

Optimal Nitrogen and Light Regimes to Grow a Medicinal Herb, *Calendula officinalis*

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Background

Calendula officinalis (pot marigold) is a perennial plant belonging to the family Asteraceae and is native to Mediterranean region. They grow up to between 30 and 50 cm high with flower heads measuring up to 5 cm in diameter, which are relatively larger than other species in the genus. The flower consists of active compounds such as oleanolic acid, and are shown to exhibit medicinal properties such as anti-inflammatory, antiviral, inhibition of existing tumor cells as well as protection against adverse effects of chemotherapy and radiation therapy.

However, very little has been understood about the optimal indoor growth requirements of the plant. The aim of the project is to evaluate the responses of vegetative growth and flower production of *Calendula* under the interaction of differential nitrogen fertilizer and light intensity.

Materials and Methods

Four different treatments were imposed to grow 18 *Calendula* plants in the greenhouse: 5 of them were grown under 100% light with nitrogen (in the form of 0.1 M ammonium nitrate); 4 under 100% light without nitrogen; 5 under 50% light with nitrogen; and the remaining 4 under 50% light without nitrogen. After a week since the initial reading (Week 0), the plants were treated with 100mL of 0.1M ammonium nitrate on alternate days for a total duration of two weeks. The treatment was stopped early due to withering of the plants.



Image 1: Setup of 9 *Calendula* Plants under 100% Light at Day 0.



Image 2: Setup of 9 *Calendula* Plants under 50% Light at Day 0.

Different physiological measurements were made on the *Calendula* plants. The height of the plant was measured as the difference in length between the highest point on the plant and the level of the soil. The total number of leaves for each plant was counted manually.

A random leaf was selected and its growth was followed by taking measurement on its length. Moreover, the chlorophyll content of the plant was measured using CCM-200 chlorophyll meter.

Results and Discussion



Image 3: *Calendula* plants after Week 6 under 100% with Nitrogen, 100% without Nitrogen, 50% with Nitrogen, and 50% without Nitrogen (left to right).

