

Morphological Features Response of Calendula to the Application of Animal Manures (Cow, Chicken, and Ostrich Manures)

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Abstract – *Calendula officinalis* L., is one of the most important medicinal herbs in Iran. The only limited researches that have been done on the need of medicinal plants to the fertilizer in arid and semiarid regions show that the use of organic fertilizers (manure and poultry) can improve environmental conditions without worrying about the effects of physical, chemical and biological of soil and also increases soil fertility.

To investigate the effect of organic fertilizers on the characteristics in *Calendula officinalis* L., an experiment was carried out in a randomized complete block design with four treatments and three replications.

This study was carried out through the 2012-2013 season at the Agricultural Research Institute related to Zabol University (Chahnimie). In addition, data obtained throughout this study were statistically analyzed using the analysis of variance method, and the differences between means were differentiated by using Duncan's range test. Treatments were different organic fertilizers include: Cow manure, Chicken manure, Ostrich manure, and control (no fertilizer) with the amount of 20 tons.h⁻¹.

Results of analysis of variance showed that the effects of animal manures on length and width of plant and also number of Capitula/plant and number of seed/Capitula were not significant. However, the study showed that the use of chicken manures significantly enhanced the some morphological components of *Calendula* compared to the others manures. The plant height, number of flowers/plant, number of leaves/plant, number of seeds/plant, and 1000-seed mass were increased by animals manure however, the chicken manure has a stronger effect than others. Moreover, the seed yield of *Calendula* in the chicken manure obviously increased in comparison with other treatments.

Keywords – *Calendula Officinalis* L., Chicken Manure, Cow Manure, Ostrich Manure, Morphological Features.

I. INTRODUCTION

Calendula (*Calendula officinalis*), or pot marigold, is an annual plant that has been used historically for ornamental and medicinal. *Calendula* typically grows 20–50 cm tall with yellow and orange flowers 4–7 cm in diameter (Tucker, 2007). *Calendula officinalis* L. is a perennial plant in the tribe Calenduleae within Asteraceae (Earle et al. 1964), and it has composite-type flowers (i.e., arranged in capitula).

Historically, *Calendula* has been grown throughout the world as an ornamental flowering plant and produced commercially in parts of Europe for pharmaceutical uses (Martin and Deo, 2000). *Calendula* produced for

ornamental use includes both cut flowers and potted flowering plants. While cut flowers and herbs may be grown either in the field (Mohammad and Kashani 2012). The species has been cultivated since Roman times for its purported general medicinal qualities, and today *Calendula* is grown for medicinal/herbal (Matic et al. 2012), and ornamental uses (Ao, 2007).

Essential oil extracted from *Calendula* flowers has been shown to possess anti-inflammatory properties and thus, is used for that purpose in topical burn and wound healing ointments. However, within the past two decades, considerable attention has been given to the development of *Calendula* for the commercial production of its seed oil. While it is native to the area surrounding the Mediterranean, it is today and has been historically grown much more widely (Ao, 2007) throughout many temperate zones.

Since the use of chemical manure in the cultivating of medical plant has a negative effect on their pharmaceutical quality and because *Calendula* has utilized both as a medicinal herb and as an ornamental floral crop therefore, it is a good candidate for an exploration into organic floriculture through the use of organic fertilizers.

The use of organic manure such as animal manures can improve soil fertility (Kapkiyai et al., 1999), increases soil organic matter (Kaur et al., 2008), plant growth (Mhlontlo et al., 2007), and soil properties (Maerere et al., 2001). Aliyu (2000), in an experiment on pepper, reported that highest yield of pepper was recorded with the application of of poultry manure with the combinations of other inorganic nutrient sources. The problematic aspect of these high rates of organic manure recommendations is the unavailability of such enormous amounts.

Maerere et al. (2001) reported that efficient utilization of animal manure requires thorough understanding of the availability of nutrients in the soil following animal manure application. However, there is also a need for comparing different types of animal manures under similar conditions. The results of their study indicated that applications of the three manures (poultry manure, goat manure, and dairy cow manure) significantly increased soil available N and P. It has also been reported that animal manure applied to soils have high soil microorganisms, P, K, Ca, Mg and NO₃ than soils to which inorganic fertilizers have been applied (Herencia et al., 2011).

Poultry birds and chicken feed mainly on grains with higher protein and fat content compared with forages fed

to ruminant; however, microbes in the stomach of the ruminants may also contribute to the nutrient enrichment of their faces. These reasons may have contributed to the varying responses observed in crops with the application of different manures.

In addition, animal manure is an organic source of nutrients for leafy vegetable production among resource poor farmers. Cattle, goat and chicken manures are the common types of animal manure used as nutrient sources. In Iran, the annual quantity of animal manure is 6 million tons that have collected on farms. Moisture, large amount and also different of their materials are limiting factors of this type of manure fertilizer (McMullen et al., 2004). Therefore, most of animal manure is wasted, with a small portion used as energy in heating. Indeed, most resource-poor farmers have little technical know-how of manure use. Since Zabol is one of the aviculture, cattle, and ostrich farming area in Iran; and as noted above, the use of such fertilizers in consecutive succession and its impact on production and performance is important. In addition, use

of organic fertilizers may have significant influence on the performance of Calendula. Accordingly, the objective of this study was to explore the effect of application of some selected animal manures on some morphological properties of Calendula. Organic fertilizers include Cow, Chicken, and Ostrich manures.

