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TWO GROWN HERBS' DRUG YIELD CHANGES UNDER DIFFERENT FERTILIZATION SETTINGS IN SMALL PLOT TRIAL

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Abstract. *While we investigated the summer savory's (Satureja hortensis L.) and the marigold's (Calendula officinalis L.) nutrient requirements in small-plot trial we measured the drug yield, which we harvested in 2015 and in 2016.*
It was concluded, based on the results, in 2015 the biggest marigold drug yield in the N30P40K60 fertilization setting and in 2016 in the N75P100K150 setting were measured. The savory's yield in 2015 in the N30P40K60, and in 2016 in the N60P80K120 settings were the biggest.
Thanks to the multiple picking the data we got with harvesting of the marigold, we investigated the effect of the different fertilization settings the flower drug's changes over time. The drug crop's change over time could show how many times it is economical to harvest under different fertilization settings.

Keywords: herb, drug, fertilization, marigold, savory

1. Introduction

Many connections had been woven between plants and humankind. The plants and their healing capabilities are here and were in the medicine, meal, science, cosmetology, and in various art forms. In the XXIth century, the phytotherapy in given cases already recognized priority, besides it is getting more and more emphasis in medicine [1].

Herb's cultivation contains different species with different nutrient requirements. The herbs are not undemanding, this statement is incorrect [2]. The cultivation and within that the nutrient requirement of the medicinal plants is a very new re-discovered field in the scientific research. The growers need new, economically and even intensively growable medicine plant species, and modern connecting agrotechnic, to could be compete the world markets [3]. There are many uncertainties which make more difficult determine the nutrient requirements of herbs [4].

According to recent researches, the different fertilization settings has not got significant influence on the marigold's flavonoids [5].

Under our research we analysed the nutrient requirements and fertilizer reactions of herbs, such as the marigold and the summer savory according to the change in the drug yield, as an effect of the different nutrient dosages.

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The marigold (*Calendula officinalis L.,* marigold, gold-bloom, Chinese safflower and the summer savory are mediterranean annual plants [6], [7]. For the marigold it's flower (with or without sepal), for the savory, it's the flowering herba gathered as a drug [7], [8].

The marigold is slightly laxative and spasmolytic, but due to it's high E vitamin content it is mainly used for healing of the skin. It is one of the most effective herbs that can be applied to treat lacerations, torn skin wounds and surgical scars [9].

In medicine investigation, there is a stable LGP (lamellar gel phase) emulsion under development with using marigold, which can be an alternative to facilitate the healing of wounds [10].

It could be used for horses' follow-up care of fractures, bruises and sprains externally. For internally used to treat stomach ulcers [11]. The high blood sugar levels mainly promotes the typical complications of diabetes, and leading to arterial stiffness, decreased myocardial compliance and aging. There are researches to prove, the marigold has great antioxidation potential, which could inhibit these two reactions.[12]. The diabetic micro traumas on limbs are constant possibility of infections, and could lead to amputation. The marigold balm could stop the progression of infections and reduced the itching, the redness, the dryness, and the pain, while the risk of allergy to the plant is very low [13].

For the marigold's growing is not recommended use directly manure or high doses of nitrogen fertilizers, because these are increase the vegetative parts' growing against the flowers'. The marigold shape quickly, the harvest of the flowers is stimulates the formation of new ones [14].

In the hungarian national list of species has one savory species, the Budakalászi, since 1959 [15]. The summer savory used in the food industry mainly as a spice for canned foods and liqueurs, or as a dietetian spice, and component of tea blends for blood pressure, inflation, gripes, and sore troat int he traditional medicine [14], [16], [17].

The savory is not demanding for the forecrop. It needs perennial weed free place. Avoid after itself for 2-3 years. It needs medium level of nutrients with more potassium [18]. It is not expedient dispatch the manure directly below, which is otherwise well utilized [19].

2. Materials and methods

The experiment took place in the experiment site of the University of Debrecen, Institute of Crop Sciences. The place's soil is chernozem. Before our research would be planned, in 2014, the regular annual nutrient dosages were spread on the

land. These nutrient supplies necessarily had an impact on the yield of the marigold and the savory.