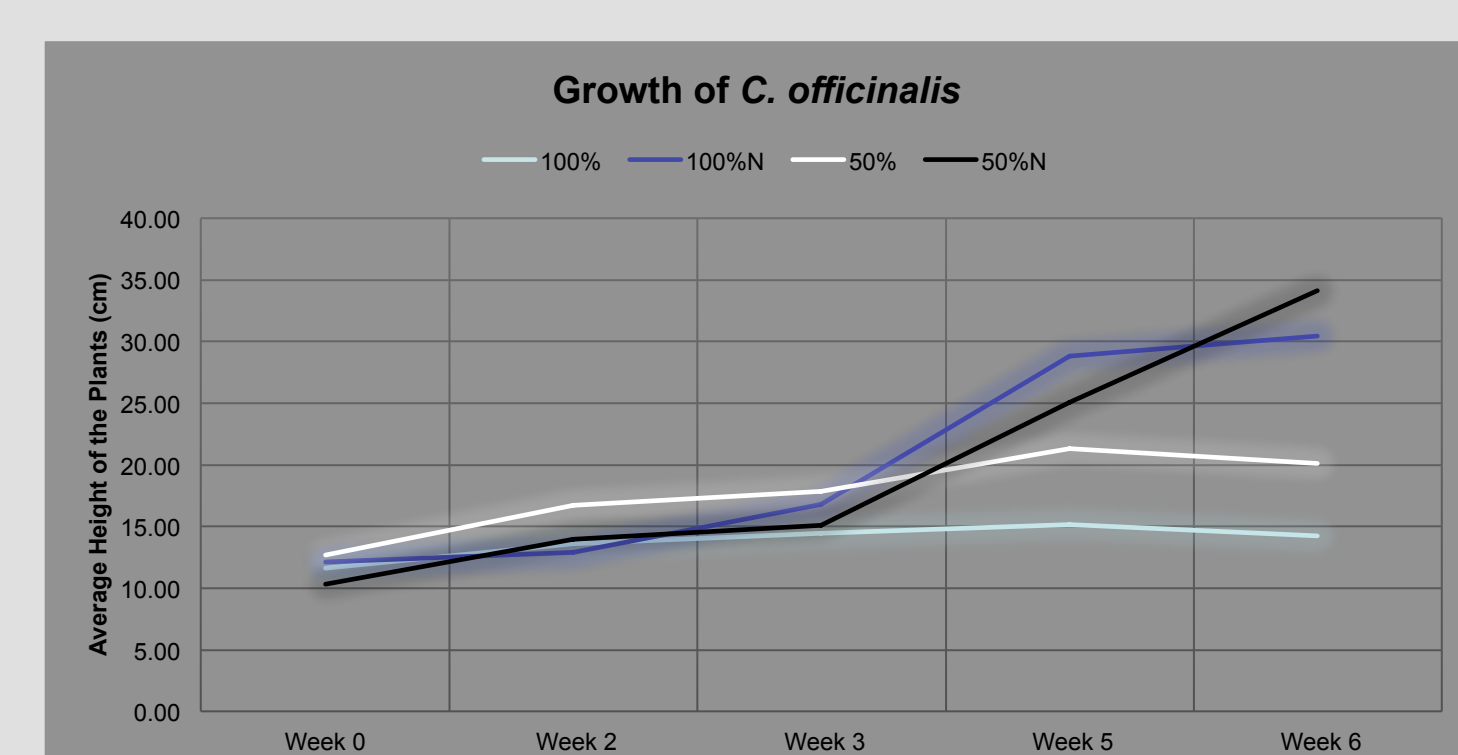


Figure 1: Increase in height of *Calendula officinalis*

- The total number of leaves increased rapidly in both Nitrogen-treated plants under 100% and 50% light compared to the two treatments without nitrogen.
- The plants grown under 50% light with nitrogen has more leaves than those grown under 100% light with nitrogen.

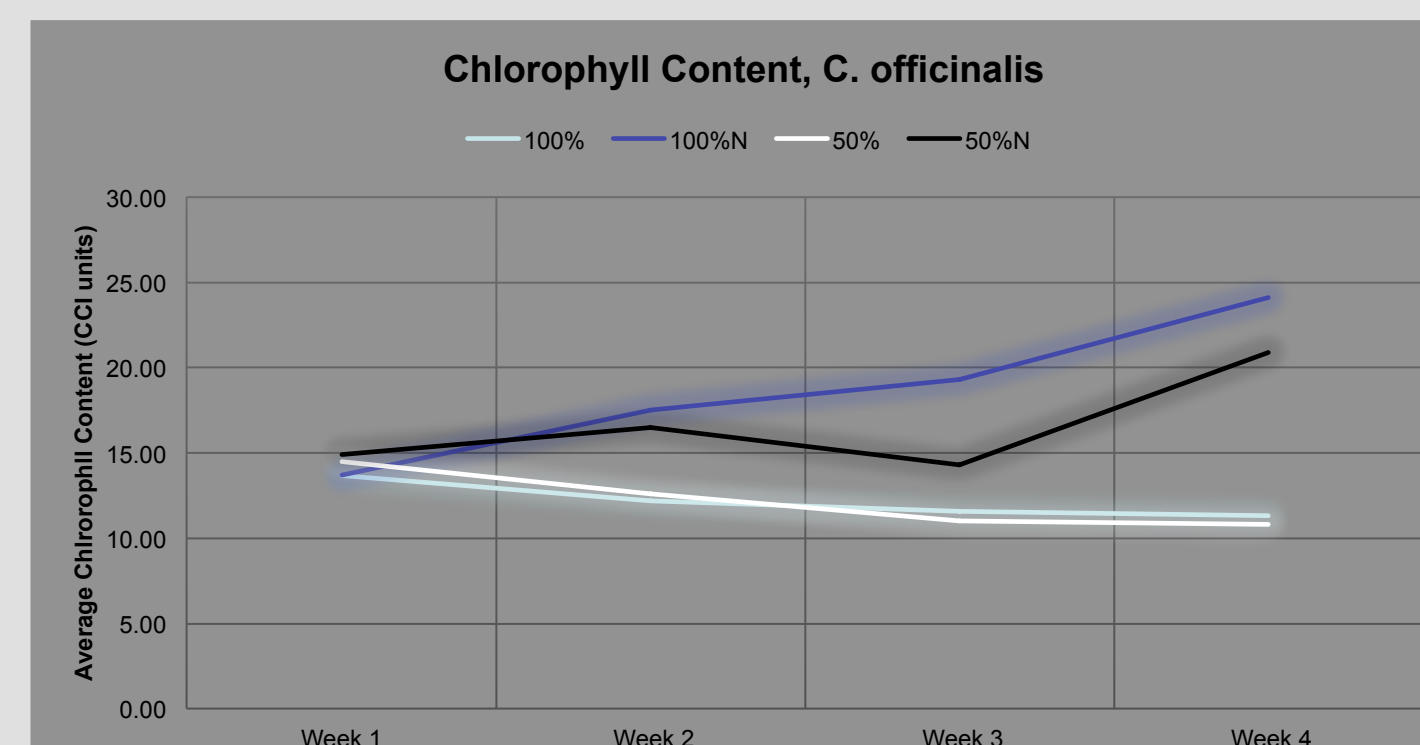


Figure 3: Change in Chlorophyll content in the leaves

- When being grown under the same nitrogen fertilization, the plants grown under 50% light had comparatively higher floral production compared to those under 100% light.
- Grown under the same light intensity, plants treated with nitrogen produced higher number of flowers or buds.

