

## The purple coneflower's (*Echinacea purpurea* L.) nutrient requirements investigation in a small plot trial

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### SUMMARY

During our research, we investigated the purple coneflower's (*Echinacea purpurea* L.) drug yield and drying loss change with different fertilization settings in a small-plot trial. We measured the raw and dry drug yield, which we harvested in 2016 and in 2017, as well as the drying loss of these yields. Harvest and all other works were performed manually. We dried the harvested herba under preumbra for three weeks. Based on the obtained data, every fertilization settings' yield was less than that of the control plots in 2016. We measured the highest drying loss in relation to the  $N_{60}P_{80}K_{120}$  supply in this year. In 2017, we measured the highest yield data in the  $N_{75}P_{100}K_{150}$  fertilization setting.

We made single-factor variance analysis to investigate the connection between the quantity of the raw, the dried herba, the drying loss and the different nutrient settings.

**Keywords:** herb, nutrient supply, purple coneflower

### INTRODUCTION

The cultivation and use of medicinal plants nowadays is a re-discovered research field. When, the interest and the demand is growing after the medicinal plants' using and production, and the phytotherapy is getting more emphasis again in traditional medicine (Nagy 1994). There is an increasing need to develop modern, species and variety specific methods of nutrient supply that ensure profitable yields and in the same time the directives of the European Union about quality assurance and environmental protection must be complied too (Zámboriné et al. 2010). Herb's cultivation contains different species with different nutrient requirements and that beliefs are incorrect, the herbs are not undemanding (Zámboriné 2010). There are many uncertainties in the herbs specific nutrient requirements (Valkovszki 2011).

The purple coneflower found in eastern and central United States, meadows and prairies (Meuninck 2016). It is a perennial herbaceous plant. Three species known in traditional and modern medicine are, the *E. purpurea* L. (spread in wet climatic hilly areas), the *E. angustifolia* L. and the *E. pallida* L. the typical plants of the prairie. Many hybrid varieties known as ornamental plants, these can be vegetatively grown. Its breded variety in Hungary the „Indián” was made especially for medicinal use (Bernáth et al. 2000).

The drug for all three species are the herb (*Echinaceae purpureae herba*, *Echinaceae angustifoliae herba*, *Echinaceae pallidae herba*), and the root (*Echinaceae purpureae radix*, *Echinaceae angustifoliae radix*, *Echinacea pallidae radix*) (Pluhár et al. 2012).

In folk medicine in India, the root (radix) used as an antivenin. In Italy the dried leaf hot water extract has taken orally for inflammations (Ross 2001). In the United States of America there are many usage modes. Some of the excited examples, the root and flowers

(flos) used as a snakebite treatment, the mashed plant was applied to wounds, and as a therapy for infections, and root infusion once considered a treatment for gonorrhoea (Meuninck 2016).

In modern medicine Clinical research in 2015 reports that a proprietary combination of a concentrated *Echinacea* herb and root extract is as effective as the conventional antiviral medicine oseltamivir (Tamiflu) when used early in the treatment of influenza (Raus et al. 2015).

The WHO keeps clinical data, which have been substantiated the root can be used for respiratory, tramadol infections and healing cold. The herba used for inflammatory skin diseases, and wound healing. In traditional folk medicine it was used for fungal infections, radiation treatments and food poisoning (WHO 1999).

The active ingredients of the coneflower's commercially available formulations are polysaccharides and alkyl amides. These ingredients with enhance the functioning of the immune system, has antiviral and antibacterial, wound healing and inflammatory effect (Babulka 1998).

For horses, this plant is one of the most effective immune system amplifier feed supplement (Marton 2005).

This plant's cultivation is 2–3, or 4 years long. It could be reproducible with sowing on place, division, or seedling. The coneflower's horticultural variants mostly are hybrids, so they could be reproducible vegetatively (Bernáth et al. 2000).

In the case of the autumn seedling could not be expected significant yield. Only the 30% of the stems develop a blooming stem. It is a better option, when the plants get place in May and were outstanding in the following year in growth and yield too (Praszna et al. 1992).

Under an investigation in 2008, in the herba's active ingredients does not made significant change

the use of different nitrogen forms. In the same time in the case of the nitrate addition higher amounts of chlorogenic acid, echinoid, cinnamon acid and chicory acid have been detected than in the leaf (Montanari et al. 2008).

Neither the *Echinacea pallida*'s, nor the *Echinacea purpurea*'s biomass production nor the measured active ingredients does not show significant differences under different compositions of NPK nutrient supply in 2003 (Dufault et al. 2003).

The *Echinacea purpurea* has a proved positive reaction for the organic fertilizers and the fertilizer dosing with the mass of the green herba, and the root, but in the same time, the percentage distribution of the different plant parts does not significantly affected (Dambrauskienė and Karklelienė 2009).