The rainfall on the experimental area in 2015 from 1st January to 30th September was considerably less (286.2 mm) than the 30 year average (445.8 mm). From January till the end of September the average temperature of each month were higher than the 30 year average**,** except April. In 2016 the rainfall from 1st January to 31th August was considerably more (574.9 mm) than the 30 year average. From the 1st January to 31th August in 2016, the measured monthly mean temperature was higher than the 30 year average.

The experimental plot size was 8 m^2. The plots were arranged in 4 replicates in randomized blocks, with 6 different fertilizer treatment levels, in 4 rows with 40 cm row space. In 2015 and 2016, sowing took place on the spot on 7th April and on 4 th April, in 1 cm depth in the case of both plants.

The fertilization settings:

- N0P0K0 (Control)
- N15P20K30
- N30P40K60
- N45P60K90
- N60P80K120
- N75P100K150

N%, P_2O_5%, K_2O%

We spread the fertilizer doses manually to the experimental place.

We measured the marigold's drug yield which, in this case, was the quantity of the raw flower with sepal. Gathering was done 6 times manually between 6th July and 18th August 2015 and 7 times in 2016 between 16 th June and 1 th August. The harvested marigold for the drying has been spread to a single layer, under semi-shade. The drying of the drug took six days average.

We measured the savouries raw drug yield. Gathering was done manually between 12th and 17th August 2015, and between 8th and 10th August 2016.

The drying of the savory herba in 2015 first happened in semi-shade, and it took an average of three weeks. Unfortunatelly, because of the rainy weather the drug got back wetted and we must make post-drying in drying cabinet 40 ^oC for 12 hours.

In 2016 because of the rainy weather too we dried the savory yield in drying cabinet 40 ^oC for 17 hours. We stored the dried marigold and crumbled savory herba drug in paper bags.

3. Results and discussion

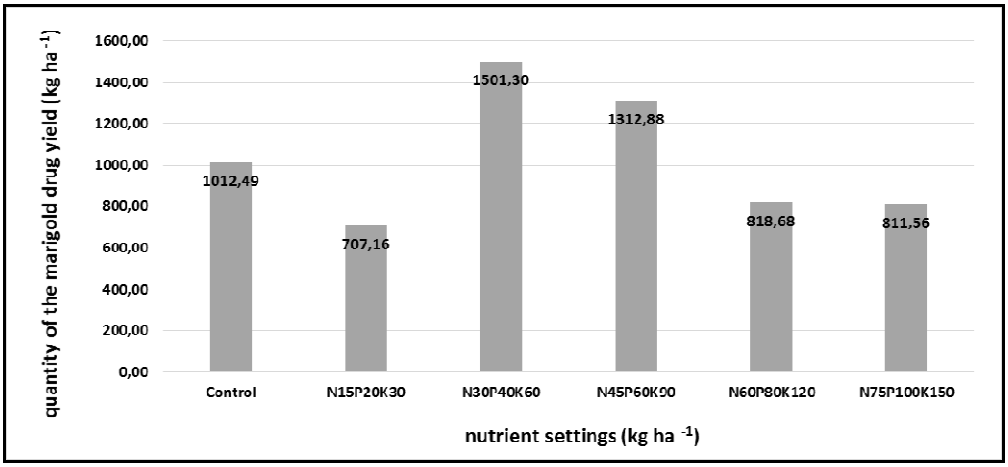

Fig. 1. The quantity of the marigold raw drug yield depending on the nutrient supply 2015 (Debrecen, 2015)

Fig. 1. shows the quantity of the marigold raw drug yield depending on the nutrient supply in 2015. The plots with N30P40K60 had the most favourable nutrient setting, followed by the results of the plots with N45P60K90, then that of the control groups.

