



Research concerning the pretability for cultivation of sweet potato (*Ipomoea batatas*) in the Satu Mare County, Romania

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Abstract. The present paper aimed to present the cultivation success of sweet potato (*Ipomoea batatas*), a recently introduced crop in the Romanian agriculture. The cuttings used were produced in greenhouse at the ICAR's USAMV Cluj-Napoca, and the production experiment was performed in Sanislău, Satu Mare County on a sandy-clayed soil. A multifactorial experiment was set up, concerning planting period, plant spacing and weed control, each with three graduations. The results showed that the pedoclimatic conditions of Sanislău, Satu-Mare County, are optimal to produce *I. batatas* roots of commercial size. The number of *I. batatas* roots/plant is highly determined genetic and is less influenced by the environmental factors. It was also found that the average weight of the *I. batatas* root is inversely correlated with the planting density. Usage of black mulching foil, resulted higher yields regardless of planting densities and planting seasons. The highest production (over 26,000 kg/ha) was obtained within the planting season of the second decade of May, at density of 44,000 plants/ha and when black mulching foil was used.

Key Words: planting density, mulching, planting season, weed control, yield.

Introduction. Sweet potato (*Ipomoea batatas* L. [Lam.]) is a plant well adapted to tropical and subtropical climates, but can grow successfully in a wide range of climatic conditions (Diaconu et al 2016) just as the *Solanum tuberosum* (Al Mayahi & Fayadh 2015; Askari et al 2012; Blas & Petrescu 2009; Ibrahim et al 2017, 2018; Motallebi-Azar & Kazemiani 2011; Slosar et al 2016; Srisuwan et al 2006). *I. batatas* (is, contrary to his novelty in the national landscape, it is an important species cultivated on large areas in China (over 3 million hectares), India (over 130 thousand hectares) and Japan over 36 thousand hectares), and in Europe in Portugal (1,051 hectares), Spain (794 hectares), Italy (624 hectares) and Greece (164 hectares) (Duda 2003). The paper presents the results of a rigorous research on the possibility of introducing *I. batatas* into the crop on the sandy soils of Satu-Mare County.

Material and Method. The biological material taken from the study was represented by cuttings of Pumpkin variety. The cuttings were produced in greenhouse at the ICAR's USAMV Cluj-Napoca.

In order to highlight the suitability for sweet potato cultivation in the pedoclimatic conditions of Satu Mare County, in 2017 a three-factorial experience of the type: 3x2x2 in three rehearsals was set up in Sanislău, Satu Mare County with the following factors and graduations:

Factor A - Planting period with three graduations:

- a₁ 19.05.2017
- a₂ 02.06.2017
- a₃ 23.06.2017

Factor B – Plant spacing with two graduations:

b₁ 30 cm

b₂ 40 cm

Factor C – Method of weed control:

c₁ black mulch wrap

c₂ unmulched

The soil on which the experience was performed was sandy-clayed with the following chemical properties: bulletin of analysis No. 162/5.07.2017 carried out at the Office for Pedological and Agrochemical Studies Cluj Napoca:

- pH: 7.06

- Nitrogen: 0.116 (poor supply)

- Phosphorus: 657 (very good supply)

- Potassium: 328 (very good supply)

- Humus: 2.47 (medium content)

The area of an experimental plot was 18.75 m² with 96 plants for each area.

The biological material studied was the Pumpkin variety (Figure 1) purchased from the Dăbuleni Research Center for Plants Cultured on Sand (DRCPCS). The production of sweet potato shoots was carried out at the ICAR's greenhouse of the Phytotechnics discipline. When the cuttings reached a length of about 30-40 cm, they were cut and transplanted into the field.



Figure 1. Experimental field of *Ipomoea batatas* production at C.C.D.C.P.N. Dăbuleni (Image source: <http://www.cvlpress.ro/12.07.2013/centrul-de-cercetare-dezvoltare-pentru-cultura-plantelor-pe-nisipuri-dabuleni-cateva-lucruri-serioase/>).

I. batatas var. Pumpkin is an early variety that can reach maturity at the pedoclimatic conditions of our country.

Soil preparation has been done since autumn. The pre-plant was corn. Vegetable scraps were chopped and embedded in the soil by a 30 cm deep cut, with a reversible plug fitted with a jointer. Field preparation in the spring was done in April, through a rotating harrow, to favor the accumulation of precipitation until the planting, in May. The maintenance of weed-free land was achieved by applying a total herbicide prior to planting, when most germinating spring weeds are risen. Prior to planting for soil loosening a passage was made using a motocultor with a rotary harrow, incorporating previously administrated fertilizers.

