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ORIGINAL ARTICLE

Growth and Essential Oil Responses of German Chamomile to Thiamine *and Ascorbic Acid*

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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. Vitamins influence many biological processes and affect on synthesis of enzymes, nucleic acids, proteins and act as co-enzyme in metabolic pathways. This pot experiment was conducted to evaluate the effects of thiamine and ascorbic acid on growth and essential oils of German chamomile. The study was carried out by spraying of thiamine or ascorbic acid (50 and 100 ppm) at the vegetative stage using a completely randomized design (CRD) with three replications. The vitamins influenced on growth and essential oils significantly. Thiamine at 100 ppm resulted in the best values of growth characteristics, while thiamine at concentration of 50 ppm resulted in the highest essential oil percentage and yield.
***Key words:** vitamin, medicinal plants, volatile oils, Matricaria recutita*

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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 [1]. 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 [2]. 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 [3].

Thiamine (Vitamin B1) is necessary for biosynthesis of the coenzyme thiamine pyrophosphate which has a role in carbohydrate metabolism [4,5]. In plants, it is synthesized in the leaves and is transported to the roots where it controls growth [4].

Ascorbic acid (Vitamin C) is synthesized in the higher plants and influences plant growth and development and plays an important role in the electron transport system [6]. Blokhina et al. (2003) reported that ascorbic acid can be a regulator on cell division and differentiation and has an important role in a wide range of functions such as antioxidant defense, regulation of photosynthesis and growth [7]. Ascorbic acid is a cofactor for many enzymes such as ones involved in the cell wall synthesis and hydroxylation of proline residues [8].

A research revealed that growth and flowering of gladiolus as affected by thiamine and ascorbic acid at 100 or 200 ppm [9]. Youssef and Talaat (2003) indicated that application of thiamine improved growth and chemical components of rosemary [10]. A report indicated that ascorbic acid at 75 ppm resulted in the best values of plant height, number of branches, number of flower heads and seed weight per plant in fennel [4].

The aim of this study was evaluation of the effects of thiamine and ascorbic acid 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 December, 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 thiamine (50 and 100 ppm) or ascorbic acid (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 15 pots. The flower heads were collected each 20 days during flowering (four times), and were dried at room temperature. Finally, shoot and root fresh weights were measured and the samples were dried at 60 °C for 72 hours in order to define shoot and root dry weights.

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

The results of this experiment revealed that thiamine and ascorbic acid altered vegetative and flowering characteristics and oil percentage and yield of German chamomile (Table 1). The highest values of flower number (61.91), flower dry weight (51.93 g/plant), shoot fresh weight (61.98 g/plant) and shoot dry weight (16.20 g/plant) were achieved on thiamine 100 ppm. The maximum percentage of essential oil (0.34%) and oil yield (0.14 g/plant) were obtained at thiamine 50 ppm.

Table 1. Effects of vitamins on growth, oil percentage and oil yield of German chamomile.

Vitamins (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	26.69 b	155.40 b	29.28 c	44.87 c	12.79 ab	0.13 c	0.04 cd
T 50	60.62 a	209.18 a	41.74 b	51.39 b	12.09 b	0.34 a	0.14 a
T 100	61.91 a	179.37 ab	51.93 a	61.98 a	16.20 a	0.15 c	0.08 b
AA 50	14.59 c	53.58 d	17.49 d	34.67 d	7.94 c	0.15 c	0.03 d
AA 100	23.87 b	106.97 c	28.02 c	32.03 d	7.49 c	0.23 b	0.07 bc

Abbreviations: T, thiamine; AA, ascorbic acid. 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. Reda et al. (1977) reported that application of thiamine significantly increased the total yield of chromone in the fruit of *Ammi visnaga* [11]. An experiment showed that application of ascorbic acid increased vegetative growth and chemical components of *Cupressus sempervirens* L. plants [12]. A report illustrated that ascorbic acid and α-tocopherol affected on the growth and some chemical compounds of *Hibiscus rosa sineses* [13]. Tarraf et al. (1999) revealed that foliar application of nicotinamide altered vegetative growth, essential oil percent and oil yield of lemongrass [14]. Application of combined treatment of 2 ppm dry yeast and thiamine at 20 ppm increased vegetative growth, seed index, yield, fixed oil and essential oil of *Nigella sativa* [15].
Thiamine is a cofactor which has an important role in biosynthesis pathway of nucleotide synthesis and other synthetic pathways [16]. A report revealed that the first dedicated step of the non-mevalonate pathway for terpenoid biosynthesis in plants is synthesis of 1-deoxy-D-xylulose-5-phosphate (DOXP), which is catalyzed by thiamine diphosphate (TPP) dependent DOXP synthase via a transketolase- like decarboxylation from pyruvate and glyceraldehyde-3-phosphate (GAP) [17], so thiamin has an important role in essential oil biosynthesis which is in agreement with present study.

CONCLUSION

Thiamine at 100ppm resulted in the best values of growth parameters, while thiamine at concentration of 50ppm revealed the highest essential oil percentage and yield. We recommend spraying by thiamine at 50ppm for production of the highest yield of essential oils.

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