In an organic fertilizer experiment with different coneflower species the highest amount of organic fertilizer applied had the highest achieved dry herb production, but in the same case the highest measured caffeic acid content was not in this setting. This confirms the assumption that different nutrient supply may be needed for the production of different active ingredients in herbs (Drutu et al. 2013).

**MATERIAL AND METHODS**

Our experiment for the purple coneflower research took place in the experiment site of the University of Debrecen, Institute of Crop Sciences. The experimental place's soil is chernozem. It is characterized by the accumulation of humus and easy tillage. The forecrops were potato and sunflower. In the previous year, before our research could be planned, the regular annual nutrient dosages were spread on the land. This nutrient supply necessarily affected the yield in the years of the harvest.

In 2016 the rainfall from 1<sup>st</sup> January to 31<sup>th</sup> August was considerably more (574.9 mm) than the 30 year average. From the 1<sup>st</sup> January to 31<sup>th</sup> August in 2016, the measured monthly mean temperature was higher than the 30 year average. In 2017 the precipitation remained below the 30 year average. This was particularly perceptible in May when it was more than 30 millimeters "missing" compared to the average

precipitation. However, the monthly measured mean temperature exceeded the 30 year average.

The used plot size in our investigation was 8 m<sup>2</sup>. The plots were arranged in 4 replicates in randomized blocks, with 6 different fertilizer treatment levels. The planting happened in 4 rows with 40 cm row space. The fertilizer dosages of the experiment were spread manually. The fertilizer doses (N%, P<sub>2</sub>O<sub>5</sub>%, K<sub>2</sub>O%) were:

- N<sub>0</sub>P<sub>0</sub>K<sub>0</sub> (control)
- N<sub>15</sub>P<sub>20</sub>K<sub>30</sub>,
- N<sub>30</sub>P<sub>40</sub>K<sub>60</sub>,
- N<sub>45</sub>P<sub>60</sub>K<sub>90</sub>,
- N<sub>60</sub>P<sub>80</sub>K<sub>120</sub>,
- N<sub>75</sub>P<sub>100</sub>K<sub>150</sub>.

Sowing was 30<sup>th</sup> March in 2015 into seedling trays. The first plants were emerged 7<sup>th</sup> April. The planting were between 18<sup>th</sup> and 21<sup>st</sup> May. The first harvest of the herba was 4<sup>th</sup> July in 2016. The second harvest was 10<sup>th</sup> July in 2017.

We measured the harvested herba drug yield which, in this case, was the quantity of the raw and the dry drug. Gathering was done manually. We dried the harvested coneflower herba under preumbra for three weeks.

During processing of the gained data, variance analysis was applied by using MS Excel 2010 and IBM SPSS 22.0 programs.

**RESULTS AND DISCUSSION**

Figure 1 shows the quantity of the raw herba drug yield of the investigated coneflower depending on the nutrient supply in 2016. The control setting exceeded all nutrient settings' results. The mass of the raw herba decreased continuously, and reached the minimum in the N<sub>60</sub>P<sub>80</sub>K<sub>120</sub> fertilization setting.

We made single-factor variance analysis to investigate the connection between the quantity of the raw and the dry herba, the drying loss and the different nutrient settings. We did not find significant differences between the currently available data of the plots of different nutrient supply levels. It is possible the reason is the great standard deviation between the repetitions.

Figure 1: Quantity of the coneflower raw drug yield depending on the nutrient supply in 2016 (Debrecen, 2016)

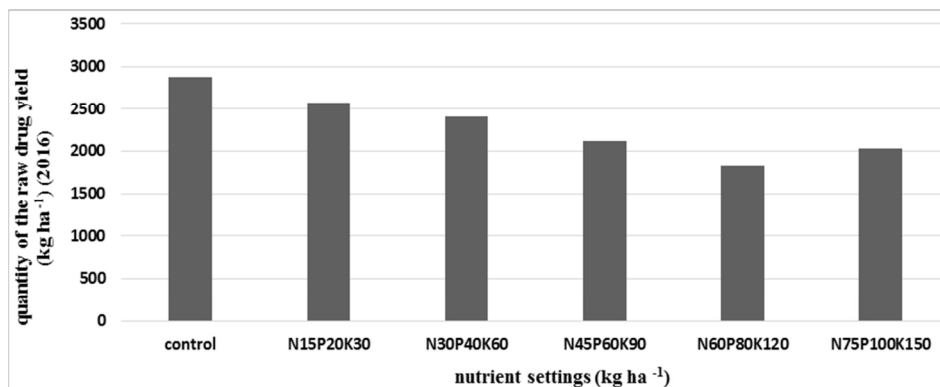


Figure 2 shows the quantity of the dried herba drug yield depending on the nutrient supply in 2016. The coneflower's control setting exceeded all nutrient settings' yield results, such as in the case of the raw yield. The mass of the dried drug decreased from the control setting, and also reached the minimum in the N<sub>60</sub>P<sub>80</sub>K<sub>120</sub> setting.

