

# MARSHMALLOW YIELD DEPENDING ON PLANT DENSITY AND YEAR OF UTILIZATION

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**Key words:** marshmallow; plant density; prinos korena; prinos droge.

**Abstract:** Field experiment with one-year and two-years old plant were conducted with *split-plot* method in four repetition, in Mošorin, and following factors were tested: effects of different nitrogen doses (0, 50, 80, and 120 kg N/ha), inter-row spacing (20, 30, 40, and 50 cm) at the same row space (50cm), and different aspects of reproduction (direct sowing on the field and production from seedlings) were investigated. Two Serbian cultivars were examined – one from Bački Petrovac and another from Pančevo.

Drug yield (*Altheae radix*) in the experiment ranged between 3071 and 4867 kg/ha for one-year marshmallow (in 2006), and between 4548 and 6514 kg/ha for two year marshmallow (2007). In average, the highest drug yield was achieved with plant spacing of 20 cm and was significantly higher in comparison to other spacings. The yield of two-year marshmallow was for 1665 kg/ha higher than the yield of one-year marshmallow. At every tested parameter, there was a tendency of linear yield increasing with reduction of spacing between plants in row. For each 10 cm of reduction in spacing between plants in row, the drug yield increased for 610 kg in case of one-year plants. As for two-years marshmallow, the drug yield increased for 649 kg with every 10 cm of reduction in spacing between plants in row.

## Introduction

The use of medicinal, aromatic and spice plants as raw material in pharmaceutical, cosmetic and food industry is increasing. The quality of herbal raw material varies due to different climatic and soil factors. There is also a risk of endangering certain uncultivated species as well as a risk of impoverishment of natural resources due to unrestricted collecting. One of such plants is the white marshmallow which has been protected since 2005 by Statute on control of exploitation and distribution of uncultivated flora and fauna. (The Official Herald of Republic of Serbia, 31/2005)

Marshmallow has been used in tradicional European medicine for over 2000 years (Leung & Foster, 1996). Today we used marshmallow root in folk medicine, and also in official medicine. Serbian pharmacopeia (Ph. Jug. V, 2000) and the most other countries in the world (Ph. Eur 5, DAB 10, BHP 1996, ÖAB 2004) prescribed root (*Altheae radix*) for therapeutic uses for treating coughs and bronchitis. In marshmallow root contain mucilage (up to 40%), starch, pectin, sugars etc.

Serbia is big consumer and exporter of marshmallow root, because this plant is commonly almost at all regions, especially on moist soils, beside rivers Danube and Tisa. Atmost dispersion of marshmallow is in Vojvodina (Kojić et al., 1999; Markoš et al., 2001), but we also met this plant in high region up to 800m (Tucakov & Lukić, 1958; Stamenković, 1993; Stanojević, 1995).

Tucakov (1970) observe that marshmallow wasnt grown in Yugoslavia region till 70th years of last century, when was bring seed from Belgium, France

and Netherland, and from different places in Vojvodina, with tendency to elaborate variety with a lot of mucilage. In Serbia today we have one variety – Vojvodinian marshmallow (Sort list, 2002), and multiplication is on two locality: Pancevo i Backi Petrovac.

### **Material and methods**

Field experiment with one-year and two-years old plant were conducted with *split-plot* method in four repetition, in vilage Mošorin, which is located in South Bačka region, 30 km north-west from Novi Sad (45° 18' N, 20° 9' E). ). The location is found on the righ bank of the river Tisa, along which the natural habitat of the tested species is situated. The type of soil on which the experiment was performed was calcareuos chernozem soil type with good physical, chemical and biological properties.

Generally temperatures in South Bačka region is about 11°C, and precipitation per year is 602 mm (in vegetation period 17,8°C i 346 mm).

Field experiment with marshmallow plants were conducted with *split-plot* method in four repetition, and the following factors was tested: effects of different nitrogen doses (0, 50, 80, and 120 kg N/ha), with invariable quantity of phosphorus and potassium (80 kgP<sub>2</sub>O<sub>5</sub>ha<sup>-1</sup> i 100 kgK<sub>2</sub>Oha<sup>-1</sup>); inter-row spacing (20, 30, 40, and 50 cm) at the same row space (50cm), i.e. plant density (100.000, 66.667, 50.000 i 40.000 plants/ha) and different aspects of reproduction (direct sowing on the field and production from seedlings). The object of investigation was two domestic marshmallow varieties from Backi Petrovac and from Pancevo.

