

## RESEARCH ON THE BEHAVIOUR OF MID-LATE POTATO CULTIVARS IN THE ENVIRONMENTAL CONDITIONS OF SOUTH MUNTENIA REGION, ROMANIA

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### Abstract

*Climatic changes are known today as one of the most serious challenges of environmental, social and economic changes facing the world.*

*Agriculture is one of the most exposed domains due to its dependence on weather conditions. The main targets of breeders are to adapt the existing cultivars to climate changes and to create new cultivars with increased resistance to the significant differences of temperature and precipitations.*

*The large alternations in temperature and precipitations, which were increasingly felt in recent decades have reduced crops, therefore the identification of cultivars with genetic characteristics that provide greater adaptability has a special importance. Concluding the results of research effected during the years 2012 – 2014 at the Cultivars Testing Centre of Targoviste, where 10 potato cultivars were tested in terms of yields, drought and low temperatures resistance, the recommended cultivars in the South Muntenia region are Productiv, Speranța and Luiza. The limiting factor for the quantitative and qualitative production is the amount of water and its distribution during the growing season. It was noticed a direct proportionality between yields levels and the distribution of rainfall during the water reserves accumulation period before the culture establishment and during the growing season.*

Keywords: potato, cultivars, resistance, low temperatures, drought

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### 1. INTRODUCTION

Agriculture is one of the most exposed domains due to its dependence on weather conditions. The main targets of breeders are to adapt the existing valuable cultivars to climate changes and to create new cultivars with increased resistance to the significant differences of temperature and precipitations.

Although the cultivar is known as the most important technological link in terms of production stability, its quantity and quality are influenced by pedoclimatic conditions, diseases and pests. At present, on the agenda of the european and national deputies there are to be solved problems related to the evolution of the European Union agricultural policy on the background of food crisis, climate changes and food safety importance (Panagoreț, 2013).

Potato is a vegetable with special importance in human nutrition, animals feeding and industrial processing (Muntean et al., 1995). Potato remains one of the basic products in the

achievement of food security. Agricultural research comes to meet the challenges imposed by the global climate, social and economic changes by new strategies of cultivation, protection and storage of agricultural products (Olteanu, 2017). During the last 50 years, the average cultivated surface ranged between 250,000 and 316,000 ha (placing Romania on the second place in Europe, together with Germany, and after Poland) with an average yield of 14.5 t/ha and a total yield of 2.6-4.4 million tones (Chiru et al., 2008).

According to "Potato variety agronomy profile"(2003), Tomasiewicz et al. (2003) and Haase et al. (2005) although potato is quite adaptable to planting conditions and it is considered to be cultivatable in almost every climate and soil conditions, nevertheless, it has, as every culture, certain requirements for ecological conditions. Stability of cultivars features and quality preservation in different conditions have particular importance. Total

and graded yield and quality factors are affected by cultivar and location.

The temperature rise is smaller when changes are weighted by the potato area and particularly when adaptation of planting time and cultivars is considered (a predicted temperature rise between 1 and 1.40°C). For this period, global potential potato yield decreases by 18% to 32% -without adaptation and by 9% to 18% - with adaptation (Hijmans, 2003).

In these conditions, Romania's target would not be the overgrowth of potato production, as in the Netherlands for example, but rather the increase of the average production as uniformly as possible throughout the entire cultivated area at a yield of 25-30 t/ha (Pop-Silaghi, 2016).

The quality of its products and the economical success of this industry are highly dependent on the available potato raw materials. This means that the availability of suitable cultivars, the potato yield and quality in its various aspects during the growing season, the good post harvest (storage) performance are of utmost importance for the potato processing industry (Keijbets, 2008). Taking into account also other factors such as quality, technological and culinary qualities of the cultivar, we realize the importance that we must attach to the cultivar choice (Hermeziu and Hermeziu, 2016).

## 2. MATERIALS AND METHODS

Experiments were effected at the Cultivars Testing Centre (C.T.C) of Târgoviște, Dâmbovița county, during the years 2012 – 2014. Ten potato cultivars (white and red) were tested using the A.U.V. test (agronomic and

use value) in terms of yields, drought and low temperatures resistance. Four repetitions were effected for each cultivar and each experiment was compared to the witness cultivars.

The placement of the potato cultivars experiments was in experimental plots according to table 1.

Production of each cultivar was noted after weighing, low temperatures tolerance was estimated with grades from 1 to 7 (grade 1 when losses are below 10%, grade 7 when losses are above 50%) and drought resistance was appreciated with grades from 1 to 7 (grade 1 when 10% of the leaves have withered, grade 7 when over 50% of the leaves have withered).

