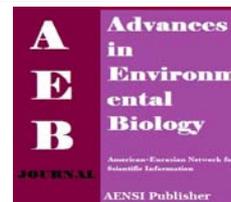




AENSI Journals

Advances in Environmental Biology

Journal home page: <http://www.aensiweb.com/aeb.html>

Effects of sowing date and nitrogen fertilizer on seed and flower yield of pot marigold (*Calendula officinalis* L.) in the Kerman

¹Sayed Mohammad Aliva Kili Shahrabaki, ²Somayeh Zoalhasani, ³Mohamadreza Kodory

¹Islamic Azad university of jiroft Branch, Iran.

²M.SC Studerntof Islamic Azad university of jiroft Branch, Iran.

³Agriculture research center of kerman, Iran.

ARTICLE INFO

Article history:

Received 15 September 2013

Received in revised form 26

November 2013

Accepted 29 November 2013

Available online 4 January 2014

Key words:

Calendula officinalis, sowing date, Nitrogen, Seedy

ABSTRACT

This research was conducted in experimental field of agriculture research center of Kerman in Iran during 2011-2012 the experiment unit was designed by achieved treatment in split-plot on the basis of completely randomized block design with four replications, the sowing date was applied to the main plots at two levels of (15 December and 15 April) and the N fertilizer was applied to the sub-plots at the rate of (non-application, 50, 100, 150, kg.ha⁻¹) the results showed that nitrogen fertilizer had a significant effect on number seed in head, flower harvest index, thousand seed weight, flower fresh weight/plant, flower fresh weight yield/hectare, flower dry weight and seed yield ha⁻¹ (P<0.01) such that maximum flower harvest index, (27/90%) thousand seed weight (411/70g) flower fresh weight/plant (183g) flower fresh weight yield (36723kg/ha⁻¹) flower dry weight (4800kg/ha⁻¹) seed yield (12615kg/ha⁻¹) number seed of head (26/90) were achieved under 150kg/ha⁻¹. Sowing date had a significant effect on all plant characteristics except on number seed in head (P=0.01) and highest thousand seed weight (423g) seed yield (10908/7kg/ha⁻¹) flower fresh weight yield (26/282kg/ha⁻¹) flower dry weight yield (4800kg/ha⁻¹), flower harvest index (27%) flower fresh weight/plant (133g) achieved after autumn sowing date (15 September), the results of the experiment showed that autumn sowing date (15 September) and 150 kg of nitrogen fertilizer at/ha⁻¹ is the best condition that could be applied in Kerman?

© 2013 AENSI Publisher All rights reserved.

To Cite This Article: Sayed Mohammad Aliva Kili Shahrabaki, Somayeh Zoalhasani, Mohamadreza Kodory., Effects of sowing date and nitrogen fertilizer on seed and flower yield of pot marigold (*Calendula officinalis* L.) in the Kerman. *Adv. Environ. Biol.*, 7(13), 3925-3929, 2013

INTRODUCTION

Pot marigold (*Calendula officinalis* L.), (Asteraceae) is an annual, aromatic, medicinal and ornamental herb with yellow and orange flowers, a native to Mediterranean region [7]. The composite flowers blossom in the spring-summer seasons three times per year [8], [16]. The leaves and flowers of marigold are applied in horticulture, medicine, cosmetics, perfume, pharmaceutical preparation, food and other industries [11;14; 21,7]. Sowing date and N fertilizer are the two most important factors that affect directly on the yield, and yield components [12]. Selection of suitable sowing date has advantages in relation to assembling the raw material and other productions. It can be accomplished by choosing the right plant species, soil, sowing date, plant nutrition [22,23], harvest [22,23], cultivation methods [22]. Early cultivation of *C. officinalis* L. causes frost-bite and finally weakly establishment of plant in spring. Also, late cultivation causes shorten of growth period and simultaneous flowering period with very high temperature in summer [4,19] evaluated the effect of three sowing dates (March 30, April 14 and 30) on *C. officinalis* L. Flowering and showed that the sowing date had significant differences on plant dry weight and seed yield. A study on the other species from Asteraceae family confirmed these results [10]. Study of [12] on the influence of sowing date on the yield of capitula of *C. officinalis* L. during two growing seasons showed that in the first year of production the highest capitula yield was obtained in the treatment sown on June 4. In the second year, there was no difference in yield between sowing dates, and the average dried capitula yield was 3685 kg/ha. The sum total yield of the two growing seasons was 4594 kg/ha of dried capitula [13] demonstrated that the highest flower yield in *C. officinalis* L. was obtained in sowing date of April 15. Sowing date affects on quantity and quality of secondary metabolites [10]. N fertilizers can substantially increase plants yield [15,9,1] indicated that N fertilizer had

