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Research Article

THE EFFECT OF GIBBERELLIC ACID AND BENZYLADENINE ON GROWTH AND ESSENTIAL OILS OF GERMAN CHAMOMILE

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ABSTRACT

German chamomile is one of the important medicinal plants from Compositae family. Essential oils extracted from the flowers are active substances of this plant. One of the factors influencing growth and essential oil production is plant growth regulators. This pot experiment was conducted to evaluate the effects of gibberellic acid and benzyladenine on growth and essential oils of German chamomile. The study was carried out by spraying of gibberellic acid or benzyladenine (50 and 100 ppm) at the vegetative stage using a completely randomized design (CRD) with three replications. The results indicated that growth regulators influenced on growth and essential oils significantly. Gbberellic acid at 50 and 100 ppm resulted in the best values of flowering. Gbberellic acid at concentration of 50 ppm resulted in the highest essential oil percentage and yield.

Keywords: *Growth Regulators, Medicinal Plants, Cytokinin, Matricaria Recutita, Gibberellins, Volatile Oil*

INTRODUCTION

Matricaria recutita L. (syn. *M. chamomilla* L., *Chamomilla recutita* L. Rauschert) is known as true chamomile or German chamomile is from family Compositae (Asteraceae). German chamomile has white ligulate flowers and is annual, grows 10 to 80 cm in height (Franke, 2005). Chamomile is widely used throughout the world. Its primary uses are as a sedative, anxiolytic and antispasmodic, and as a treatment for mild skin irritation and inflammation. It has widespread use as a home remedy (Gardiner, 1999). The biological activity of chamomile is mainly due to the phenolic compounds, primarily the flavonoids apigenin, quercetin, patuletin, luteolin and their glucosides, but also to the principal components of the essential oil extracted from the flowers (Hadaruga *et al.*, 2009).

Plant growth regulators can influence growth and essential oil production. Endogenous levels as well exogenous application could affect essential oil production (Prins *et al.*, 2010).

Gibberellins (GAs) are a family of plant hormones controlling many aspects of plant growth and development. Gibberellic acid is a member of this family.

Cytokinins are involved in the regulation of various processes of plant growth and development while interacting with other phytohormones. Benzyladenine is one of the cytokinins.

Abou Zied and Sherbeany (1971) indicated that chloremquat enhanced the volatile oils of chamomile. Sharafzadeh *et al.*, (2012) revealed that naphthaleneacetic acid and spermidine altered oil constituents of German chamomile. Another research showed that α-bisabolol oxide A, increased in chamomile with application of 100 ppm IAA (Reda *et al.,* 2010). Growth and essential oil yield of *Mentha piperita* were improved by the application of polyamines (Youssef *et al.*, 2002). Silva *et al.,* (2005) reported that auxin and cytokinin increased some components of the lemon balm oil. Povh and Ono (2007) showed that application of gibberellic acid influenced the chemical composition of *Salvia* oil. A report revealed that sodium salt of NAA and IAA increased the essential oil of *Mentha piperita* (Koseva-kovacheva and Staev, 1978).

The subject of this experiment was evaluation of the effects of gibberellic acid and benzyladenine on growth and essential oils of German chamomile.

MATERIALS AND METHODS

Plant materials and experimental conditions: This study was conducted as pot experiment on Firoozabad Branch (28°35' N, 52°40' E; 1327 m above sea level), Islamic Azad University, Firoozabad, State of Fars, Iran, on October (autumn), 2012. The pots were filled by a mixture contained 2/3 soil and 1/3 sand (v/v) which was amended by cow manure vermicompost. This mixture was tested before sowing and showed PH=7.79, organic C=1.14%, total N=0.1%, available P=5.5 mg/kg, available K=184 mg/kg, TNV=52.5% and EC=0.7 ds/m. Chamomile seeds were germinated in pots and thinned at 2-4 leaves stage to one plant per each pot. The plants were treated by spraying of gibberellic acid (50 and 100 ppm) or benzyladenine (50 and 100 ppm) at the vegetative stage, before flower budding, twice within 10 days and compared to control. Experiment was carried out using a completely randomized design (CRD) with three replications. Each replicate contained 14 pots. The flower heads were collected each 20 days during flowering (four times), and were dried at room temperature. Finally, shoot fresh weight was measured and the samples were dried at 60 °C for 72 hours in order to define shoot dry weight.

Essential oil isolation: Isolation of essential oils was performed using hydrodistillation of dried sample of flower heads using a Clevenger-type apparatus over 3 hours. The oils were dried over sodium sulphate.

Statistical analysis: Data from the experiment were subjected to analysis of variance (ANOVA) using SAS computer software and the means compared with Duncan's new multiple range test (DNMRT) at $P< 0.05$.

RESULTS AND DISCUSSION

Our results indicated that gibberellic acid and benzyladenine altered growth, oil percentage and oil yield of German chamomile (Table 1). The highest values of flower number (61.11) and flower dry weight (50.07 g/plant), were achieved on GA 100 ppm which were not significantly different when compared to GA 50 ppm. Shoot fresh and dry weights were the maximum at concentration of 100 ppm GA which were significantly different when compared to other treatments. The maximum percentage of essential oil (0.28%) and oil yield (0.121 g/plant) were obtained at GA 50 ppm.

Table 1: Effects of growth regulators on growth, flowering, oil percentage and oil yield of German chamomile

Growth regulators (ppm)	Flower NO	Flower FW (g/plant)	Flower DW (g/plant)	Shoot FW (g/plant)	Shoot DW (g/plant)	Essential oil percentage	Essential oil yield (g/plant)
Control	24.80 b	154.34 b	29.65 b	42.36 c	10.71 b	0.11 c	0.033 d
GA 50	60.78 a	207.15 a	43.89 a	48.42 b	10.13 b	0.28 a	0.121 a
GA 100	61.11 a	178.03 ab	50.07 a	58.75 a	14.59 a	0.11 c	0.053 b
BA 50	13.21 c	52.43 d	14.94 c	31.13 d	6.33 c	0.13 c	0.019 d
BA 100	23.14 b	108.89 c	26.14 b	29.04 d	5.81 c	0.19 b	0.050 c

Abbreviations: GA, gibberellic acid; BA, benzyladenine. In each column, means with the same letters are not significantly different at 5% level of Duncan's new multiple range test.

Our results are in agreement with previous studies reported by researchers. The studies show that plant growth regulators can influence the yield of essential oils such as lemongrass, peppermint and rose-scented geranium (Eid and Rofaeel, 1980; El-Keltawi and Croteau, 1986; Mishra and Srivastava, 1991).

Growth regulators can influence essential oil production through effects on plant growth, essential oil biosynthesis and the number of oil storage structures (Sharafzadeh and Zare, 2011).

Literatures illustrated that exogenous applications of methyl-jasmonate can alter essential oil constituents of basil by gene regulation, promoting an increase in the number of transcripts of the enzymes linked to metabolic pathway of those compounds (Kim *et al.*, 2006; Li *et al.*, 2007).

The application of growth regulators may affect essential oils due to their effects on enzymatic pathways of terpenoid biosynthesis (Sangwan *et al.*, 2001).

Conclusion

Gibberellic acid at 50 and 100 ppm resulted in the best values of flowering and at concentration of 50 ppm indicated the maximum essential oil percentage and yield. Under present experimental conditions, spraying by gibberellic acid at 50 ppm can be recommended as a suitable rate for optimum flowering and production of the highest yield of essential oils.

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