

## Effects of gibberellic acid as a gametocide on different genotypes of German Chamomile (*Matricaria recutita* [L.] Rauschert)

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### Summary

The objective of the present research was to determine statistically before made observations on reactions of Chamomile after treatment with gibberellic acid undertaken to find a feasible way of chemical castration to create maternal lines as a base for hybrid progeny. Chamomile plants of three cultivars were set up in a split plot design, with treated and untreated parts. Four traits: 'percentage affected capitula', 'seeds per capitulum', 'percentage of germination' and 'percentage infertile pollen' were valuated, twice per plant. Analyses showed a significant effect of treatment on pollen viability and a strong tendency on the visible affection of capitula, but no influence on number of seeds or germination rate. Neither did cultivars show any influence, nor did an interaction between cultivar and treatment appear. According to the aim to find a suitable method to generate male sterile maternal lines, the reactions, affecting male, but not female fertility, seem to be highly appreciated, but the repeated spray application in a necessarily sensible stage of flower development and a reduction of pollen viability of only about 10% constrain the practicability.

### Introduction

Looking for a suitable gametocide for German Chamomile in order to produce male sterile lines comprehensive research work was undertaken. In publications treating other *Asteraceae* in this context mostly gibberellic acid ( $GA_3$ ,  $C_{19}H_{22}O_6$ ) was mentioned as a useful agent (SCHUSTER and LIU, 1983; BAYDAR and GÖKMEN, 2003; MILLER and FICK, 1978; SPIROVA, 1975). Additionally there is a patent web entry on the use of sulfonyl urea derivative as a gametocide on sun flowers (PATENT-DE, 2008). Basing on the recommended use of gibberellic acid in a threefold spray application on *Carthamus tinctorius* in a concentration of 100ppm and a result of reduced pollen viability from 81.6% to 6.7% (BAYDAR and GÖKMEN, 2003) similar trials with German Chamomile were undertaken.

### Material and methods

In a split plot design with two factors (cultivars 'Bona', 'Manzana', 'Lutea' and treatment with  $GA_3$ , treated or not treated, respectively) 18 Chamomile plants were set up under green house conditions with six replications per combination of factors. In the treated plot eight spray applications of gibberellic acid in a concentration of 100ppm started in a very early flowering stage and were continued with always three days interval, while the second plot stayed untreated. After that the four traits 'percentage affected flower heads', 'seeds per flower head', 'percentage of germination' and 'percentage infertile pollen' were evaluated, each twice per plant. The valuation of the primarily mentioned trait started a few days after the last application and was repeated two weeks later. 'Percentage of germination' was tested in Petri dishes with wet filter paper and controlled after a two weeks period – in accordance to recommended germination tests in HEEGER

(1989). Each Petri dish was filled with the seeds of one capitulum. Pollen viability was estimated by analyzing fresh, mature pollen after acetocarmine staining (2% acetocarmine solution), according to LAMBROU et al. (2001) and GERLACH (1984). The percentage of affected flower heads concerns visually cognizable damages of the disc flowers and/or the ray flowers.

### Results

$GA_3$ -treatment showed a significant negative influence on pollen viability ( $p = 0.023$ ) and a strong tendency on affection of flower heads ( $p = 0.054$ ), at a level of significance of  $\alpha = 0.05$ . The mean for the  $GA_3$ -treated plot was 9.8 % of infertile pollen vs. 1.4 % for the untreated plot and 9.3 % of affected flower heads vs. 0 % for the untreated plot, respectively (Fig. 1 and 2).