## 3. RESULTS AND DISCUSSION

In the climatic conditions of 2012 (table 2) the average yield was of 29.99 kg/plot, representing 18.74 t/ha, which is considered a good production in Romania. From this point of view Speranța, Luiza and Productiv cultivars distinguished this year. Speranța cultivar obtained the highest average yield of 35.8 kg/plot (an average of over 21 t/ha), followed by Productiv cultivar with an average of 33.3 kg/plot (about 20 t/ha) and by Luiza witness with an average of 33.23 kg/plot (19.8 t/ha). The least productive cultivar in this year was Rozal with an average of only 25.88 kg/plot (15.4 t/ha).

All these productions were obtained given that from August 2011 to June 2012 there were 100 days with precipitation, resulting in a total rainfall of 524.6 l and the monthly averages of daily temperatures were of only 9,08°C.

**Table 1: Layout of the experimental plot**

| Specification                    | Mid-late potato cultivars |            |
|----------------------------------|---------------------------|------------|
|                                  | Planting                  | Harvesting |
| Plot size (m <sup>2</sup> )      | 19.3                      | 16.8       |
| Plot length (m)                  | 6.9                       | 6          |
| Plot width (m)                   | 2.8                       | 2.8        |
| Number of rows/plot              | 4                         | 4          |
| Number of mounds/row             | 29                        | 25         |
| Number of mounds/plot            | 116                       | 100        |
| Plants spacing (cm)              | 70 x 24                   | 70 x 24    |
| Density (thousands of mounds/ha) | 60                        | 60         |
| Number of repetitions            | 4+1                       | 4+1        |

**Table 2: Production data in the year 2012**

| Cultivar name | Production/plot (kg) |      |      |      | Emergence date | Resistance (grade) |         |
|---------------|----------------------|------|------|------|----------------|--------------------|---------|
|               | R1                   | R2   | R3   | R4   |                | low temperatures   | drought |
| ROBUSTA (W)   | 29.3                 | 27.6 | 28.4 | 28.1 | 9.05           | 1                  | 1       |
| CUMIDAVA (W)  | 30.4                 | 28.7 | 27.8 | 24.2 | 8.05           | 1                  | 1       |
| LUIZA (W)     | 33.2                 | 33.6 | 33.5 | 32.6 | 11.05          | 3                  | 3       |
| RUXANDRA (W)  | 33                   | 27.9 | 28.3 | 28.4 | 8.05           | 5                  | 3       |
| ARMONIA       | 28.5                 | 26.4 | 27.8 | 27.5 | 9.05           | 5                  | 5       |
| IOANA         | 28.8                 | 29.5 | 29.2 | 28.2 | 8.05           | 3                  | 3       |
| ROZAL         | 26.9                 | 26.5 | 25.8 | 24.3 | 9.05           | 3                  | 3       |
| SPERANTA      | 34.5                 | 36.3 | 37.2 | 35.2 | 8.05           | 1                  | 5       |
| PRODUCTIV     | 33.4                 | 33.9 | 34.2 | 31.7 | 9.05           | 1                  | 3       |
| WHITE LADY    | 31.2                 | 29.9 | 29.4 | 28.6 | 11.05          | 3                  | 5       |

Note: W – witness cultivar

Although it was a pretty cold year for potato production, as mentioned above, the tested cultivars had good yields.

Regarding the correlation between the emergence date and the low temperatures and drought tolerance we can highlight the following: cultivars that emerged first (on 08.05) Speranța, Ioana, and also Cumidava and Ruxandra witnesses behaved as follows: Cumidava witness presented a good resistance both at low and high temperatures while the other cultivars had variable behaviour (for example Speranța showed good resistance at low temperatures, and weak resistance at drought).

Cultivars that emerged last (Luiza witness and White Lady) had moderate resistance both at negative temperatures and at those which exceeded 30<sup>0</sup>C in the summer.

Cultivars behaved differently this year in terms of low temperatures resistance. Speranța and Productiv had under 10% production losses, same as Robusta and Cumidava witnesses. Losses between 10% and 25% had Ioana, Rozal and White Lady cultivars, but also Luiza witness. The weakest cultivars at low temperatures this year were Armonia and Ruxandra witness with production losses between 25 and 50%.

Only Robusta and Cumidava witnesses behaved very well in terms of drought

resistance, being marked with grade 1 - grade for under 10% withered foliage. The other two witnesses (Luiza and Ruxandra), Ioana, Rozal and Productiv cultivars, suffered losses of 25% of the foliage due to drought. The highest losses of foliage due to drought had Armonia, Speranța and White Lady with 50% withered foliage.

