6th IFAOM-Asia Scientific Conference

"Benign Environment and Safe Food"

7th – 11th September 2004
Yangpyung / Korea

Organized by

Yangpyung county,
Research Institute of Organic Agriculture / Dankook Univ.
Korean Organic Farmers Association

Supported by

Ministry of Agriculture and Forestry ,
Rural Development Admistration,
Korea National Tourism Organization,
Kyonggi Province
Natioal Agricultural Cooperative Federation

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Organic production of German Chamomile *(Matricaria chamomilla L.)* intercropped with Pot Marigold *(Calendula officinalis L.)*

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Abstract : Effects of organic production of German Chamomile intercropped with Pot Marigold, on agronomic criteria and chemical composition of German Chamomile was studied in a split plot design with three applications. Treatments were four levels of animal manure (0, 30, 40 and 50 tons/ha) as main plots and five seeding ratio of German Chamomile with Pot Marigold (100:0, 75:25, 50:50, 25:75 and 0:100) as sub plots. Results showed that animal manure has no effects on total dry matter of Matricaria chamomilla. However with decreasing proportion of seeding rates of German Chamomile in the mixture, leaf area, total dry matter yield and seed yield of German Chamomile was reduced. Chamazulene content of essential oil was affected by leaf area and seed yield. Seeding ratios of 50:50 or 25:75 were the most promising seeding rates in terms of Chamazulene content.

Keywords: Organic farming; Matricaria chamomilla; Calendula officinalis; Chamazulene; Manure.

Introduction

German Chamomile is one of the old medicinal plants and it has been used by humans since the Roman era (4). Since the fifteen century, its beneficial essential oil has been recognized and widely used (2). Overutilization in natural habitats has been severe and therefore for the last few decades cultivation of these plants in many European countries including Finland, Czech, Slovenia, Germany and Greek has been practiced. German Chamomile has not been produced widely under cultivation in Iran. However In natural habitats, different species of German Chamomile are grown but German Chamomile is the most widespread (3). Rechinger (11) has reported the natural distribution area of this species as Iran, Pakistan, India, China and Japan. Essential oils of German Chamomile are mainly of terpenoids, or terpenoid based compounds (1, 5). However the medicinal significant of German Chamomile is due to compounds such as α-bisabulol, Cineol, Maricarin, Matricin and Chamazulene, the most important of which is Chamazulene. Matricin is a predecessor of Chamazulene and its content is regarded as an index for Chamazulene content. Essential oil 's content of German Chamomile is 0.24 to 1.9 percent of fresh weight of the flowers. By proceeding the age of plants, the amount of essential oil and its composition is changed (6). Environmental conditions also affect essential oil content and sunny days enhance the amount of these compounds (7). Optimum temperature of 20 to 40 oC has also been recorded for Chamazulene accumulation (9). Beginning of flowering period and in the

second growth period Chamazulene content is higher (7, 8). Spring planting has been reported to improve Chamazulene content compared to autumn planting and tube flowers which consist 70% of the total flower weight contains higher essential oils (1). Nitrogen is important in biosynthesis of essential oils and therefore nitrogen fertilizers have positive effects on these compounds (10). However, in organic production systems these chemical are not allowed and therefore the aim of this study was to find out how this medicinal plant responds to organic farming systems in terms of quality and agronomic criteria.

Material and Methods

This experiment was conducted in experimental farm of the Faculty of Agriculture, Ferdowsi University of Mashad, Iran in 2002-2003.Animal manure was applied in advance for further decomposition and planting was carried out in early March. Seeds were mixed with saw dust for a better uniformity of distribution in time of planting. An split plot with 3 replications in complete randomized block arrangement was used with 0, 30, 40 and 50 tons/ha of animal manure as mail plots and 5 levels of seed mixture ratio of 100:0, 70:25, 50:50, 25:75, 0:100 for German Chamomile and Pot Marigold as sub plots. Plot dimensions were 8*4 meters and seeds were sown on both side of rows with 40 centimeter between rows and 8 centimeter within rows for German Chamomile and 15 centimeter for pot Marigold. Weeding were done by hand as required and all other practices were based on organic production procedures. Harvesting of flowers was conducted when more than 50% of flowers were open. Factors such as flower yield, total dry matter yield, leaf area, seed yield and Chamazulene content were determined.

