EFFECT OF NITROGEN FERTILIZER ON DECORATION VALUE AND MACRONUTRIENT CONTENT OF SOME SEGETAL SPECIES

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Abstract: *Nitrogen sensitivity of Cyanus segetum Hill. (cornflower), Consolida orientalis Schrödinger (larkspur) and Papaver rhoeas L. (poppy) was investigated in outdoor experiment with ammonium nitrate fertilizer application. The flower counts were increased by nitrogen fertilization in the case of cornflower and larkspur. The flowering period of poppy was decreased by 240 kg/ha ammonium nitrate treatment. Dry weight of larkspur was increased. Well known ion antagonisms and synergisms were detected in the case of Cyanus segetum. The correlation result did not show any significant ion antagonism in the case of Papaver rhoeas.*

Key words*: cornflower, larkspur, poppy, ion antagonism*

INTRODUCTION

Nitrogen plays a vital role in the physiology of plants. It is an essential building block of proteins and pigments. Not surprisingly there is a strict correlation between the nitrogen content of a leaf and photosynthesis, as enzymes participating in the Calvin-cycle and thylacoids give the vast majority of it's nitrogen content [2]. It is an easily mobilized macronutrient, which has influence on the plant's vegetative growth. Several factors affect the uptake [3].

Overdose of nitrogen causes stronger growth of vegetative organs. Leaves getting bigger, getting a darker color, the stem and the leaves grow thicker. Because of this the tissues become looser; the plant's biotic and abiotic stress tolerance decreases. Also, generative parts can be involved, like delay in flowering and abortion of fruits [6]. Hormone balance shifts, the amount of cytokinins increases, while the amount of abscisic acid decreases in the shoots and roots. Because of greater leaf area the lower nodes become overshadowed, which increases internode length, this causes the plants to flap over. Because of too much nitrogen, the evaporating area also increases, which decreases the drought tolerance [4].

Mean macro- and mesonutrient percentage composition of *Centaurea iberica* shoots was 4,7-5,18 % nitrogen, 0,41-0,78 % phosphorous, 4,02-4,4 % potassium, 1,33-1,64 % calcium and 0,35-0,44 % magnesium oven-dry basis. The highest nitrogen value was detected in this cornflower species with comparison the other 7-15 species [5].

MATERIALS AND METHODS

The trial was set up in 2016 at the Show Garden of the Faculty of Horticulture and Rural Development of Neumann János University (46° 55' 10" N, 19° 41' 13" E). The soil is sand based, continuously cultivated, weed free. The marking of plots and plowing to 20 cm depth was on 22nd of February 2016. Even, aerated, small particle size sowing bed was made after plowing, 15 plots total were sown. Cornflower and larkspur seeds were incorporated 1-2 cm deep, poppy seeds were scattered on the surface. Sowing was not

irrigated due to adequate soil moisture, the weather forecast predicted ample precipitation. During the trial we did not applied any form of agro- or phytotechnical method, the plants were extensively maintained.

Seeds quantities sown:

- *Cyanus segetum:* 0,4 g (approx. 200 seeds)
- *Consolida orientalis*: 0,5 g (approx. 400 seeds)
- *Papaver rhoeas* (formula mixture): 0,04 g (approx. 400 seeds)

Plant species in the same treatment were put in one plot, there was a 30 cm walkway between treatments. The marking of plots were made with a 50 m tape measure, the edges were marked with 50 cm wooden sticks. One plot was 1,5 × 1,5 m. The fertilizer (ammonium nitrate) was applied on 13th of April, 2016 on the 12 plots. Each plot received 20,25 g, 40,5 g, 81 g and 162 g, which is equivalent of 30, 60, 120, 240 kg/ha nitrogen active ingredient.

Measured an observed parameters, methodology:

- Assessing the ornamental value twice weekly from the beginning of flowering.
- Comparison of developmental speed based on the test of flowering dynamics (flowering individuals/plots, number of flowers/plots, average flower count/plots).
- Collection of seeds after ripening.
- Collecting leaf samples for macro-element analysis at the beginning of flowering, which was carried out in the accredited Soil- and Plant Testing Laboratory of the University.

The statistical assessments were made by using single or multifactorial analyses of variance (ANOVA, MANOVA) and multifactor correlation tests. Significant difference was determined by Tukey's test, Least Significant Difference and Games-Howell tests (α=0,05). For assaying we used SPSS 20 program (IBM, New York, US).

RESEARCH RESULTS

1. Flowering

Cyanus segetum

Treatments had no effect on the weighted flower count (ANOVA F=0,776 SL=0,545>α).