Figure 3 demonstrates the drying loss of the coneflower's herba produced with the different nutrient settings. The highest value of the loss occurred in the N<sub>60</sub>P<sub>80</sub>K<sub>120</sub> plots, followed by the N<sub>30</sub>P<sub>40</sub>K<sub>60</sub>, and the N<sub>45</sub>P<sub>60</sub>K<sub>90</sub>. The lowest drying loss was detected in the nutrient level N<sub>75</sub>P<sub>100</sub>K<sub>150</sub>, overtaken the control group.

Figure 2: Quantity of the coneflower dried drug yield depending on the nutrient supply in 2016 (Debrecen, 2016)

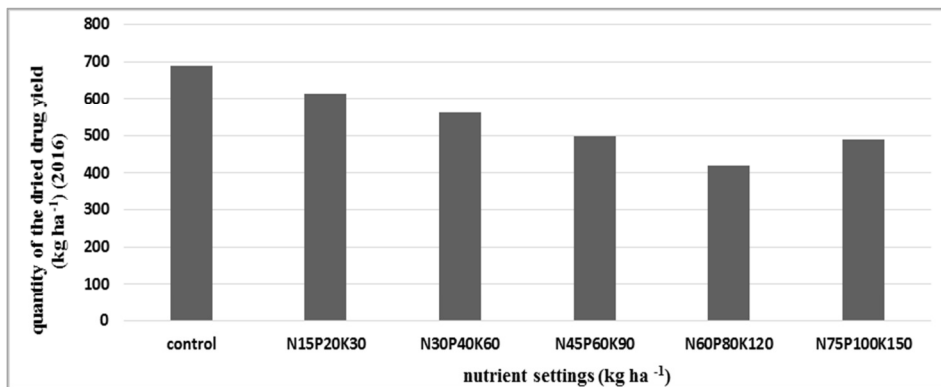


Figure 3: Drying loss of the drug yield of purple coneflower depending on the nutrient supply in 2016 (Debrecen, 2016)

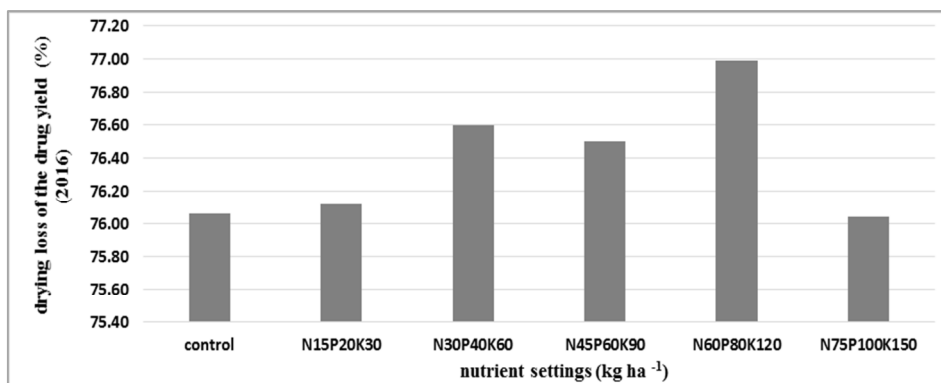


Figure 4 shows the quantity of the raw drug yield of the purple coneflower depending on the applied nutrient settings in 2017. The mass of the herba increased from the least nutrient dose, and reached the maximum in the N<sub>75</sub>P<sub>100</sub>K<sub>150</sub> fertilization setting. The control reached the lowest amount of yield.

On Figure 5 can be observed the quantity of the dried coneflower drug yield depending on the nutrient supply in 2017. Such as in the case of the raw yield, the control setting reached the minimum, and with the yield's increasing, we measured the biggest dried mass in the N<sub>75</sub>P<sub>100</sub>K<sub>150</sub> setting.

Figure 4: Quantity of the coneflower raw drug yield depending on the nutrient supply in 2017 (Debrecen, 2017)