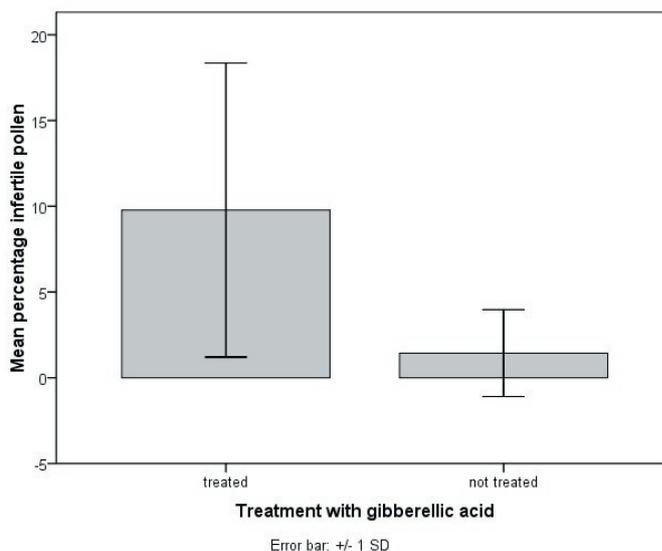
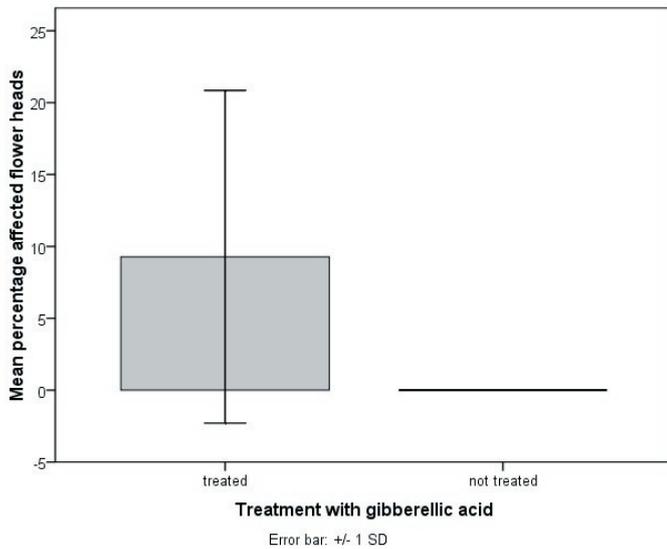


Fig. 1: Means of percentage of infertile pollen in treated and untreated plots.

The traits 'seeds per flower head' and 'percentage of germination' showed no significance or tendency for the influence of  $GA_3$ -treatment. Neither did the factor 'cultivar' cause any significant influence, nor did interactions between 'GA-treatment' and 'cultivar' occur.

### Discussion

Considering the intended aim to find a suitable agent for the production of maternal lines with male sterility the application of gibberellic acid initially seems to be highly suitable due to the negative effect on male fertility ('percentage infertile pollen', 'percentage affected capitula') and the non-effect on female fertility



**Fig. 2:** Means of percentage of affected flower heads in treated and untreated plots.

(‘seeds per capitulum’, ‘percentage of germination’). Additionally the result shows no influence of cultivars and no interactions between the factors. But reduction of pollen fertility is less than ten percent (9.8 % vs. 1.4 %) and even if having in mind that this refers only to despite affection of flower heads yet developed pollen this extent of reduction is too little to be used in practice. Also due to a necessarily reiterate application in a sensible flowering stage, the danger of damaging the whole plant in case of a too-much of the agent and the dependency of weather conditions the use of gibberellic acid as a gametocide for Chamomile cannot be recommended.

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### References

- BAYDAR, H., GÖKMEN, O., 2003: Hybrid seed production in safflower (*Carthamus tinctorius*) following the induction of male sterility by gibberellic acid. *Plant Breed.* 122, 459-461.
- GERLACH, D., 1984: *Botanische Mikrotechnik, eine Einführung.* Georg Thieme Verlag Stuttgart, New York.
- HEEGER, E., 1989: *Handbuch des Arznei- und Gewürzpflanzenbaues, Drogengewinnung.* VEB Deutscher Landwirtschaftsverlag, Berlin.
- LAMBROU, M., BEIN-LOBMAIER, B., FRANZ, C., 2001: Cytological analysis of di- and tetraploid plants of *Matricaria recutita* (Asteraceae) and their hybrid progeny, poster presentation.
- MILLER, J., FICK, G., 1978: Adaptation of reciprocal full sib selection in sunflower breeding using gibberellic acid induced male sterility. *Crop Sci.* 18, 161-162.
- PATENT-DE, 2008: Verwendung von Sulfonylharnstoffen als Gametozide. <http://www.patent-de.com/19890302/DE3727629A1.html>.
- SCHUSTER, W., LIU, S., 1983: Über die gametozide Wirkung von Gibberellinsäure auf unterschiedliche Genotypen der Sonnenblume. *J. Appl. Bot. Food Qual. – Angew. Bot.* 57, 85-98.
- SPIROVA, M., 1975: New data on the male sterility in sunflowers induced by gibberellic acid. *Plant Sci.* 12, 10-17.

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