As shown in table 3 analysis, in the year 2013 the average yield of the tested cultivars was of 32.45 kg/plot, representing 19.32 t/ha, with 0.6 tons more than in the previous year, which is considered a good to very good production in the country.

Productiv and Ioana cultivars together with Cumidava witness distinguished this year in terms of production. The Productiv cultivar had the highest average yield, of 42.45 kg/plot (an average of over 25 t/ha), followed by the Cumidava witness with an average of 40.63 kg/plot (about 24 t/ha) and Ioana cultivar with an average of 35.63 kg/plot (21 t/ha). This year the less productive cultivars were White Lady with an yield of only 25.25 kg/plot (15 t/ha) and Luiza witness with an yield of 26.28 kg/plot (15.6 t/ha).

All these productions were recorded given that from August 2012 to June 2013 there were 111 days with precipitation, with only 11 days more than in the same period of the previous agricultural year resulting a total of 579.7 l

**Table 3: Production data in the year 2013**

| Cultivar name | Production/plot (kg) |      |      |      | Emergence date | Resistance (grade) |         |
|---------------|----------------------|------|------|------|----------------|--------------------|---------|
|               | R1                   | R2   | R3   | R4   |                | low temperatures   | drought |
| ROBUSTA (W)   | 31.9                 | 33.9 | 32.8 | 33.3 | 13.05          | 1                  | 1       |
| CUMIDAVA (W)  | 40.9                 | 41.6 | 39.7 | 40.3 | 10.05          | 1                  | 3       |
| LUIZA (W)     | 26.4                 | 27.3 | 25.6 | 25.8 | 13.05          | 1                  | 3       |
| RUXANDRA (W)  | 32.7                 | 33.1 | 33.3 | 31.7 | 09.05          | 3                  | 3       |
| ARMONIA       | 32.6                 | 32.9 | 32.7 | 31.9 | 09.05          | 3                  | 3       |
| IOANA         | 35.8                 | 34.9 | 35.7 | 36.1 | 13.05          | 1                  | 3       |
| ROZAL         | 28.5                 | 29.3 | 28.5 | 27.9 | 10.05          | 1                  | 1       |
| SPERANTA      | 27.6                 | 25.9 | 28.6 | 28   | 17.05          | 3                  | 1       |
| PRODUCTIV     | 42.3                 | 41.7 | 42.6 | 43.2 | 13.05          | 1                  | 3       |
| WHITE LADY    | 25.8                 | 24.7 | 25.3 | 25.2 | 10.05          | 3                  | 1       |

Note: W – witness cultivar

precipitation, with only 55.1 l more than in the previous year. The monthly averages of daily temperatures were of only 10,24<sup>0</sup>C during this period.

We can conclude that only a few more rainy days and a few more degrees than in the previous year have made productions to grow to a good level for our country.

This year all cultivars had better behaviour than in the previous year in terms of resistance at low temperatures and drought, this aspect being underlined by the obtained yields.

Losses below 10% had three varieties and three witnesses (Ioana, Rozal, Productiv cultivars, Robusta, Cumidava and Luiza witnesses). Losses between 10% and 25% had Armonia, Speranța and White Lady cultivars and Ruxandra witness. Losses exceeding these percentages have not been registered this year compared to the previous one when two cultivars had 50% losses.

Robusta witness together with Rozal, Speranța and White Lady cultivars showed very good behavior in terms of resistance to drought, being marked with grade 1 - grade for under 10% withered foliage. The other three witnesses (Cumidava, Luiza and Ruxandra) together with Armonia, Ioana and Productiv cultivars suffered losses due to the drought of 25% of the foliage. There were not losses of 50% or more compared to the previous year.

In the year 2014 (table 4) the average yields were of 45.55 kg/plot, representing 27.11 t/ha, with 13.1 tons more than in the previous year and with 13.7 t more than in the first year of experiments, wich is a very good production in Romania.

In this last year of experiments all cultivars showed better resistance than the previous year in terms of low temperatures and drought resistance, this aspect being underlined by the obtained yields. Absolutely all cultivars and all witnesses had losses below 10% due to negative temperatures. Also, in terms of drought resistance, all witnesses and all cultivars had below 10% withered foliage.

#### 4. CONCLUSIONS

The limiting factor for the size of quantitative and qualitative production is the amount of water and its distribution during the growing season. It was observed a direct proportionality between the production level and the distribution of rainfall during the accumulation of water reserves, before the establishment of culture and during the growing season.

The climate in the three years of testing has not deviated from multiannual media, this constancy showing positive effects on production potential of cultivars.