Results and discussion

Results showed that application of animal manure had no effect on total dry matter yield (Fig 1).

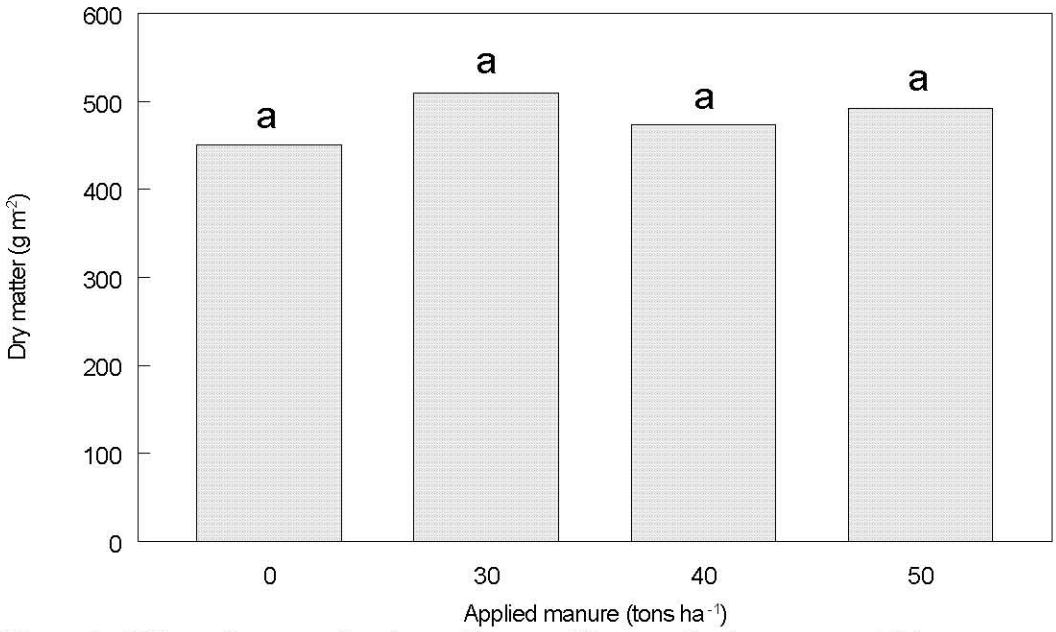

Figure 1. Effect of manure levels on German Chamomile dry matter yield

Leaf area index for German Chamomile was reduced by application of manure. Although this parameter showed no particular trend in response to seed mixture ratio, but the highest value was obtained in 50:50 seed mixture (Fig 2-a). However, total dry matter yield of German Chamomile was significantly affected by seed mixture ratio (Fig 2-b), where the highest DM was obtained in 100:0 and the yield reduced was proportional to the reduction of seed in the mixture.