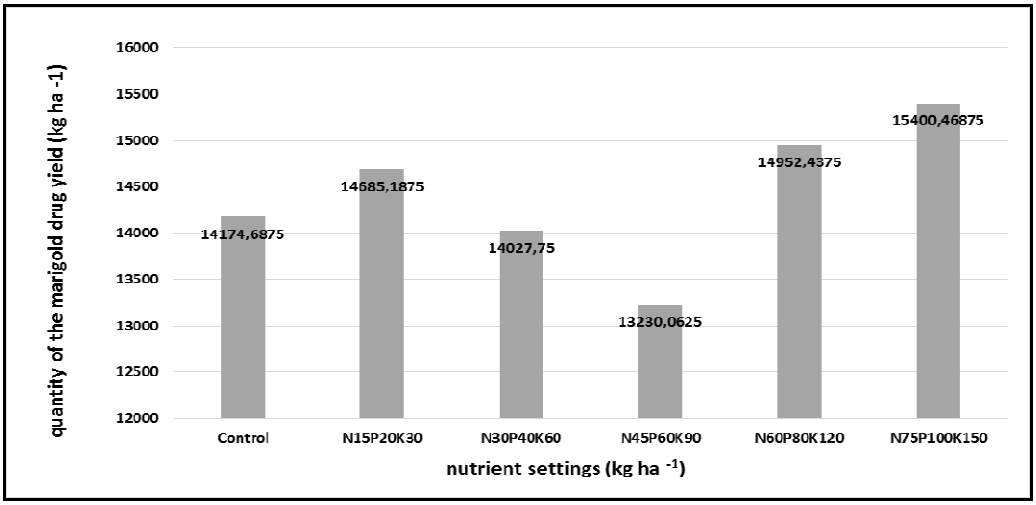

Fig. 2. The quantity of the marigold raw drug yield depending on the nutrient supply 2016 (Debrecen, 2016)

Fig. 2. shows the quantity of the marigold raw drug yield and the nutrient supplies connection in 2016. In this year the N75P100K150, the N60P80K120 and the 15P20K30 fertilization setting has the biggest effect to the raw drug yield, and the N45P60K90 setting has the weakest effect on the yield.

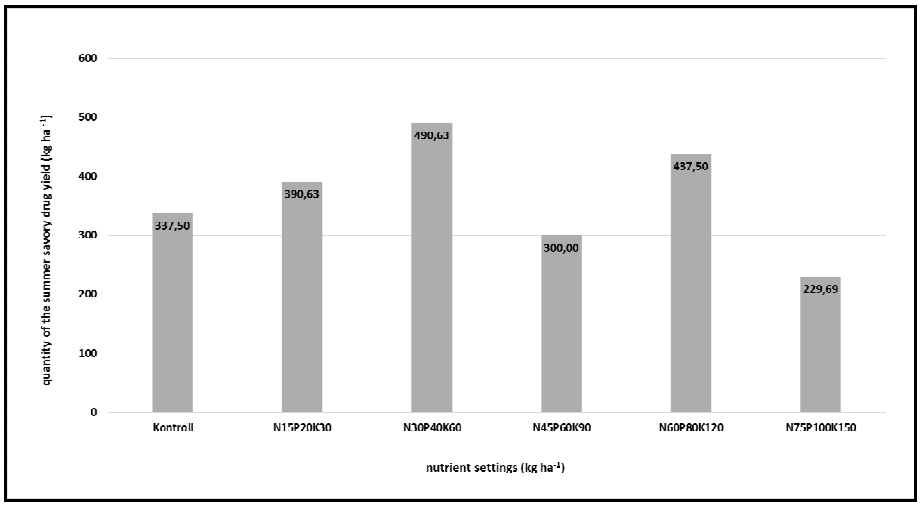

Fig. 3. The quantity of the summer savory raw drug yield depending on the nutrient supply 2015 (Debrecen, 2015)

On Fig. 3. can be observed the savory raw herba drug yield changes depending on the nutrient supply in 2015. Considering the quantity of the drug crop, the plots with N30P40K60 had the most favourable nutrient setting, followed by the results of the plots with N15P20K30, then that of the N60P80K120 groups. The highest nutrient level (N75P100K150) had the weakest effect on the quantity of the herba drug.