**Table 4: Production data in the year 2014**

| Cultivar name | Production/plot (kg) |      |      |      | Emergence date | Resistance (grade) |         |
|---------------|----------------------|------|------|------|----------------|--------------------|---------|
|               | R1                   | R2   | R3   | R4   |                | low temperatures   | drought |
| ROBUSTA (W)   | 49.4                 | 48.6 | 47.5 | 48.3 | 28.04          | 1                  | 1       |
| CUMIDAVA (W)  | 38.5                 | 37.6 | 36.9 | 38.4 | 28.04          | 1                  | 1       |
| LUIZA (W)     | 56.3                 | 57.1 | 55.4 | 56.1 | 28.04          | 1                  | 1       |
| RUXANDRA (W)  | 36.7                 | 35.9 | 35.7 | 36.3 | 28.04          | 1                  | 1       |
| ARMONIA       | 44.6                 | 43.9 | 43.6 | 44.4 | 01.05          | 1                  | 1       |
| IOANA         | 43.5                 | 43.1 | 42.7 | 42.3 | 28.04          | 1                  | 1       |
| ROZAL         | 49.9                 | 47.6 | 48.3 | 47.2 | 28.04          | 1                  | 1       |
| SPERANTA      | 48.5                 | 47.6 | 47.9 | 48.1 | 28.04          | 1                  | 1       |
| PRODUCTIV     | 49.3                 | 49.6 | 48.9 | 47.9 | 05.05          | 1                  | 1       |
| WHITE LADY    | 44.5                 | 45.2 | 44.2 | 44.7 | 02.05          | 1                  | 1       |

Note: W – witness cultivar

Production was growing from one year to another, as well as rainfall.

All tested cultivars and witnesses had high yields but Productiv cultivar, Speranța and Luiza witness distinguished by higher yields than the other cultivars.

From the climatic perspective, only two of the three experimental years, can be considered very favorable for potato cultivation (2013 and 2014), the year 2012 being characterized as the most warm and dry year in the last 52 years. This was because the average monthly temperature from June to August was higher by 4<sup>0</sup>C and the amount of monthly precipitation in the same period compared to the annual average of the last 52 years was 51.83% lower. Given the observations effected, the high and constant yields in different conditions of drought and low temperatures, the recommended cultivars in the climatic conditions of the South Muntenia region are Productiv, Speranța and Luiza.

## 5. REFERENCES

- [1]. Chiru S.C., Olteanu Gh., Asanache L.E - History, statistics and trends in romanian potato industry - Potato for a Changing World, Annals of National Institute of Research and Development for Potato and Sugar Beet (INCDCSZ) Braşov, 2008, ISSN 1016-4790
- [2]. Haase T., Krause T., Haase N. U., Böhm H., Loger R., Heß J., Effect of location and cultivar on yield and quality of organic potatoes for processing to crisps, Abstracts of Papers and Posters II of 16th Triennial conference of the EAPR, Bilbao, 2005, 699 –703.
- [3]. Hermeziu M., Hermeziu R. - Asigurarea producţiei de cartof prin diversificarea sortimentului de soiuri româneşti, vol. 25, 2016, pp. 77
- [4]. Hijmans R.J. – The effect of climate change on global potato production, vol. 80 (4), 2003, pp. 271-279
- [5]. Keijbets M., Potato processing for the consumer: developments and future challenges, Potato for a Changing World, Annals of National Institute of Research and Development for Potato and Sugar Beet (INCDCSZ) Braşov, 2008, ISSN 1016-4790
- [6]. Muntean L. S., Borcean I., Axinte M., Roman V. G. – Fitotehnie, Editura Didactică și Pedagogică, R. A., Bucureşti, 1995
- [7]. Panagoreţ I. - The Common Agricultural Policy and the Current Food Crisis, Ştiinţe Sociale, Politice și Umaniste, Bucureşti, Universitatea Titu Maiorescu, vol. 2, 2013, pp. 75 - 81
- [8]. Pop-Silaghi V. - Câteva reguli de bună practică agricolă în cultura cartofului, Cartoful in Romania, vol. 25, 2016, pp. 46.
- [9]. Olteanu G., Anul 2017 – an de referință pentru cercetarea la cartof, Cartoful in Romania, vol. 25, 2016, pp. 91
- [10]. Tomasiewicz D., Harland M., Moons B.. Irrigation. Guide to Commercial Potato Production on the Canadian Prairies. Western Potato Council of Canada, 2003, 55–60.
- [11]. Potato variety agronomy profile, Crop Monitor, College of Agriculture, Food and Rural Enterprise. I. 8: 1 – 8. 2003.