Corresponding Author: Sayed Mohammad Aliva Kili Shahrabaki, Islamic Azad university of jiroft Branch, Iran.
E-mil: mohammadvakili72@yahoo.com. Tell:009893401595

significant effect on seed yield of balm. Their results showed that highest seed yield was achieved under application of 100 kg N ha⁻¹ and highest oil yield was achieved under application of 50 kg N ha⁻¹. Also, [18] investigated the effect of N fertilizer on seed yield and composition of fennel and N application increased seed yield significantly. Therefore, the objective of this study was to evaluate the effects of nitrogen fertilizer and sowing date on the growth, flowering and seed yield of pot marigold (*Calendula officinalis* L).

MATERIALS AND METHODS

Seeds of marigold (*C. officinalis*L.) were prepared from PakanBazr Co.Isfahan, Iran. Investigation was carried out on experimental field in the agriculture research center of kerman, Iran (N 31° 7' 5.5'' and E 57° 14' 12.6'' altitude 1749 m above sea level; mean annual rainfall, 175-200 mm; mean annual temperature, 26°C. Experiment was designed in split-plot test on the basis of completely randomized block design with 4 replications the sowing date were considered as the main plot. at. (15 April and 15, September) and Nitrogen fertilizer at the rate of (0, 50, 100, 150, kg/ha) were sown in sub plots, totally, 32 plots were used in this experiment. Plot area was 10/5 m² (5m × 2/10 m), totally; 32 plots Initially, plant nutrient need of phosphorus and potassium were added by applying 100kg.ha⁻¹ ammonium phosphate 200 kg.ha⁻¹ k₂O and nitrogen (urea) treatments at planting time respectively. Distance between plots and blocks were 0.5 and 1 m, respectively; row distance was 20 cm. Thinning was performed 2 weeks after cultivation. Irrigation was carried out in 7 days intervals, Hoeing was conducted in three stages: 15, 30 and 45 days after planting. The chemical analysis of the growing medium is presented in Table 1. to determine seed yield, flower dry weight yield /plant .thousand seed weight, number of seed per head. flower fresh weight/plant ,and number of seed per head 10 plants were selected randomly from each plot at maturity Data processing of the results was carried out by an EXCEL. Analysis of variance (ANOVA) was done using SPSS statistical software and means were compared using Duncan's test.

Results:

Final results of plants characters showed that N fertilizer had significant effect on seed yield ,thousand seed weight, number seed per head ,flowers harvest index, flower fresh weight /plant, flower fresh weight yield, and flower dry weight yield (p<0/01) and highest thousand seed weight(411/7g), seed yield(12615kg. ha⁻¹) number seed per head(26/9), flowers harvest index(27/9%) flower fresh weight /plant(183g) flower fresh weight yield(36723kg. ha⁻¹) were achieved under application of 150kgNha-I therefore our findings indicated a significant improvement in morphological characteristics of plant under application on of N fertilizer(table 2 and 3). In addition sowing date had a significant effect on all. plant characteristics except number seed /head(p<0/01). And highest flower harvest index(27%) thousand seed weight(423g) flower fresh weight /plant (133g), flowers fresh weight yield(26282kg. ha⁻¹) seed yield(109/87kg. ha⁻¹), were achieved on a fall cultivation (table2 and3), those results were similar with the findings of (19) in Calendulla, and interaction between application of Nitrogen and sowing date has been demonstrated in table5, Interaction had significant effect on flower fresh weight yield/plant ,and flower fresh weight yield/ha⁻¹ (P ≤ 0.01) and on other characteristic were not significantly. affected by the interaction(table5). Also highest seed yield (15051kg. ha⁻¹), thousand seed weight (494/09g), flower fresh weight /plant(221g), flower fresh weight yield (44747kg.ha⁻¹). Flower dry weight yield (7128kg.ha⁻¹) were achieved under 150kg.ha⁻¹ Nitrogen fertilizer and sowing date in the fall (table5). our results of treatments interaction were similar to the results of [6,17,5].