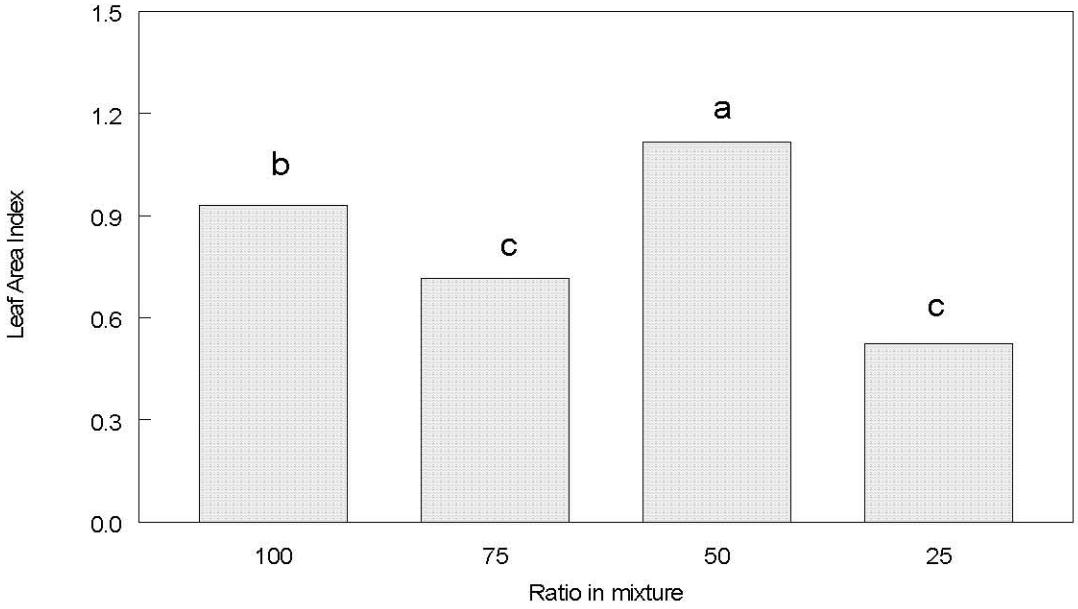

Figure 2-a: Effect of Ratio in mixture of German Chamomile and Pot Marigold on German Chamomile Leaf Area Index

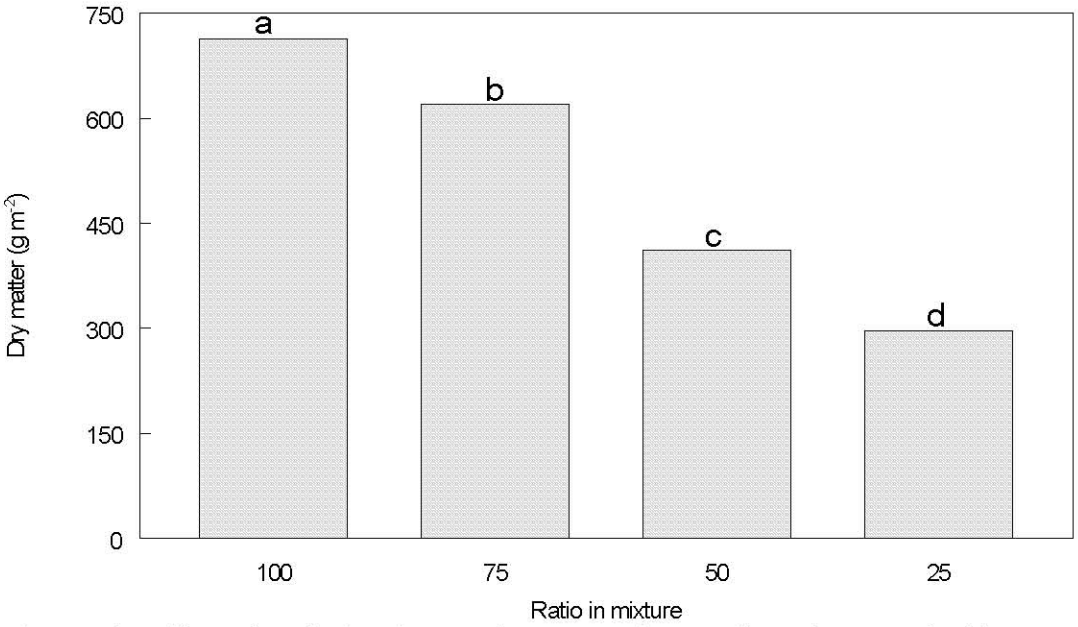

Figure 2-b: Effect of Ratio in mixture of German Chamomile and Pot Marigold on German Chamomile dry matter yield

