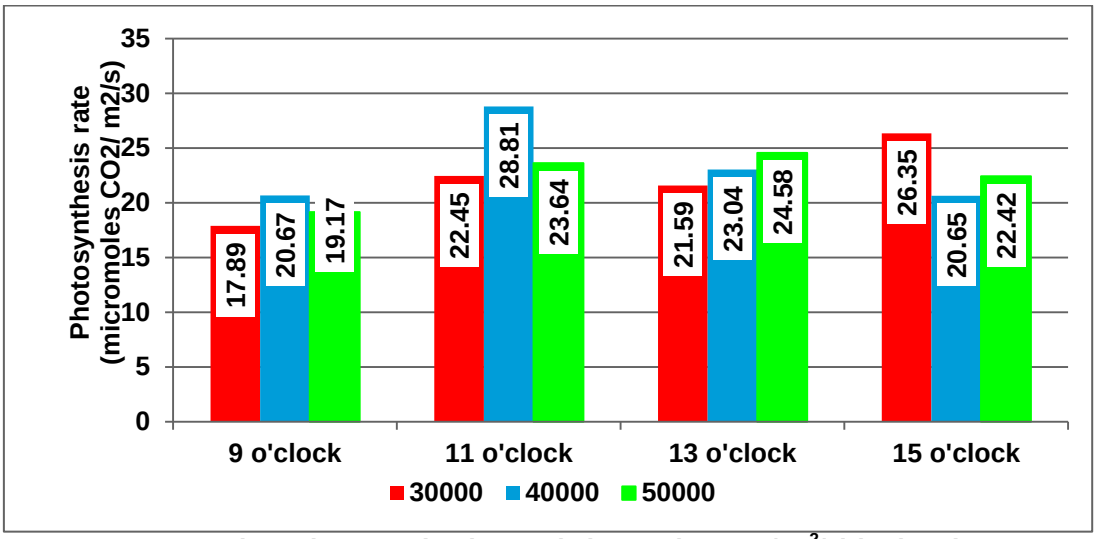

Figure 1. Sweet potato plant photosynthesis rate (micromoles CO_2/ m^2/s) in the phase root tubers, depending on planting density

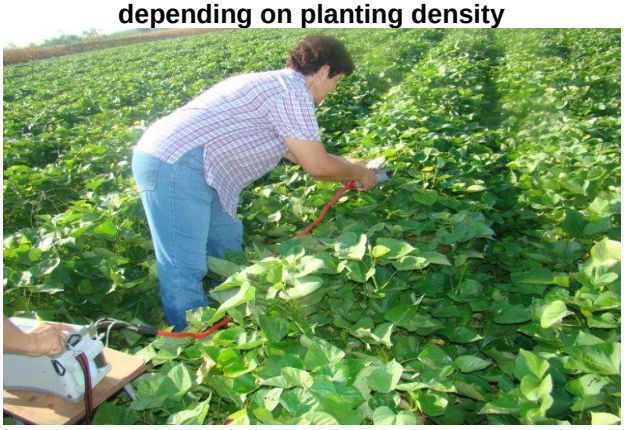

Photo 1. Physiological determinations of the sweet potato plant

Sweet potato plant productivity is differentiated depending on variety and planting density (Table 3). At harvest, for the variety of sweet potato KSP 1, has averaged 4.42 tubers / plant, with a length of 22.99 cm and a diameter of 4.75 cm, and for KSC 1 variety was recorded 4.49 tuber / plant with a length of 24.84 cm and a diameter of 4.72 cm. These parameters productivity were negatively correlated with the increase in the number of plants per unit area.