The experimental plots were divided into two halves, whereby one half was extraction in October 2006 (one-year old marshmallow plants), and another half was assigned for a two-years experiment (extraction in October 2007)

When extracted, the quantity of fresh root has been established (natural yield – unpeeled root with heads and remains of soil), the quantity of fresh peeled root (root prepared for drying – peeled and without heads), the mass of completely dried root (marshmallow drug).

### **Results**

In average, as well as in both tested years, the yield of whole unpeeled root (tab.1) decreased as the spacing between plants in row increased. In avewage years the highest yield of unpeeled root (31994 kg/ha) was achieved with a 20 cm spacing between plants in row, and difference was statistically significant in relation to other spacings between plants. Allso, significant difference was between 30 cm comparing with greater space between plants, till between 40 cm and 50 cm wasn't determinated yield difference.

Equivalantly regularity like in average, we can observe in 2006 and 2007 year, herewith in 2007 we have statistically significant difference between 40 cm and 50 cm spacing between plants. From table 1 we can see that yield in 2007 year was higher for 8577 kg in compare to 2006, what is rational because tested plants was two-years old.

Table 1

Influence of different space between plants in row on yield of marshmallow root and drug.

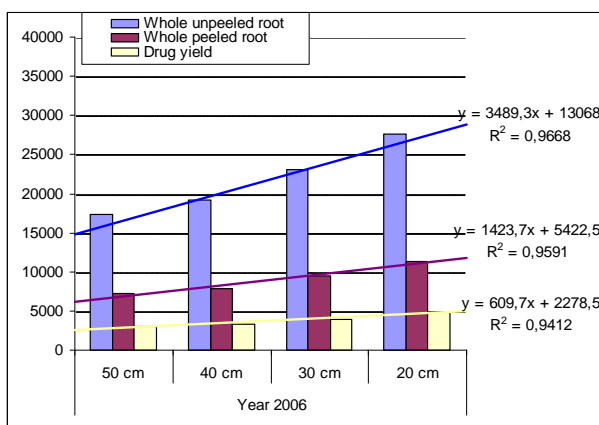
| Space between plants in row | The yield of whole unpeeled root (kg/ha) |       |         | The yield of whole peeled root (kg/ha) |       |         | Drug yield (kg/ha) |      |         |
|-----------------------------|--|-------|---------|--|-------|---------|--------------------|------|---------|
|                             | 2006                                     | 2007  | Average | 2006                                   | 2007  | Average | 2006               | 2007 | Average |
| <b>20cm</b>                 | 27657                                    | 36330 | 31994   | 11385                                  | 16273 | 13829   | 4867               | 6514 | 5691    |
| <b>30cm</b>                 | 23050                                    | 31871 | 27461   | 9516                                   | 14372 | 11944   | 3991               | 5699 | 4845    |
| <b>40cm</b>                 | 19123                                    | 28205 | 23664   | 7822                                   | 12666 | 10244   | 3282               | 5108 | 4195    |
| <b>50cm</b>                 | 17335                                    | 25065 | 21200   | 7204                                   | 11282 | 9243    | 3071               | 4548 | 3810    |
| Average                     | 21791                                    | 30368 | -       | 8982                                   | 13648 | -       | 3803               | 5467 | -       |
| LSD <sub>0,05</sub>         | 2400                                     | 2854  | 2627    | 1357                                   | 1006  | 1182    | 520                | 333  | 427     |
| LSD <sub>0,01</sub>         | 3218                                     | 3827  | 3523    | 1820                                   | 1348  | 1584    | 698                | 446  | 572     |

The yield of whole peeled root contains weight after primary processing (removing ground and other uncleanness, thin roots and heds). The highest yield of whole peeled root was achieved with a minimal spacing between plants in row (13829 kg/ha), whereby yield in this version was significantly higher comparing to others. Also, the yield obtain with 30 cm spacing between plants was significantly higher comparing 40 cm and 50 cm, but between plots with 40 cm and 50 cm wasn't significantly. Observing individually years proves the same regularity like yield of whole unpeeled root. Compared to the one-year marshmallow the two-year marshmallow had higher yield of raw peeled root for 4664 kg/ha. According to exposed we can see linear decrease root yield with increasing spacing between plants in row (graf 1 and 2).