In other words by reducing the proportion of seed of German Chamomile in the mixture, its DM yield was reduced. This is not an unexpected case because by doing that, plant density is reduced and hence dry matter yield. Seed weight was also showed the same trend in response to the seed mixture ratio. In other words seed yield of 100:0 was 2.5 times higher than seed yield in 25:75 ratio (Fig 2-c). This has been reported for other plants in mixtures too (12, 13). However yield in mixture is higher than in pure culture; due to better efficiency in utilization of resources (14).

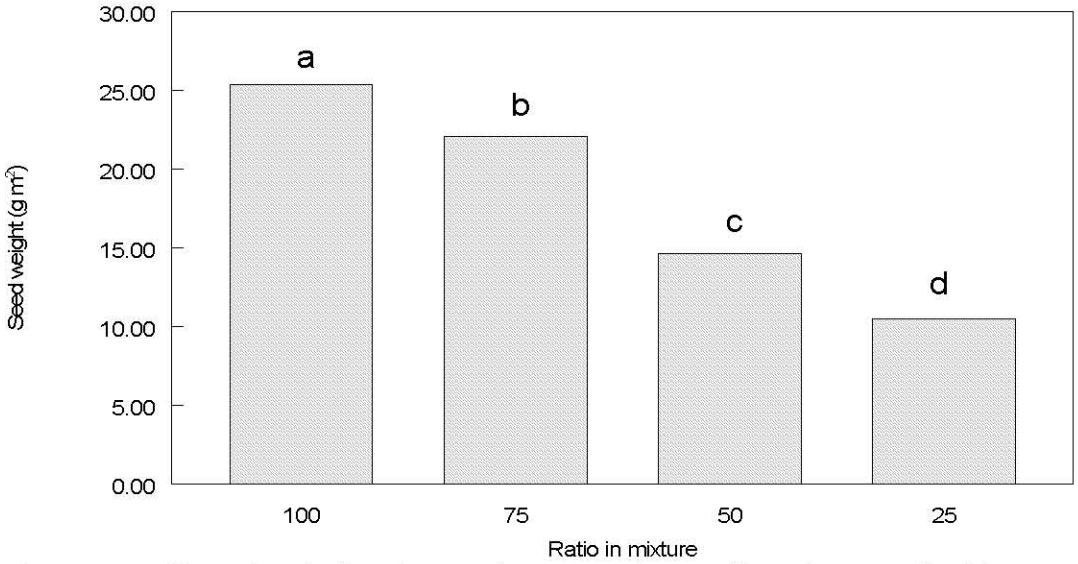

Figure 2-c: Effect of Ratio in mixture of German Chamomile and Pot Marigold on German Chamomile seed weight

Chamazulene content was reduced by application of animal manure and there was no differences between the amount of applied manure (Fig 3-a). By reducing the ratio of German Chamomile seed in the mixture, Chamazulene content was significantly increased (Fig 3-b).