Discussion:

the results showed that applications of N fertilizer increased seed and flower yield of calendula, because nitrogen, which is a primary constituent of proteins, is extremely susceptible to loss when considering that average recovery rates fall in the range of 20 to 50% for dry matter production systems in plants. Nitrogenous fertilizers generally cause deficiency of potassium, increased carbohydrate storage and reduced proteins, alteration in amino acid balance and consequently change in the quality of proteins and are a main element in chlorophyll production [3]. Toxic concentrations of nitrogen fertilizers cause characteristic symptoms of nitrite or nitrate toxicity in plants, particularly in the leaves. Although pre plant fertilizer applications decrease the potential for nutrient deficiencies in early stages of growth, presence of residual soil NO₃N (plant-available mineral N from the previous season) may pose a risk to the environment. The soil water is salty by inordinate N application which increases its potential [2]. Finally, the plant use high energy to absorb salt water that causes dry matter reduction.. Selection of suitable sowing date has advantages in relation to assembling the raw material and other productions. It can be accomplished by choosing the right plant species, soil, sowing date, plant nutrition, harvest etc. Early cultivation of *C. fficinalis* L. causes frost-bite and finally weakly establishment of plant in spring. Also, late cultivation causes shorten of growth period and simultaneous flowering period with very high temperature in summer [4]. [19] evaluated the effect of three sowing dates

(March 30, April 14, and 30) and three row spacing (10, 20, and 30 cm) on *Officinalis* L. flowering and showed that the plant density and sowing date had significant differences on plant dry weight and seed yield.

Table 1: Results of soil analyses

Clay (%)	Silt (%)	Sand (%)	K(mg ka ⁻¹)	P(mgka ⁻¹)	N(mg ka ⁻¹)	OC (%)	PH	EC (Ds m-1)	Depth of sampling (cm)
34	32	64	170	10	0/028	0/28	7/7	3/6	0-30

Table 2: Analysis of variance.

Mean Squares								
Seed yield (kg.ha ⁻¹)	Number of seeds per head	Flower dry weight yield (kg.ha ⁻¹)	Flower s harvest index	Flower fresh weight yield (kg.ha ⁻¹)	Flowers fresh weight/plant (g)	Thousand seed weight (g)	df	Sources of variation
5098000*	7/2ns	797/7**	71/3*	26970000**	7019/4**	3433/1ns	3	Replication
12070000	11/4ns	1/1**	318/3**	94700000**	20887/6**	103560	1	Sowing date
1691000	9/6	282/8	34/4	6690000	1480/1	724/4	3	Error a
13730000	55/3**	15/3**	236/5**	162000000	39334/4**	32643/5**	3	<i>N</i> fertilizer
2182072/5	10/2ns	61/6ns	21/3ns	10040000*	1995/4*	14394/9**	3	<i>Sowingdate</i> × <i>N</i> fertilizer
345881/5	6/3	54/16	19/2	3303000	819/8	3284/9	18	♀Error b
					7019/4**		32	Total
11/6	13/3	19	8/33		26	15/6		% C.V.

*and **significant at 5 and 1% levels respectively ns:no significant

Table 3: means comparison of main treatments.

seed yield (kg.ha ⁻¹)	Thousand seed weight (g)	Flowers dry weight yield (kg.ha ⁻¹)	Flower fresh weight yield (kg.ha ⁻¹)	Flower harvest index (kg.ha ⁻¹)	Number seed per head	Flower fresh weight/plant(g)	treatments sowing date
10908/7a	423a	4800a	26282a	27a	25/3a	133a	fall
7024b	309b	2410b	16401b	20/7b	24/1a	82b	spring

Means within the same Column and factors, followed by the same letter are not significantly difference (p<0.05) and (P ≤ 0.01)

Table 4: means comparison of main treatments.