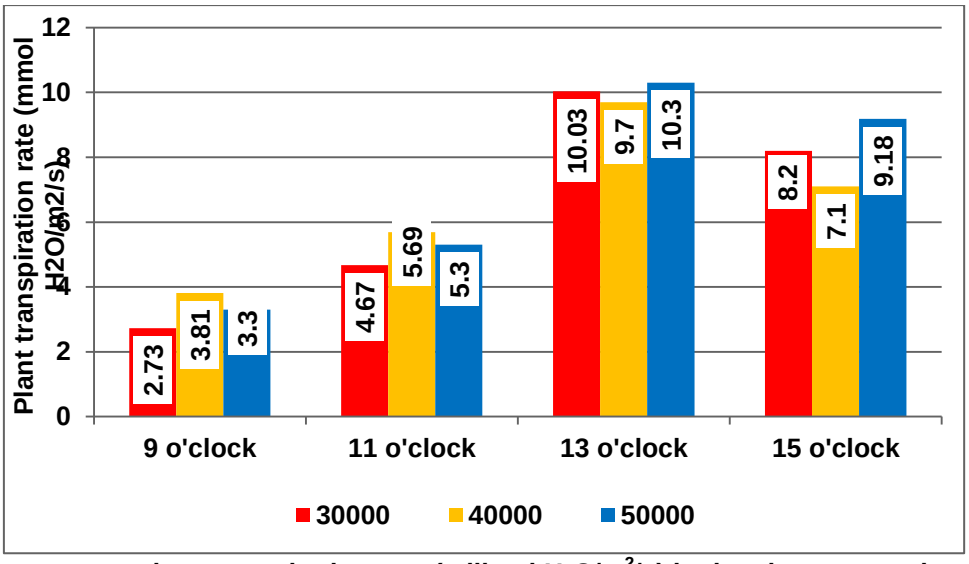

Figure 2. Sweet potato plant transpiration rate (milimol $H_2O/m^2/s$) in the phase root tubers, depending on planting density

Production of tubers obtained from sweet potato was influenced by variety and nutrition space size, fluctuating between 19585.12 and 22317.57 kg / ha for the variety KSC 1 and 18857.72 to 20950.14 kg / ha for the variety KSP 1 (Figure 3). Both varieties were established positive correlation between the increase of density and production of tubers obtained, but the connection is closer to the variety KSP 1, where the correlation coefficient is significant (r = 0.997 *). If analyzed the average density influence on tuber production, be noticed production of about 19221 kg/ha (density of 30,000 plants / ha) and 21634 kg/ha (density of 50,000 plants / ha). The results obtained in Cameroon in varieties: 1112, Tib1 and This 2498, have shown that the they gave very good yields (29.6 and 18.7 t / ha) at a density of 20000 pl / ha (J. T. Ambe, 2008).

Table 3

The influence of variety and planting density on the process of the sweet potato tuberization

Variety	No. of plants / hectare	No of tubers	No tubers/ plant density	Length tubers	Length tubers / plant density (cm)	The diameter of the tuber (cm)	The average diameter / plant density (cm)
KSP 1	30000	4.94	30000=5.19 40000=4.25 50000=3.93	23.6	30000=24.58 40000=24.24 50000=22.94	4.73	30000=4.86 40000=4.87 50000=4.49
	40000	4.11		23.16		5.09	
	50000	4.2		22.22		4.43	
Average KSP 1 variety		4.42		22.99		4.75	
KSC 1	30000	5.43		25.55		5.0	
	40000	4.39		25.32		4.65	
	50000	3.65		23.65		4.55	
Average KSC 1 variety		4.49		24.84		4.72	