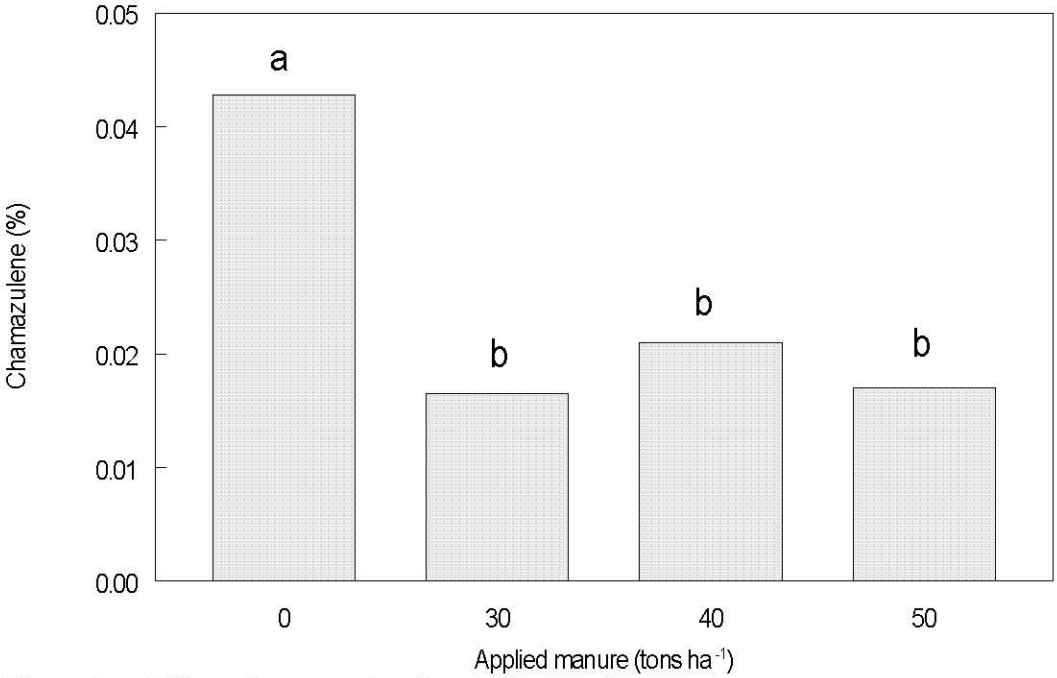

Figure 3-a: Effect of manure levels on Chamazulene content

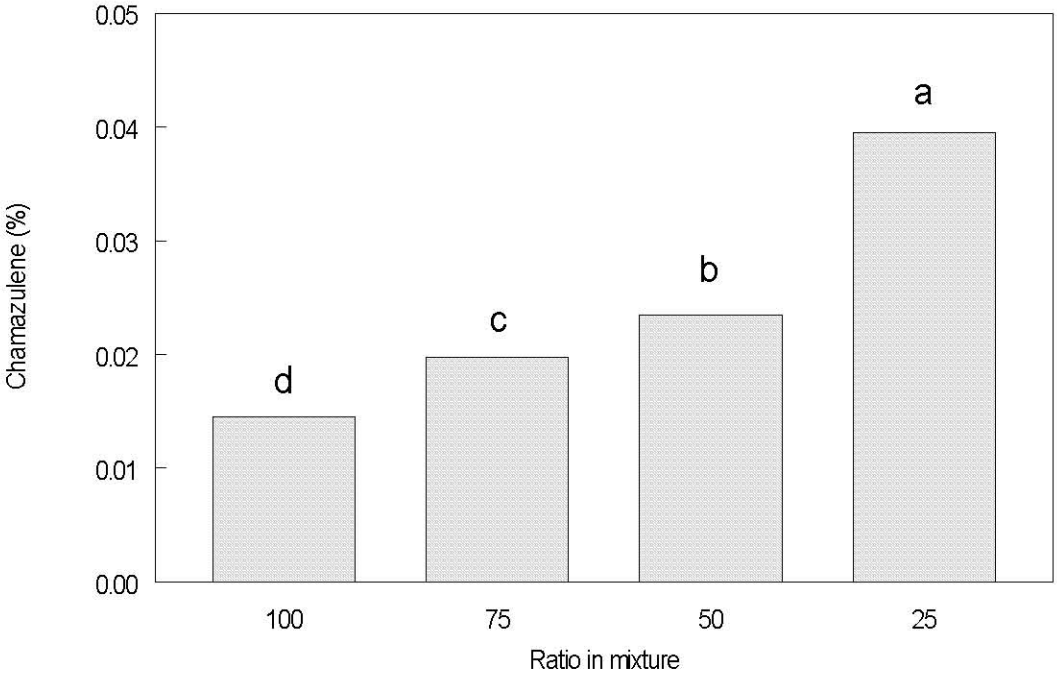

Figure 3-b: Effect of Ratio in mixture of German Chamomile and Pot Marigold on Chamazulene content

Figure 4 shows that by increasing dry matter yield, Chamazulene content were initially reduced up to 0.02% (flower dry weight) and thereafter it was almost unchanged.