Planting takes place when the length of the shoots reaches about 40 cm or at least 7 internodes. In the experimental field, the first planting took place on 19 May 2017, followed by June 2 and June 23, 2017. After the planting, a watering was performed to prevent the drying of the shoots.

During the growing season, the main works were irrigation or weed control where the black mulch was not used. Watering was carried out periodically according to the pedoclimatic conditions during the vegetation period.

The watering method used was dripping, using drip tapes with a drop of 15 cm, with a flow rate of 1.25 L/h at a pressure of 1 bar. The installation of the irrigation system was done after the formation of the billoons, the bands are placed on the top so that the planting of the seedlings is as close as possible to the drops.

Because of the clayed-sandy texture, waterings were carried out more often and with smaller amounts of water, during the dry season from August to September the watering frequency was of three days with a watering standard of about 50 m³/ha. Watering was done in the morning to prevent stress in plants due to temperature differences between irrigation water and soil temperature.

Weed control was achieved by mulching the soil with a black foil, 0.8 μ thick, which also has a soil heating effect, thus favoring the development of the roots. Weed control in variants without mulch foil was performed by hand hoeing three times, followed by rebiloning until *I. batatas* have completely covered the soil, thus stifling the growth of weeds. The most frequent weeds were annual dicotyledonate such as *Portulaca oleracea* and *Galinsoga parviflora* and less monocotyledonate, so we could not use chemical control with anti-herbicide herbicides.

I. batatas culture is little widespread in Romania so no chemical treatments for disease and pest control have been justified.

The harvesting of *I. batatas* took place on 6 October 2017, immediately after the fall of the first hoarfrost, by carefully dismantling the roots to avoid rooting or wounding roots. In order to be able to harvest *I. batatas*, the halum must be destroyed by mowing, which can then be incorporated as an important source of organic matter in the soil.

The calculations and interpretation of the results were performed according to established statistical methods such as variance analysis. For the significance of the differences, the "t" test was used with the calculation of the limit differences for significance thresholds of 5, 1 and 0.1%, as well as the Duncan multiple comparison test, in which each variant can be considered as a control for all others (ANOVA program).

During *I. batatas* growing period, the average temperature was 17.6°C. The warmest month was July with an average temperature of 21.5°C and the coldest month was October with an average temperature of 11.9°C (Table 1)

Table 1

The thermal regime during the growing season of *Ipomoea batatas* in Sanislău, Satu Mare County

<i>The months of 2017</i>	<i>Average temperatures (°C)</i>
May	15.3
June	20.0
July	21.5
August	21.0
September	16.1
October	11.9
Average temperature for May- October	17.6

Table 2 shows that the plants of the first planting period benefited during the vegetation of 320 mm, the plants of the second era of 307 mm and those of the third era of 264 mm precipitation. The need for water was completed by irrigation as previously described.

Table 2

The pluviometric regime during the growing season of *Ipomoea batatas* in Sanislău, Satu Mare County

<i>The months of 2017</i>	<i>Precipitation amount (mm)</i>
May	68
June	67
July	105
August	63
September	72
October	15
Average temperature for May-October	390

Results and Discussion. The number of roots per *I. batatas* plant is of a genetic character less influenced by the experimental factors (Table 3).

Table 3

Influence of protection method, planting period and density on the number of *Ipomoea batatas* root/ plant (Sanislău, Satu Mare County)

<i>Planting period</i>	<i>Density (plant/ha)</i>	<i>Protection method</i>	<i>No. of roots</i>	<i>%</i>	<i>Diference/significance</i>	<i>Duncan test</i>
19.05.2017	44.400	Without foil	6.33	100	Control	ABC
		With foil	7.67	121	1.33 ⁻	BC
	35.700	Without foil	8.00	100	Control	C
		With foil	6.00	75	-2.00 ⁻	ABC
2.06. 2018	44.400	Without foil	5.33	100	Control	A
		With foil	6.00	113	0.67 ⁻	ABC
	35.700	Without foil	6.33	100	Control	ABC
		With foil	5.67	90	-0.67 ⁻	AB
23.06.2018	44.400	Without foil	7.33	100	Control	ABC
		With foil	5.67	77	-1.67 ⁻	AB
	35.700	Without foil	5.33	100	Control	A
		With foil	6.67	125	1.13 ⁻	ABC
LSD (p 5%)					2.03	2.03-2.31
LSD (p 1%)					2.85	
LSD (p 0.1%)					4.03	

During the first two planting seasons (19.05.2017 and 2.06.2018) at the density of 35,700 plants/ha by applying the black mulch foil there were very significant differences in the average weight of the *I. batatas* roost. At the last season (June 23, 2018), by applying the mulching black foil to the same extent, small differences and statistically unreliable differences were identified neither by variance analysis nor by the Duncan test. At all three planting periods at 44,400 plants/ha by application of black mulch foil there were small differences in the mean weight of *Ipomoea batatas* roots, differences not statistically ensured by variance analysis and nor by the Duncan test (Table 4).