- The height of the plants under the treatments did not differ until the end of Week 3.
- Both the plants under 100% and 50% light with nitrogen showed a greater increase in height.
- Plants under 50% light with nitrogen showed a more steady increase in height over time.

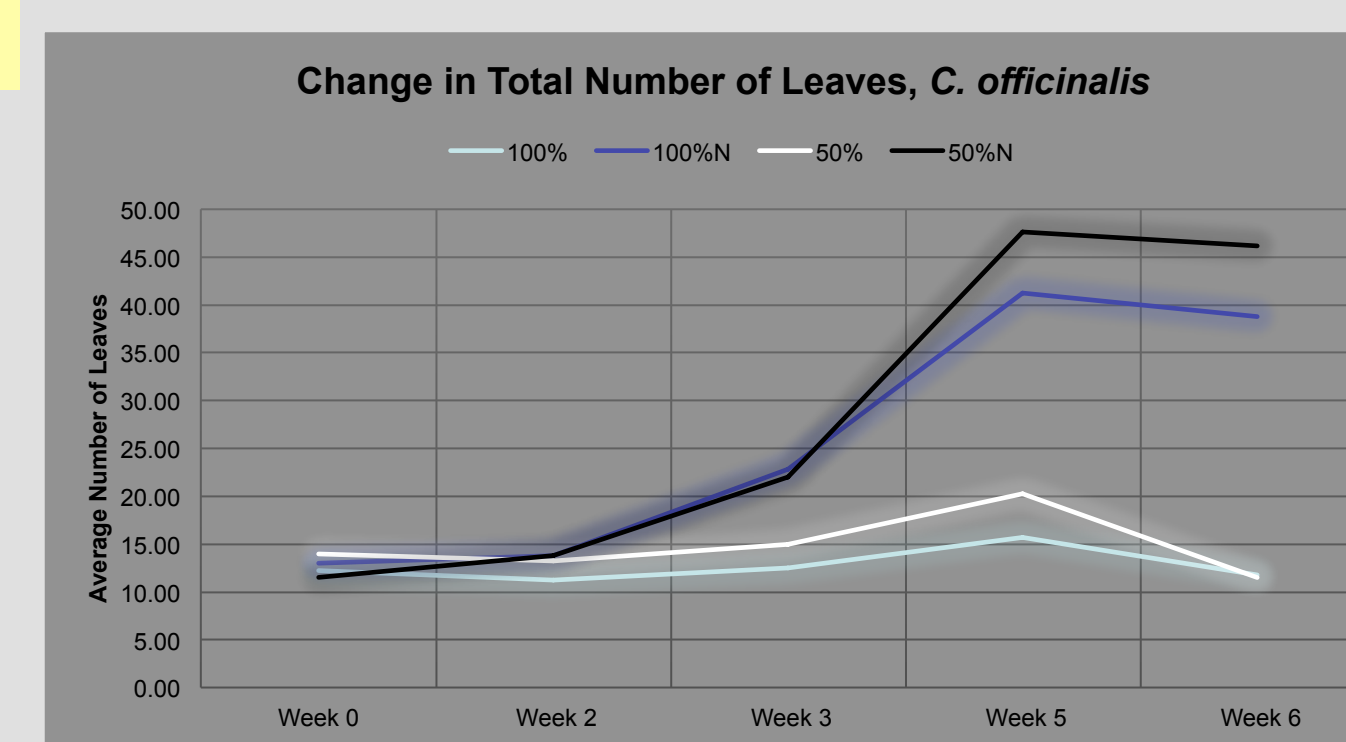


Figure 2: Change in total number of leaves on average

- The average chlorophyll content was much higher in nitrogen treated plants compared to untreated ones under both light intensities.
- There was a more steady increase in chlorophyll content in plants under 100% with nitrogen.