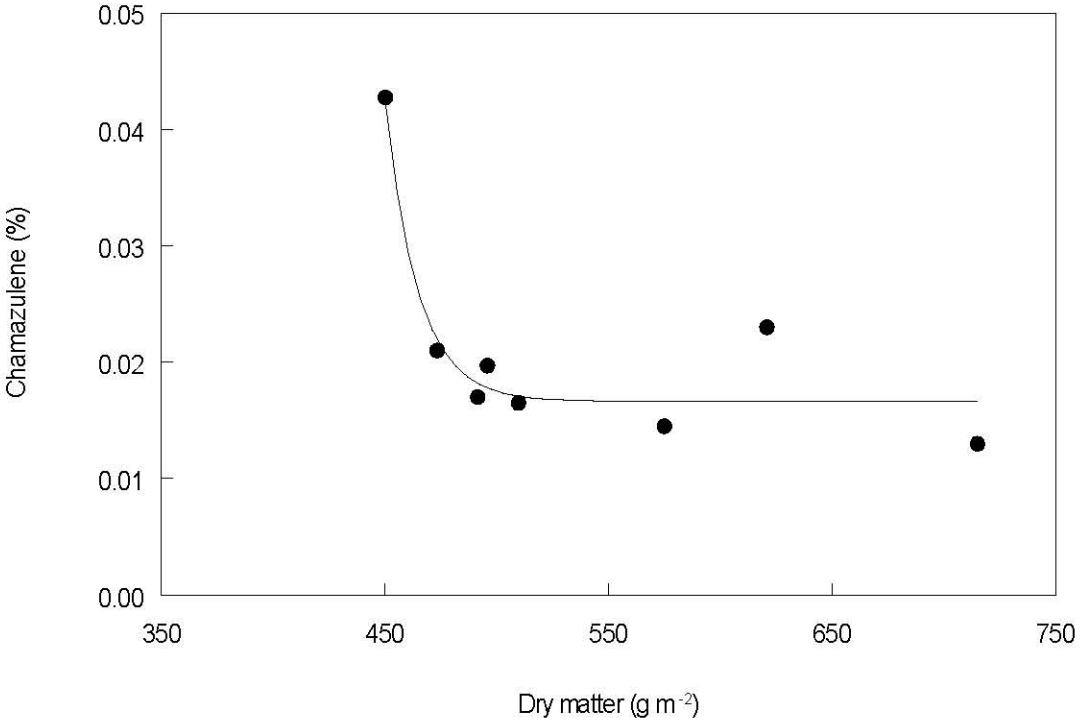

Figure 4: Changes in Chamazulene content associated with German Chamomile dry matter yield

Leaf area index showed a positive relationship with chamazulene content (Fig 5-a). However, at leaf area index lower than 1.4, Chamazulene content was relatively constant. Seed yield showed a negative relationship with Chamazulene content (Fig 5-b).