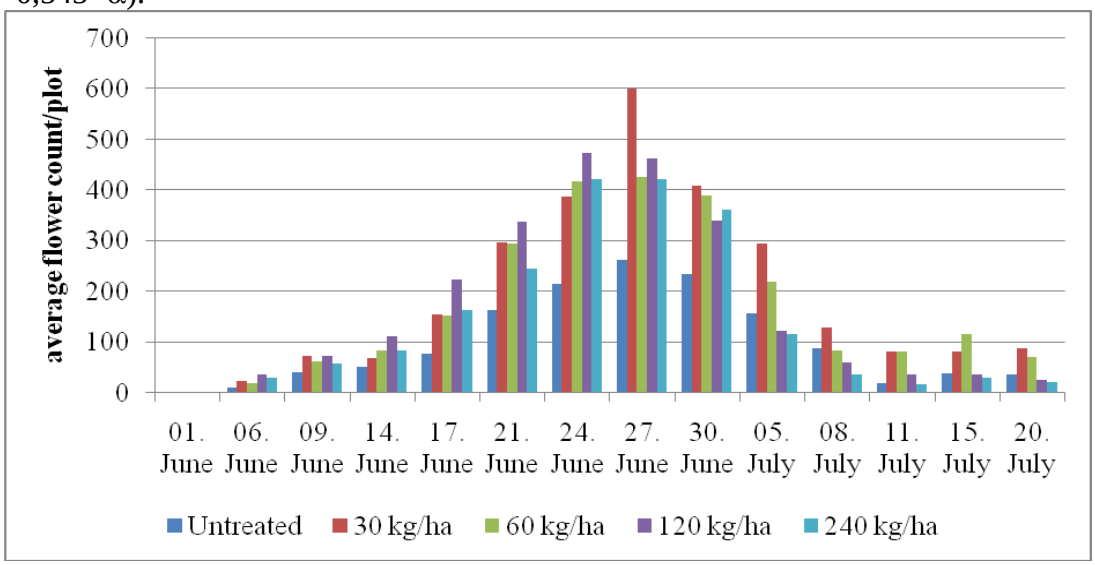

Figure 1. Effect of nitrogen fertilization on the average flower count of *Cyanus segetum*

From all the species tested *Cyanus segetum* had the longest flowering season. The number of simultaneously flowering individuals reached 150-160 per 2,25 m^2 plot on

the height of it's decoration period (last decade of June). The average number of flower heads was about 1 to 4, less than other species in this genus. In the case of *Centaurea maculosa* 16,35, and *Centaurea diffusa* 74,23 flower heads/plants was measured by WATSON and RENNEY, 1974. The application of nitrogen did not affected the flowering season's duration, but at the height of flowering and the end of the decoration period the average flower count of the treatments have risen (Fig. 1.). This was most prominent at the 2 lowest (30 and 60 kg/ha) doses. Higher doses had no or positive effect compared to the untreated.

Consolida orientalis

Application of nitrogen also had no significant effect (ANOVA F=0,618 SL=0,651>α) on the weighted flower count (average flower number × flowering individuals). The flowering season is almost the half of *Cyanus segetum*, but it has an outstanding decorative property, because in mid-June the number of flowering individuals reached 60-80 on each plot. Average flower count was 15-20 per plant which far exceeds the other two taxa's flower count (1,5 and 3-3,5 respectively). Unfortunately this species is not a rebloomer, after seed set and ripening plants die.