Seed Yield (Kg.ha ⁻¹)	Flower Dry Weight Yield (Kg.ha ⁻¹)	Flower Fresh Weight Yield (Kg. Ha ⁻¹)	Flower Harvest Index	Number Seed Per Head	Flower Fresh Weight/Plant (G)	Thousand Seed Weight (G)	Treatment N Fertilizer
3138c	788c	4591/6d	15/9b	21/2b	22d	271/9b	NON FERTILIZER
9102b	3231b	16484c	24/6a	24/2a	82c	384/1a	50 Kg/h
11011ab	4845a	29568/4b	26/8a	26/5a	143b	397/2a	100 Kg/h
12615a	5558a	36723a	27/9a	26/9a	183a	411/7a	150 Kg/h

Means within the same column and factors, followed by the same letter are not significantly difference (p<0.05) and (P ≤ 0.01)

Table 5: means Comparison of interaction

Seed yield (kg. ha ⁻¹)	Flower dry weight yield (kg. ha ⁻¹)	Flower fresh weight yield (kg. ha ⁻¹)	Flower harvest index	Flower fresh weight/plant	Thousand seed weight (g)	treatments N fertilizer	Sowing date
4458a	1129a	6092f	18a	30e	265/4c	Non-application	fall
10809a	4687a	19904d	26a	99c	459ab	50 Kg/h	
13317a	6257a	38376ab	31/7a	182ab	473/5a	100 Kg/h	
15051a	7128a	44747a	32a	221a	494/09a	150 Kg/h	
1818a	448a	3090fg	13/8a	15e	278c	Non application	spring
7395a	1774a	13064e	23/2a	65d	308bc	50 Kg/h	
8706a	3432a	20760d	22a	103c	320/9b	100 Kg/h	
10179a	3988a	28692c	23/6a	144bc	329/5b	150 Kg/h	

Means within the same column and factors, followed by the same letter are not significantly difference (p<0.05) and (P ≤ 0.01)

Conclusion:

The results showed that, autumn sowing date (15 September) and 150 kg of nitrogen fertilizer/hectar. Is the

best condition that could be increased seed and flower yield of calendula in Kerman our finding may give applicable advice to farmers and medicinal and aromatic plants researches for management and proper use of nitrogenous fertilizers in arid and semi-arid areas.

ACKNOWLEDGEMENTS

We thank Islamic azad university of jiroft and Agriculture research center of kerman, for their great support encouragement, and help with the experiment