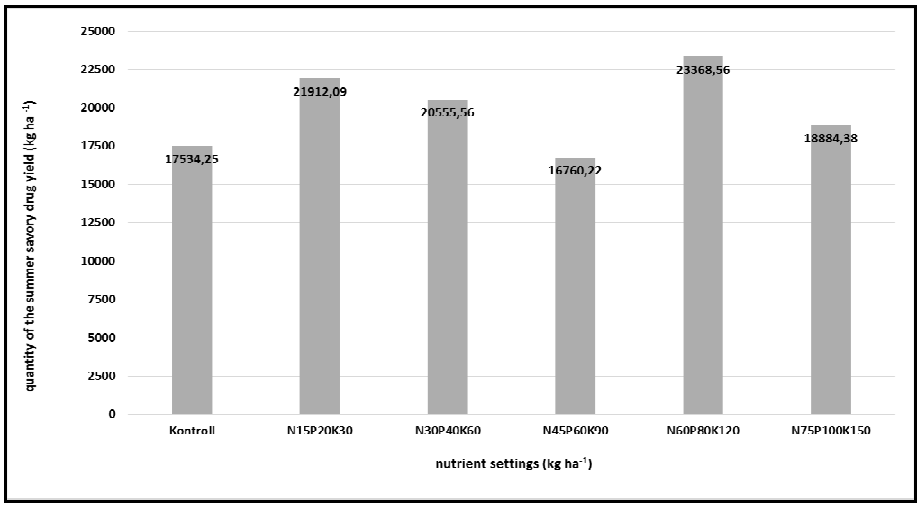

Fig. 4. The quantity of the summer savory raw drug yield depending on the nutrient supply 2016 (Debrecen, 2016)

On Fig. 4. there is the herba drug yield of savory depending on the nutrient supply in 2016. In contrary to the raw yield data of the year 2015, the plots with N60P80K120 had the most favourable nutrient setting, followed by the results of the plots with N15P20K30, then that of the N30P40K60 groups.

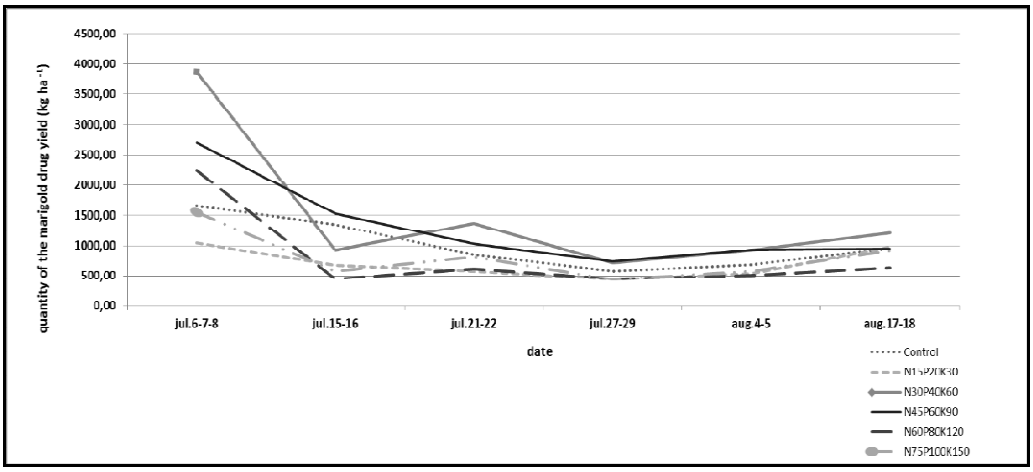

Fig. 5. The marigold raw drug yield changeing depending on time in 2015 (Debrecen, 2015)

During the marigold's weakly harvest in 2015 all of the plots' yield decreased. Between 21th and 22th July and between 17th and 18th August we measured a weak growth which was the biggest in N30P40K60 fertilizer treatment (Fig. 5.).