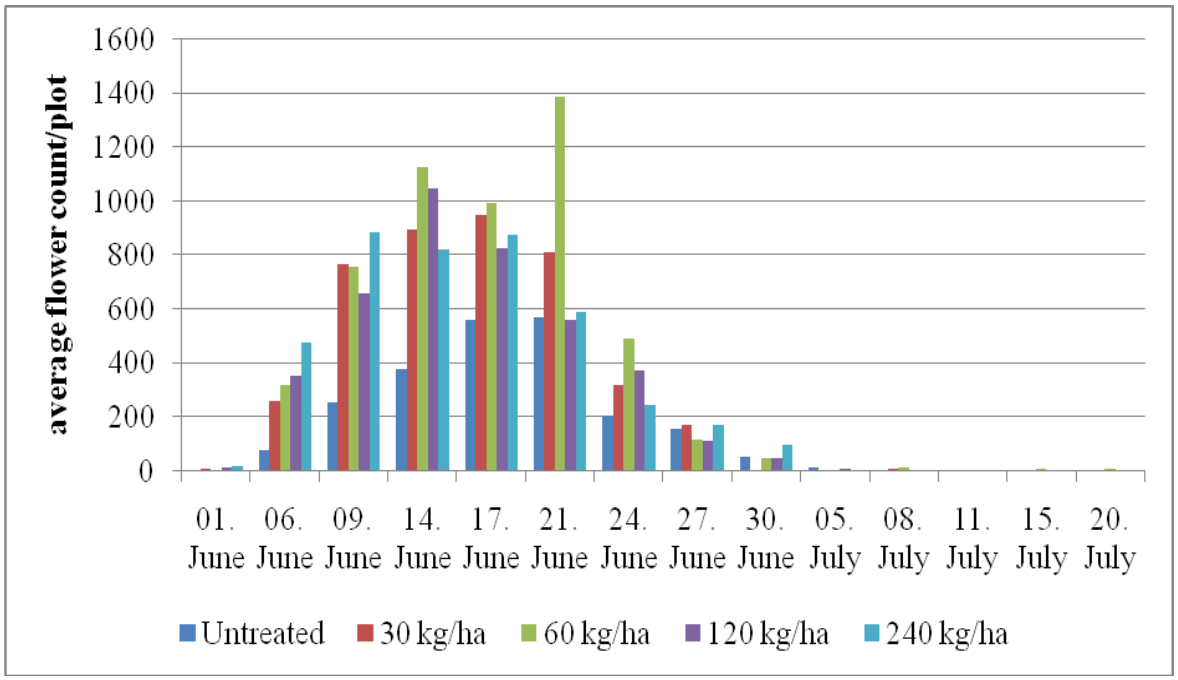

Figure 2. Effect of nitrogen fertilization on the average flower count of *Consolida orientalis*

For *Consolida orientalis* the application of nitrogen had a positive effect on the flower count. At the height of flowering all 4 treatments had a higher average flower count compared to the untreated (Fig. 2.).

Papaver rhoeas

There wasn't any significant effect of treatments (ANOVA F=1,198 SL=0,320>α). Simultaneously flowering individuals at the height of flowering season were between 30-40, which was the least from the tested plants. The duration of flowering season was the same as *Consolida orientalis*, data from the July assessment is from 1-5 plants. During the trial simultaneously open flowers per plant were 1-2.

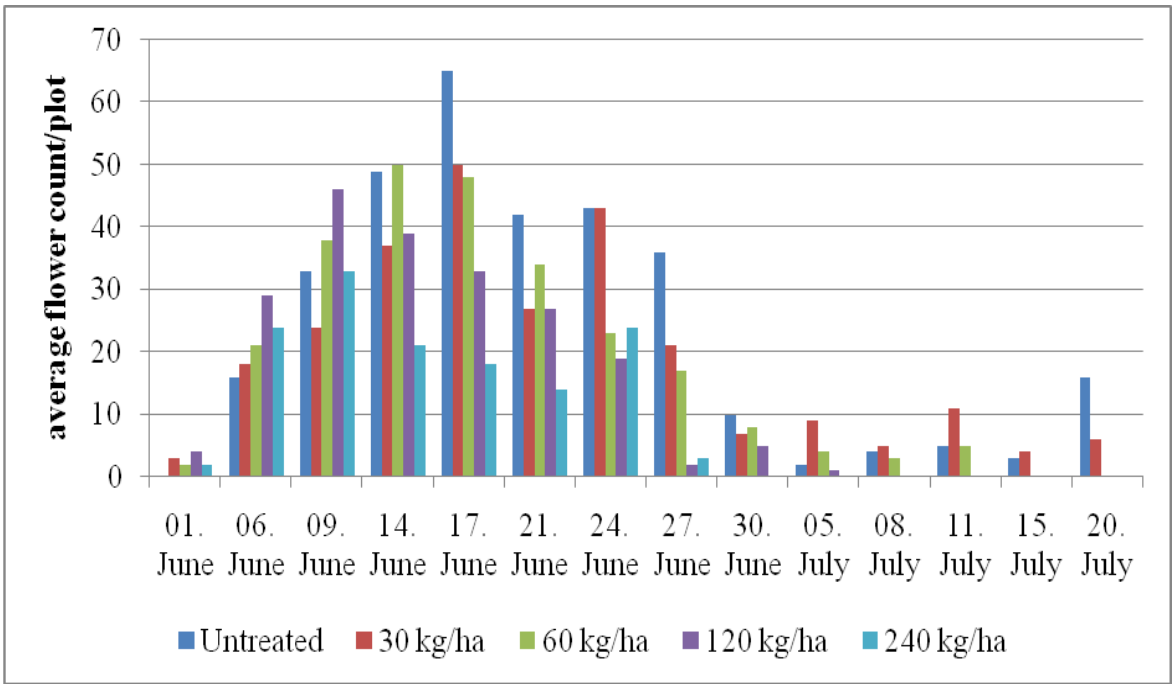

Figure 3. Effect of nitrogen fertilization on the average flower count of *Papaver rhoeas*