Following the study carried out under the pedoclimatic conditions at Sanislău, Satu Mare County, it was found that the average mass of an *I. batatas* root is inversely correlated with the planting density. The higher the planting density decreases the average mass of *Ipomoea batatas* root. The average weight of fresh potato roots ranged from 53.05 g to 95.51 g at the first planting date. The high average root mass was found at the first planting date (19 May 2017) at 35,700 plants/ha using black mulching foil (Table 4).

The following results were obtained as a result of the research. The highest production of *I. batatas* was obtained through the early planting of shoots in May.

Production differences were very significant in the two planting dates and in both densities used by the use of black mulching foil. By using the black mulching foil there were very significant production differences on both used densities and at the first planting dates. In the third planting period production differences are small and not statistically significant.

Table 4

Influence of protection method, planting period and density on the average weight of one root of *Ipomoea batatas* (Sanislău, Satu Mare County)

Planting period	Density (plant/ha)	Protection method	Average weight (g)	%	Diference/significance	Duncan Test
19.05.2017	44.400	Without foil	76.63	100	Mt.	e
		With foil	79.67	104	3.04 ⁻	ef
	35.700	Without foil	53.05	100	Mt.	d
		With foil	95.51	180	42.47***	f
2.06.2018	44.400	Without foil	33.52	100	Mt.	bc
		With foil	48.89	146	15.37 ⁻	cd
	35.700	Without foil	41.21	100	Mt.	cd
		With foil	76.57	186	35.29***	e
23.06.2018	44.400	Without foil	15.16	100	Mt.	a
		With foil	21.03	139	5.86 ⁻	ab
	35.700	Without foil	13.16	100	Mt.	a
		With foil	16.86	128	3.69 ⁻	ab
LSD (p 5%)					16.42	16.41-18.65
LSD (p 1%)					23.05	
LSD (p 0.1%)					32.55	

In the pedoclimatic conditions of Sanislău County Satu Mare, the highest root production of *I. batatas* was 26,795 kg/ha, at the first planting period with a density of 44,400 plants/ha with applying of black mulching foil (Table 5).

Table 5

Influence of protection method, planting season and density on *Ipomoea batatas* production (Sanislău, Satu Mare County)

Planting period	Density (pl/ha)	Protection method	Production (kg/ha)	%	Diference/significance	Duncan Test
19.05.2017	44.400	Without foil	20,593.00	100	Mt	E
		With foil	26,795.44	130	6.202,44***	F
	35.700	Without foil	15,096.67	100	Mt	D
		With foil	19,993.33	132	4.896,67***	E
2.06.2018	44.400	Without foil	7,924.45	100	Mt	C
		With foil	12,864.45	162	4.940,00***	D
	35.700	Without foil	9,161.67	100	Mt	C
		With foil	14,695.00	160	5.533,33***	D
23.06.2018	44.400	Without foil	4,760.00	100	Mt	AB
		With foil	5,271.11	111	511,12 ⁻	B
	35.700	Without foil	2,531.67	100	Mt	A
		With foil	4,015.00	159	1.483,33 ⁻	AB
LSD (p 5%)					2,332.16	2,329.9-2,674.61
LSD (p 1%)					3,273.58	
LSD (p 0.1%)					4,621.53	

pl – plant.

The results obtained in the present study are similar with those obtained by CCDCPND (2017).

According to the results of the present study and of those previously performed (Al Mayahi & Fayadh 2015; Askari et al 2012; Blas & Petrescu 2009; Ibrahim et al 2017, 2018; Motallebi-Azar & Kazemiani 2011; Slosar et al 2016) can be concluded that *I. batatas*, just like *Solanum tuberosum* and other important cosmopolite agricultural crops, is a very versatile crop plant, which can tolerate a fairly wide range of pedoclimatic conditions and produce a satisfying yield.

Conclusions

- Under the pedoclimatic conditions of Sanislău, Satu-Mare County, *I. batatas* roots of commercial size can be obtained.
- The number of roots per *I. batatas* plant is a genetic feature less influenced by the experimental factors.
- The average weight of an *I. batatas* root is inversely correlated with the planting density, the higher the planting density decreases the average mass of an *I. batatas* root.
- By applying the black mulching foil, higher yields were obtained at both densities practiced and at all three planting seasons.
- The production obtained from the early planting of *I. batatas* shoots was close to that obtained at SCDA Dăbuleni.
- The highest production (over 26,000 kg/ha) was obtained when the planting was performed in the second decade of May, at a density of 44,000 plants/ha and mulching with black foil.

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