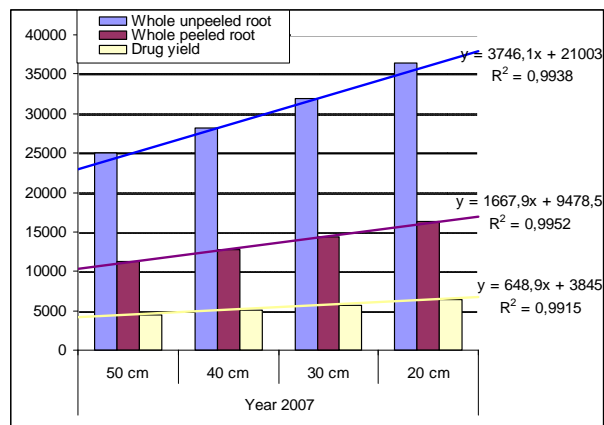
The most important parameter is drug yield (*Altheae radix*), which in the experiment ranged between 3071 and 4867 kg/ha for one-year marshmallow (in 2006), and between 4548 and 6514 kg/ha for two year marshmallow (2007). In average, the highest drug yield was achieved with plant spacing of 20 cm and was significantly higher in comparison to other spacings. Like as previously testing parameters, 30 cm spacing between plants in row, drug yield was statistically significant comparing to 40 and 50 cm, but between 40 and 50 cm wasn't determined statistically significant difference for drug yield. The yield of two-year marshmallow was for 1665 kg/ha higher than the yield of one-year marshmallow.

As we already underline at every tested parameter (whole unpeeled root, whole peeled root, drug), there was a tendency of linear yield increasing with reduction of spacing between plants in row (graf 1 and 2). Possibly the high yield is because in high plant density root branching is less, and this is reflection for less dropping during peeling. For each 10 cm of reduction in spacing between plants in row, the yield of unpeeled root was increased for 3489 kg/ha, yield of peeled root for 1424, and the drug yield increased for 610 kg in case of one-year plants (graf 1).

As for two-years marshmallow, yield of unpeeled root was increased for 3746 kg/ha, yield of peeled root for 1668 kg, and the drug yield increased for 649 kg with every 10 cm of reduction in spacing between plants in row (graf 2).



Graph 1: Yield of marshmallow root and drug in 2006 year.



Graph 2: Yield of marshmallow root and drug in 2007 year

### Conclusions

- In average, as well as in both tested years, the yield of whole unpeeled root decreased as the spacing between plants in row increased. The highest yield of unpeeled root (31994 kg/ha) was achieved with a 20 cm spacing between plants in row.
- The highest yield of whole peeled root was achieved with a minimal spacing between plants in row (13829 kg/ha). Compared to the one year marshmallow the two year marshmallow had higher yield of raw peeled root for 4664 kg/ha.
- Drug yield (*Altheae radix*) in the experiment ranged between 3071 and 4867 kg/ha for one-year marshmallow (in 2006), and between 4548 and 6514 kg/ha for two year marshmallow (2007). In average, the highest drug yield was achieved with plant spacing of 20 cm and was significantly higher in comparison to other spacings. The yield of two-year marshmallow was for 1665 kg/ha higher than the yield of one-year marshmallow.
- At every tested parameter, there was a tendency of linear yield increasing with reduction of spacing between plants in row. For each 10 cm of reduction in spacing between plants in row, the drug yield increased for 610 kg in case of one-year plants. As for two-years marshmallow, the drug yield increased for 649 kg with every 10 cm of reduction in spacing between plants in row.

### Acknowledgements

This research is a part of the project „Modern approach to cultivation technology of medical plants with retrospect at the most important pathogens in Vojvodina and Romanian part of Banat“. Project is financially supported by the Provincial Secretary for Science and Technological Development of the Vojvodina province.

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