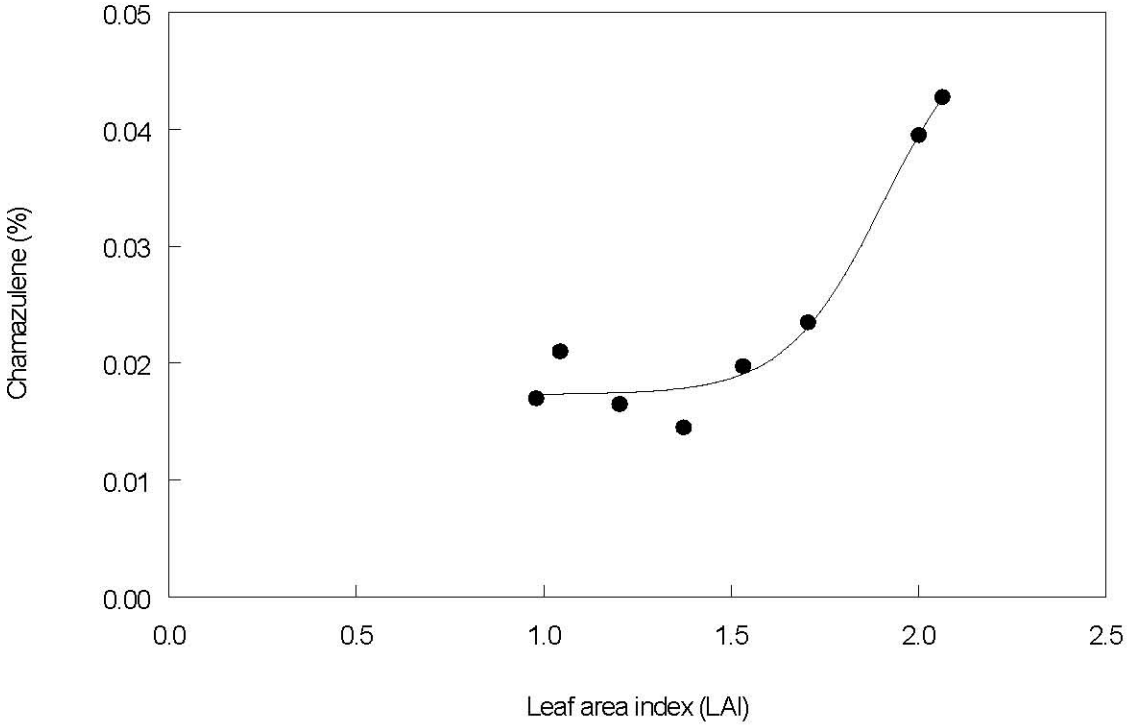

Figure 5-a: Changes in Chamazulene content associated with German Chamomile Leaf Area Index

