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

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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 (GA₃, C₁₉H₂₂O₉) 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 GA₃, treated or not treated, respectively) 18 Chamomile plants were set up under greenhouse 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
GA₃-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 α = 0.05. The mean for the GA₃-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 GA₃-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.
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.
LAMBIROU, M., BEIN-LOBMAIER, B., FRANZ, C., 2001: Cytological analysis of di- and tetraploid plants of Matricaria recutita (Asteraceae) and their hybrid progeny, poster presentation.

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