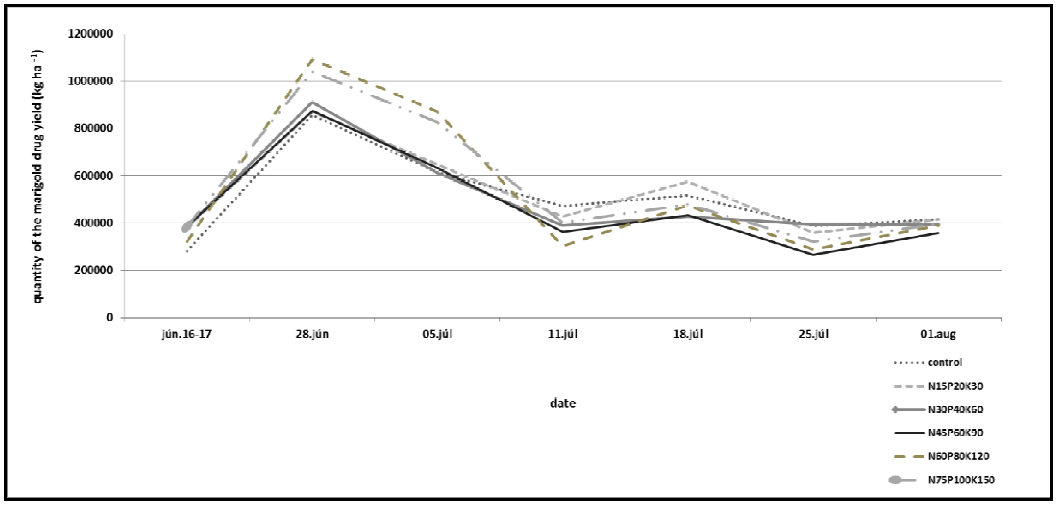

Fig. 6. The marigold raw drug yield changeing depending on time in 2016 (Debrecen, 2016)

During the also weakly harvest of the marigold plots' the yield firstly increased. We measured the highest yield in the harvest of 28th June. Then the quantity of the yield start to decrease. There were a slight increase again on 18th July, but the yield reduction then continued. Until 11th July the N60P80K120 and the N75P100K150 settings' yields reduced least (Fig. 6.).

4. Conclusions

4.1. Conclusions for the marigold's data

Conclusion (1). As for the drug yield of the marigold, it seems the N30P40K60 level was the ideal nutrient setting in 2015.

Conclusion (2). In 2016 the N75P100K150 nutrient supply was the most effective

Conclusion (3). In our opinion, one of the main reason for the fluctuation of the yield besides the different fertilizer dosages was the very warm and dry weather of the vegetative period in 2015.

Conclusion (4). In our opinion, one of the main reason for the fluctuation of the yield besides the different fertilizer dosages was the fluctuations in rainfall in 2016.

Conclusion (5). The nutrient supply has effect on the biomass production and yield of the crops also in case of herbs.

Conclusion (6). The variance analysis of the drug mass' data did not show significant differences between the plots with the different fertilizer treatments.

Conclusion (7). In our opinion the changes of the temperature and the rainfall are more effective for the marigold's drug yield than the increasing nutrient settings. This phenomenon can influence the changes of the harvests' number, as well as the possible renewal term of the stand.

Conclusion (8). We need more research work to do to clear the complex connections between the quantity and the changes of the marigold drug yield and the effect of the different nutrient settings.

4.2. Conclusions for the summer savory's data

Conclusion (1). As for the herba drug yield of the summer savory in 2015 the N30P40K60 level was the ideal nutrient setting.

Conclusion (2). In 2016 the N15P20K30 fertilizer treatment was the ideal.

Conclusion (3). The three nutrient settings which provided the best results in 2015 and 2016 were the N15P20K30, the N30P40K60, and the N60P80K120.

Conclusion (4). In our opinion, one of the main reasons for the fluctuation of the yield with a given nutrient setting was the very warm and dry weather of the vegetative period in 2015.

Conclusion (5). In our opinion, one of the main reason for the fluctuation of the yield besides the different fertilizer dosages was the fluctuations in rainfall in 2016.

Conclusion (6). The variance analysis of the data of the drug mass did not show significant differences between the plots with different fertilizer treatments.

Conclusion (7). Based on the results, it seems concluded, the savory drug yield depending on the crop land's ecological endowment, and cropping technologies.

Conclusion (8). We need more research work to do to clear the complex connections between the quantity and the changes of the summer savory drug yield and the effect of the different nutrient settings.

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