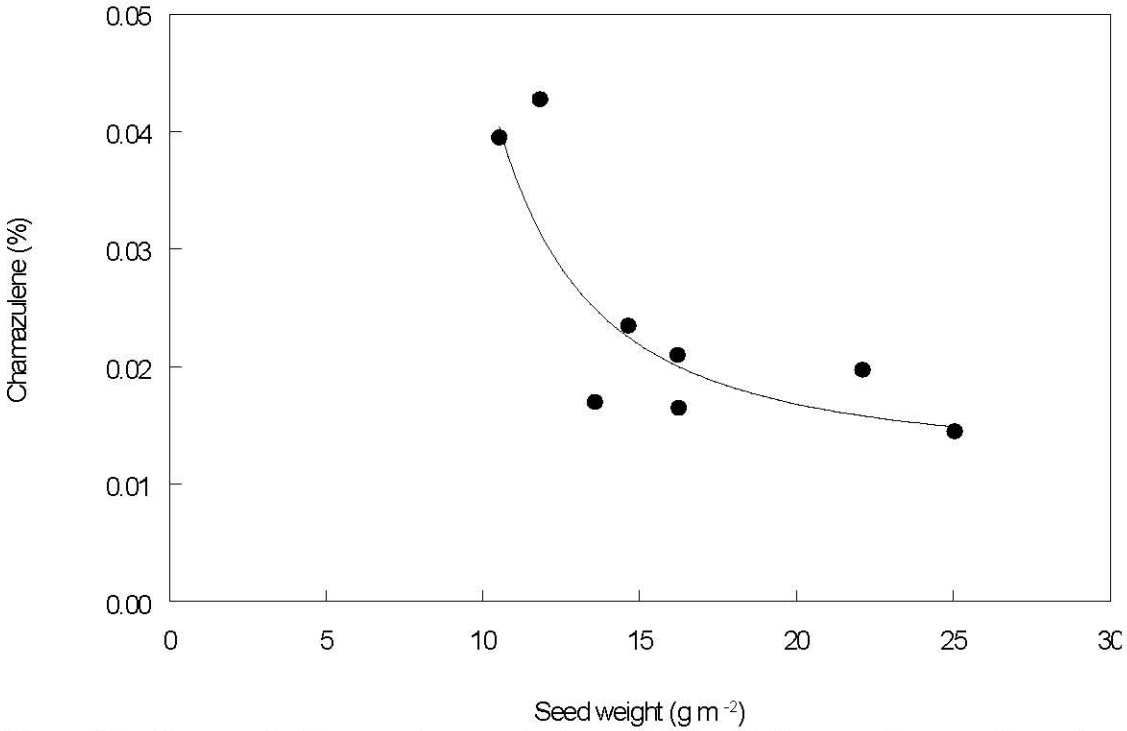

Figure 5-b: Changes in Chamazulene content associated with German Chamomile seed weight

By comparing Figs 5-b and 2-b it appears that the effect of seed yield on Chamazulene content in comparison to the effects of leaf area index and total dry matter yield is more pronounced where the factors which have a negative effects on seed yield, caused an increase in Chamazulene content.

Acknowledgement

The authors would like to appreciate Center of Excellence for Special Crops (CESC) for financing and help for doing this research and also very appreciated to professor Koocheki and Dr. Nassiri Mahalati for their guides.

References

1_ Omidbaigi, R. 1997. Approaches to production and processing of medicinal plants. Fekre Rouze publish Co. Tehran, Iran.
2_ Hajihashemi, V. 1987. Evaluation of camomile species for cultivation in Isfahan. Msc thesis, Faculty of agriculture. Isfahan university of science and technology.
3_ Rahimi Kalamroudi, H. 1990. Botany and cultivation of diploid and tetraploid species of camomile and evaluation of it's essential oil. Msc thesis, Faculty of pharmacology, Isfahan university of medicinal science.
4_ Mirhidar, H. 1994. Knowing the plants. Nashre farhang eslami Co. Tehran.
5_ Arctander, S. 1960. Perfume and flavor materials of natural origin. Simon & Schuster Corp., New York, U.S.A.
6_ Emonger, V.E. and J.A. Chweya. 1989. Effect of Plant age on camomile (German Chamomile L.) flower yield, essential oil content and composition. Discovery and Innovation.1: 18-25.
7_ Emonger, V.E. 1988. Effects of nitrogen and phosphorus on growth, yield of flowers and essential oil of camomile grown under Kenya conditions. M.Sc. Thesis, Faculty of Agriculture, University of Nairobi.
8_ Franz, Ch. and C. Kirsh. 1974. Growth and flower bud formation of German Chamomile in dependence on varied nitrogen and potassium nutrition (in German). Horti. Sci. 21: 11-19.
9_ Hornok, L. 1992. Cultivation and processing of medicinal Plants. Academic Pub. Budapest.
10_ Letchamo, W. 1995. A comparative study of camomile yield, Essential oil and flavonoides content under two sowing seasons and nitrogen levels. Acta – Horti. 306: 375-384.
11_ Reichinger, K.H. 1977. Flora Iranica. Vol. 22. No. 158:82-88.
12_ Reilly, J. 1990. Resource use in intercropping systems. Field Crops Research. 21: 45-61.
13_ Spitters, C.J. and C.T. De Wit. 1990. Additive and replacement series experiments in intercropping studies. In: Principal of Production Ecology. PUDCO Monograph Series, pp: 83-98.
14_ Vandermeer, J. 1989. Ecology of Intercropping. Elsevier Publishers, The Netherlands.