REFERENCES

- [1] Abbaszadeh, B., A.E. Sharifi, M.R. Ardakani, M.H. Lebaschi, F. Safikhani, H.B.M. Naderi, 2006. Effect of application methods of nitrogen fertilizer on essential oil content and composition of balm (*Melissa officinalis* L.) under field condition. Iran. J. Med. Aroma. Plant. Res., 22(3): 124-131.
- [2] Alizadeh, S.A., A.E. Sharifi, A.H. Shiranirad, B. Abbaszadeh, 2006. The effects of different methods and levels of using nitrogen on some quality and quantity characteristics of *Saturejahortensis* L. Iran. J. Med. Aroma. Plant. Res., 23(3): 121-128.
- [3] Cooper, J.E., 1974. Effects of post-planting applications of nitrogenous fertilizers on grain yield, grain protein content, and mottling of wheat. Queensl. J., Agric. Anim. Sci., 31: 33-42.
- [4] Cromack, H.T.H., J.M. Smith, 1988. *Calendula officinalis*, production potential and crop agronomy in southern England. Indust. Crop Prod., 7: 223-229.
- [5] Diaz, P., O. Borsani, A. Marquez, J. Monza, 2005. Nitrogen metabolism in relation to drought stress responses in cultivated and model *Lotus* species. *Lotus* newsletter, 35(1): 83-92.
- [6] Eghball, B., J.W. Maranville, 1993. Root development and nitrogen influx of corn genotypes grown under combined drought and nitrogen stresses. Agron. J., 85: 147-152.
- [7] Gazim, Z.C., C.M. Rezende, S.R. Fraga, T.I.E. Svidzinski, 2008. Antifungal activity of the essential oil from *Calendula officinalis* L. (Asteraceae) growing in Brazil. Brazilian J. Microbiol., 39: 61-63.
- [8] Gilman, E.F., T. Howe, 1999. *Calendula officinalis*. Cooperative Extension Service Institute of Food and Agricultural Science, University of Florida. Fact Sheet, FPS-87.
- [9] Grant, C.A., E.H. Stobbe, G.J. Racz, 1985. The effect of fall-applied N and P fertilizers and timing of N application on yield and protein content of winter wheat grown on zero-tilled land in Manitoba. Can. J. Soil Sci., 65: 621-628.
- [10] Jamshidi, K.H., 2000. Effects of row spacing and plant density on quantities. 13 Martin aspects of chamomile flower (*Matricaria chamomilla*). Iranian J. Agric. Sci., 31(1): 203-210.
- [11] Marczał, G., 1987. Data on the essential oil content and composition of *C. officinalis* L. Herba Hung., 26(2-3): 179-189.
- [12] Marisol Berti, D., E. Rosemarie Wilckens, H. Felicitas Hevia, Y. Alejandro Montecino, 2003. Influence of sowing date and seed origin on the oil content of capitulum *Calendula officinalis* L. during two growing seasons in Chile. Agric. Technol., 63(1).
- [13] Martin, J., B. Deo, 2000. Effect of plant population on calendula (*Calendula officinalis* L.) flower production. New Zealand J. Crop Hort. Sci., 28(1): 37-44.
- [14] Muusa, B.G., F.P. Cuperus, J. Derksen, 1992. Composition and physical properties of oils from new oilseed crops. Indust. Crops prod., 1: 57-65.
- [15] Olson, R.V., C.W. Swallow, 1984. Fate of labeled nitrogen fertilizer applied to winter wheat for five years. Soil Sci. Soc. Am. J., 48: 583-586.
- [16] Omidbaigi, R., 2005. Production and processing of medicinal plants. Behnashr Publication, Mashhad, Iran
- [17] O'Neill, P.M., J.F. Shanahan, J. Schepers, B. Caldwell, 2004. Agronomic responses of corn hybrids from different eras to deficit and adequate levels of water and nitrogen. Agron. J., 96: 1660-1667.
- [18] Sharifi, A.E., B. Abbaszadeh, 2003. Effects of manure and fertilizers in nitrogen efficiency in fennel (*Foeniculum vulgare* Mill). Iran. J. Med. Aroma. Plant. Res., 19(3): 133-140.
- [19] Seghatoleslami, M.J., G.R. Mousavi, 2009. The effects of sowing date and plant density on seed and flower yield of pot marigold (*Calendula officinalis* L.). Acta Hort., pp: 371-376.
- [20] Stepanović, B., 1998. Medical and aromatic plant production. Institute for medical plant study, Dr. Josif Pančić, Belgrade.
- [21] Van Wyk, B.E., M. Wink, 2004. Medicinal plants of the world. Briza Publications, Pretoria.
- [22] Abdelrazzaq Al-Tawaha, Ghazi Al-Karaki, Adnan Massadeh. 2013. Comparative response of essential oil composition, antioxidant activity and phenolic contents of spearmint (*Mentha spicata* L.) under protected soilless vs. open field conditions, Advances in Environmental Biology, 7(5): 902-910.
- [23] Abdelrazzaq Al-Tawaha, Ghazi Al-Karaki, Adnan Massadeh. 2013. Antioxidant activity, total phenols and variation of chemical composition from essential oil in sage (*Salvia officinalis* L.) grown under protected

soilless condition and open field conditions. *Advances in Environmental Biology*, 7(5): 894-901.