Applied nitrogen treatments had a neutral effect on *Papaver rhoeas*. The only exception was the 240 kg/ha dose, which seemed to have a negative effect on the number of flowering individuals and on average flower count, and reduced the flowering season for almost a month. At the end of flowering season of the untreated, the highest dose treatment finished it's decorative time. This was only slightly visible or not visible on the other treatments.

2. Macro element content

Table 1.

Effect of nitrogen fertilization on the macro element content of 3 tested taxa

Taxa	Treatment	Dry weight (m/m %)	Nitrogen in dry weight m/m %.	Phosphorous in dry weight m/m %.	Potassium in dry weight m/m %.	Calcium in dry weight m/m %.	Magnesium in dry weight m/m %.
Papaver rhoeas	Untreated	12,5	2,52	0,653	4,28	2,13	0,362
	30 kg/ha	12,6	2,11	0,489	3,56	2,4	0,362
	60 kg/ha	12,1	2,49	0,694	3,78	2,06	0,341
	120 kg/ha	11,3	4,02	0,776	4,02	1,82	0,365
	240 kg/ha	11,4	3,74	0,812	3,62	2,43	0,485
Consolida orientalis	Untreated	13,7	2,29	0,269	3,56	4,06	0,706
	30 kg/ha	14,7	2,34	0,276	1,43	3,19	0,619
	60 kg/ha	16,5	3,22	0,35	0,948	2,75	0,535
	120 kg/ha	16	4,08	0,341	0,895	3,7	0,684
	240 kg/ha	17,7	4,57	0,269	0,849	4,42	0,771
Cyanus segetum	Untreated	10,8	2,9	0,358	4,11	2,96	0,541
	30 kg/ha	11,9	2,56	0,365	2,42	2,85	0,662
	60 kg/ha	10,2	3,65	0,345	1,25	2,9	0,995
	120 kg/ha	10,5	3,93	0,292	0,979	3,35	1,01
	240 kg/ha	10,9	4,21	0,246	1,15	3,86	1,07

In the case of cornflower we see a correlation between nitrogen – phosphorous (SL<0,05), and a strong correlation between phosphorous – calcium (SL<0,01). Nitrogen and phosphorous are antagonistic elements, this means nitrogen fertilization raises nitrogen levels in the leaves, and decreases phosphorous levels at the same time. Increase of nitrogen also increased magnesium levels, which can be the cause of reduced potassium levels. Also because of the nitrogen – potassium antagonism, calcium levels rise. The calcium – magnesium antagonism was not detected in the case of *Cyanus segetum* (Table 1.).

In the case of *Consolida orientalis*, strong correlation was observed between calcium and magnesium (SL<0,01). The two elements did not show the effect of antagonism, but they moved together in the leaves. Also, the nitrogen – phosphorous antagonism was not detectable, but nitrogen – potassium antagonism was clear. The amount of calcium and magnesium were reduced in the first 2 lowest dose, but in the last 2 they rise, while potassium levels further decreased. We could also observe the increase in dry weight (Table 1.).

In the case of *Papaver rhoeas* no correlation was observed in the pairwise analysis of macro elements. The highest amount of nitrogen and potassium was detected in the case of 120 kg/ha nitrogen application. Test results do not show clear antagonism or synergism (Table 1.). The amounts of dry weight are similar (11,3-12,6 m/m %) to the measuring results of other researchers (10,9 m/m %) (Bianco et al. 1998).

CONCLUSIONS

By the test of *Papaver rhoeas* flowering dynamics we saw a small increase of the generative parts, like flower count. In the case of cornflower smaller doses increased, while in the case of larkspur all doses increased flower count, but does not increased the length and intensity of flowering season significantly. In the case of poppy treatments had no effect, except the highest dose, where flowering intensity and flowering season suffered. In the case of *Cyanus segetum* the chemical composition followed the ion antagonisms and synergisms, while we were observing the increase of dry weight in the treated plots of *Consolida orientalis*. *Papaver rhoeas* data did not show any similar correlation.

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