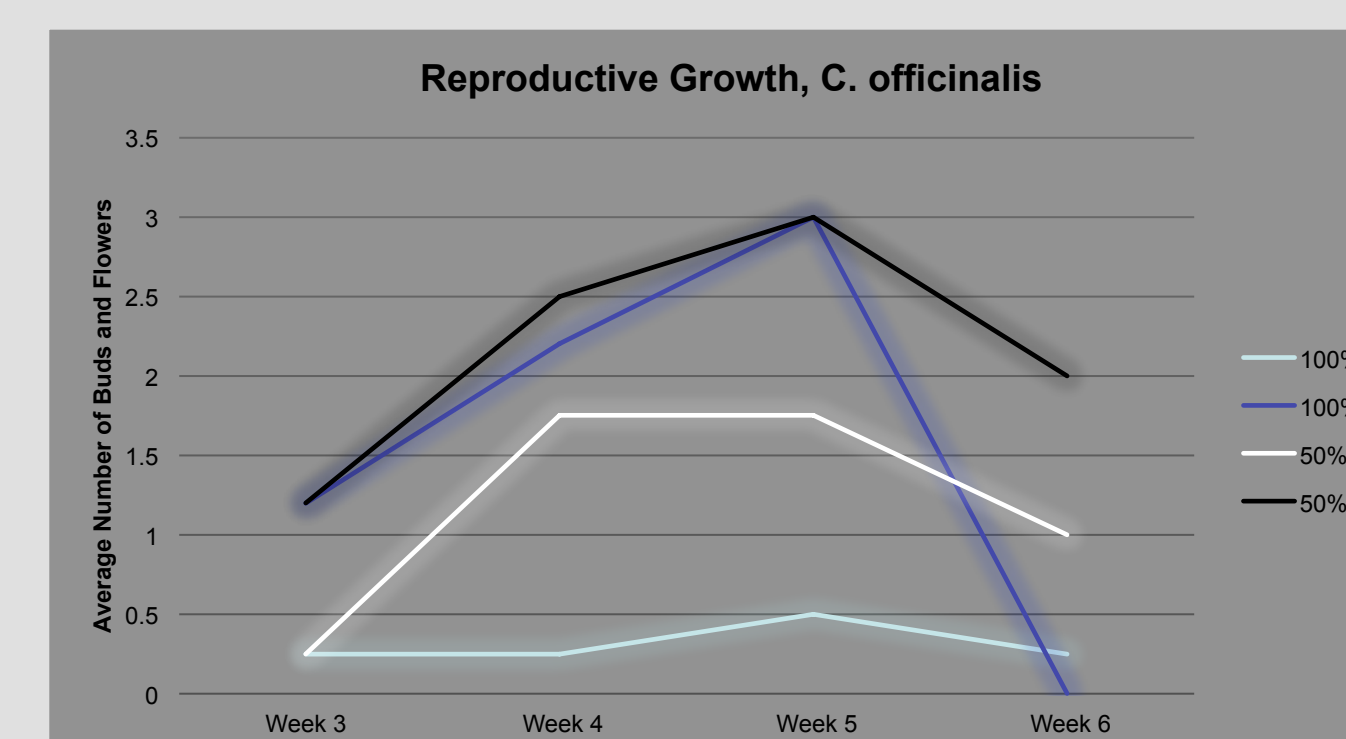


Figure 4: Change in total number of buds and flower heads

Conclusions

- The treatment of *Calendula* with nitrogen boosted the vegetative growth of the plants under both intensities of light as shown by the increase in the height of the plants, number of leaves as well as the chlorophyll content of the leaves.
- The difference in the vegetative growth under the light conditions did not differ significantly and they both followed a similar trend.
- The treatment of nitrogen also affected the reproductive growth of *Calendula* as more buds and flowers were produced by the plants treated with nitrogen compared to the untreated ones.
- Light seemed to play a crucial role in reproductive growth. A significantly higher floral production was observed for plants under 50% light compared to in plants under 100% light.
- Overall, the results indicate that 50% light with nitrogen seems to be a better combination of light and nitrogen regime that stimulated both steady vegetative growth and floral production.

Future Work

- Wet-Lab examination of expression patterns in 4 target genes: Ribulose phosphate gene, Gibberellin gene, Flowering Locus T-Like (FT) gene and Delta-12 fatty acid desaturase (FAD2) gene.
- Grow *Calendula* plants under lower concentrations of nitrogen in combination with the same two light conditions.
- Using tissue culture techniques to better regulate the independent variables in order to identify the best light and nitrogen combination.

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