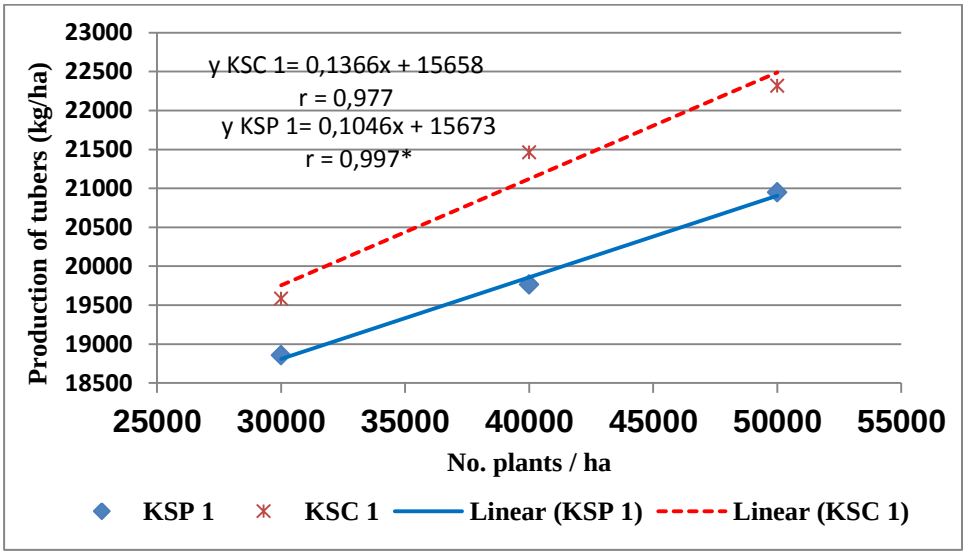

Figure 3. The relationship between plant density per hectare and the production of sweet potato tubers obtained from sweet potato varieties KSP 1 and KSC 1

Planting density influenced the quality of sweet potato tubers (Table 4). Increasing the density planting has led to decreasea total dry matter and starch and increasing the amount of soluble dry matter, Simple soluble carbohydrates and C vitamin in tubers harvested at maturity. They noted a significant positive correlations between planting density and soluble dry matter (r = 0.996 *) and between density and simple soluble

carbohydrates (r = 0.997 *). By analyzing the chemical composition of the variety (Table 5) is observed that the KSC 1 variety, was distinguished by higher values of total dry matter, starch and C vitamin and theKSP 1 variety, was highlighted by values higher in soluble dry matter and soluble carbohydrates simple

Table 4

Biochemical composition of fruits sweet potato depending on planting density

Density (no. plants/ha)	Total dry matter %	Water %	Soluble dry matter %	Simple soluble carbohydrates %	Starch %	C vitamin mg/100g f.s.
30 000	39.85	60.15	9.555	7.95	12.63	8.36
40 000	39.04	60.96	9.89	8.23	12.51	9.213
50 000	37.11	62.89	10.14	8.45	12.46	10.34
Correlation coefficients (density x quality indices)	r= - 0,973	r=0,973	r = 0,996*	r=0,997*	r= - 0,972	r=0,992

Table 5

Biochemical composition of fruits sweet potato depending on variety

Variety	Total dry matter %	Water %	Soluble solids %	Simple soluble carbohydrates %	Starch %	C vitamin mg/100g f.s.
KSP 1	38.41	61.59	10.00	8.33	12.55	7.99
KSC 1	38.93	61.07	9.72	8.09	12.69	10.56

CONCLUSIONS

The sandy soils in southern Oltenia area offers a favorable microclimate for growth and development of sweet potato.

The results obtained show a diurnal variation sweet potato physiology processes. depending on the temperature of the leaf surface and in the photosynthetic active radiation. The highest value of plant photosynthesis rate (28.81 micromoles CO_2/ m^2/s / s) was recorded at 11 o'clock. at a density of 40.000 plants / ha, when sweet potato plant lost by transpiration about. 5.69 mmol $H_2O/m^2/s$.

The two varieties of sweet potato Korean origin, which we have studied in Romania, behaved well, recording productions between 19585.12 kg / ha and 22317.57 kg / ha (variety KSC 1) and 18857.72 to 20,950 14 kg / ha (variety KSP 1).

Between the planting density and the production of tubers obtained from the two varieties, there is a positive correlation, maximum production being achieved in variant in which were planted 50,000 plants / ha.

Increasing the density planting has led to decreasea total dry matter and starch and increasing the amount of soluble dry matter, Simple soluble carbohydrates and C vitamin in tubers harvested at maturity.

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