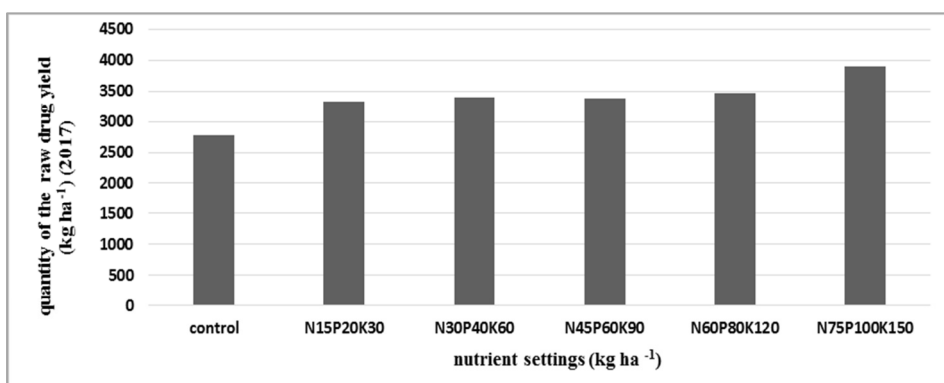


Figure 5: Quantity of the coneflower dried drug yield depending on the nutrient supply in 2017 (Debrecen, 2017)

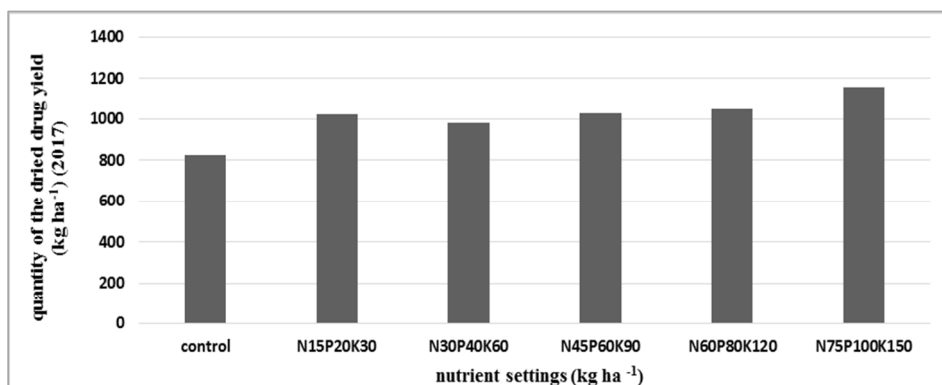
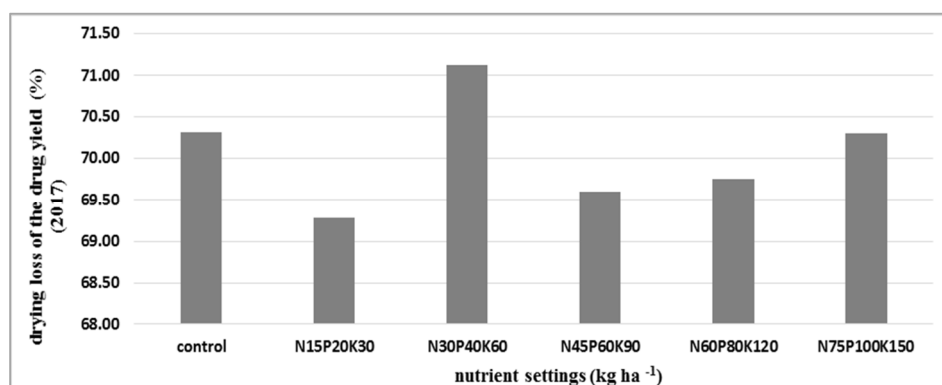


Figure 6 demonstrates the drying loss of the herba drug yield with the different nutrient settings. The highest value of the loss occurred in the N<sub>30</sub>P<sub>40</sub>K<sub>60</sub> plots, followed by the control, and the N<sub>75</sub>P<sub>100</sub>K<sub>150</sub>. The lowest drying loss was detected in the nutrient level N<sub>15</sub>P<sub>20</sub>K<sub>30</sub>.

Figure 6: Drying loss of the drug yield of purple coneflower depending on the nutrient supply in 2017 (Debrecen, 2017)



## CONCLUSION

As for the raw and the dried drug yield, each nutrient setting was underlined the control setting in 2016. In contrary to these results, in 2017, the N<sub>75</sub>P<sub>100</sub>K<sub>150</sub> nutrient setting has the biggest, and the control group has the least raw and dried herba drug yield. Based on our data, in our opinion the different weather conditions of the two examined years could have led to the conflicting results in the raw and dry drug mass.

In terms of the drying loss, the lowest value was reached by the N<sub>75</sub>P<sub>100</sub>K<sub>150</sub> and the highest was produced by the N<sub>60</sub>P<sub>80</sub>K<sub>120</sub> treatment in 2016. In 2017

we measured the highest loss in the N<sub>30</sub>P<sub>40</sub>K<sub>60</sub>, and the lowest value in the N<sub>15</sub>P<sub>20</sub>K<sub>30</sub> settings.

The variance analysis of the data of the raw and dry herba drug mass and the drying loss did not show significant differences between the plots with different fertilizer treatments.

For the sake of clarity, more research work is needed to clear up the complex connections between quantity of the coneflower herba drug, its drying loss and the effect of the different nutrient settings.

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