II. MATERIALS AND METHODS

A. Soil and Manure Analyses

The present study was conducted in 2012 and 2013 on a sandy-loam soil at the Agricultural Research Institute located 35 km southeast of Zabol, Iran (30°54'_N, 61°41'_E). According to Koppen Climate Classification System Zabol has a dry (arid and semiarid) climate. The soil sample used for the study was analyzed for some properties. A summary of physical and chemical characteristics of the soil is described in the following table.

Table 1: A summary of physical and chemical characteristics of the soil

Soil texture	Sand	loam	Silt	K	P	N	Organic matter	pH	Electrical conductivity
	%			mg/kg		%			
Sandy – loam	20	31	26	176	1.11	05.0	15.0	7.7	5.1

All the manure samples were analyzed by standard procedures. The following table shows the proportions of N, P, and K in three kinds of manures.

Table 2: Comparison of the elements three kinds of animal manures (%)

Treatments	N	P	K
Cow manure	1.20	0.512	0.36
Chicken manure	1.25	1.43	0.78
Ostrich manure	1.37	1.80	0.36

B. Experimental Design

The experimental design was a randomized complete block replicated three times. The treatments consisted of application of three animal manures from Cow, Chicken and Ostrich; a control treatment to which no fertilizers were also added. The individual plot size was 4 m × 12 m. The application rate of each manure was 20 tons.ha⁻¹ that were applied to the each plot when the bed was prepared in the fall.

C. Plant Sampling and Measurements

Calendula, which has an indeterminate growth habit, was harvested when the earliest capitula were fully mature and dry (Heyn and Joel, 1983). To evaluate some quantitative properties of Calendula, four randomly selected plants of each plot in different rows were randomly selected and four leaves from each plant were randomly selected to measure of some properties. Vegetative growth components including plant height, leaf length, leaf width, number of flowers/plant, number of leaves/plant, number of capitula/plant, number of

seeds/capitula, and 1000-seed mass was also determined.

To measure of 1000-seed mass, two samples of 500 seeds were counted, and then the weight of each sample with a digital scale with an accuracy of 0.001gr was measured separately. The plants were dried in the Oven set for 24 hr with 78°C before threshing and screen cleaning seed.

Statistical analysis included analysis of variance and mean comparisons were performed using the software SAS and mean comparisons using Duncan 's multiple range test at the 5% level were analyzed.

III. STATISTICAL ANALYSIS

Data were analyzed using the analysis of variance method as reported by (Snedecor and Cochran, 1980) by using the SAS software. Treatments were arranged using a randomized complete block design with three replications. Treatments were different organic fertilizers include: Cow manure, Chicken manure, Ostrich manure, and control (no fertilizer) with the amount of 20 tons.h⁻¹. Mean comparisons were made by least significant difference (LSD) at the P ≤ 0.05 levels.

IV. RESULTS AND DISCUSSION

ANOVA results showed the significant effect of organic manures (Chicken , cattle and ostriches) on plant height, leaf weight, number of flowers per plant, number of leaves per plant, number of capitula/plant, number of seeds per capitula, and seed weight (P ≤ 0.01) (Table3).

Table 3: Analysis of variance for Morphological Features of Calendula that affected by animal fertilizers.

S.OV	df	Means of Square							
		PH	LL	WL	NF	NL	NKP	NSK	W1000S
Replication	2	18.11**	0.67**	18.11**	22.58*	523**	0.58 ^{ns}	8.33**	6.27**
Treatments	3	757.9**	0.062 ^{ns}	757.9**	5228.07**	31759.28**	3597.87**	481.33**	54.25**
Error	6	17.8**	3.64**	17.8**	10 ^{ns}	189.37**	20.43*	5.77**	2.96**
C.V (%)		3.5	2.43	5.65	7.32	3.09	6.92	3.37	6.53

*significant at $p < 0.001$; ^{ns} non significant.

PH: Plant Height; LL: Leaf length; WL: Width Leaf; NF: Number of Flowers/Plant, NL: Number of Leaves/Plant; NKP: Number of Capitula/Plant; NSK: Number of Seeds/Capitula; W1000S:1000-Seed Mass.

It was found that receiving the plants chicken manure led to a greatly significant increase in Calendula component as compared to other treatments.

The obtained data in Table 3 indicate that plant height of *Calendula officinalis* was significantly affected by chicken manure. The chicken manure application had the highest plant height of *Calendula officinalis*, averaging 38.33 cm and the lowest plant height was found in the control treatment, without fertilizer application (16.88 cm). In all organic manures, plant height was increased (Table 4). The positive effect of organic manure in improving plant height was studied by many researchers, Nejadalirezai et al. (2011), Somida (2002) on marigold (*Tagetes minuta* L.), Bishr et al., (2006) on marjoram plants, Gewaily et al., (2006) on marjoram plants and Azzaz et al., (2009) on fennel plants.

However these results are in accordance with those obtained by Qadri et al.,(2011) by use of organic fertilizers (compost) but this study covers a wider range of organic fertilizers include chicken, ostrich and cow manure.

These results are in accordance with the results of Tahami et al., (2010) on the comparing the effect of organic fertilizers (manure and chicken manure and sheep, and vermicompost manures) and chemical yield of

Ocimum basilicum, Akbarnejad et al. (2011) on *Nigella sativa*, and Nejadalirezai et al., (2011) on *Calendula*.

Studies have shown favorable effects of organic fertilizers due to changes in physical, chemical and biological properties and microbial culture medium (Brussard et al., 1997) and adjust the PH and moisture - holding capacity and a significant increase in the nutrient medium (McGinnis et al., 2003).

Illustrated data in Table 3 pointed out that the number of flowers /plant of *Calendula officinalis* had significantly affected by organic manure. However, it is obvious that supplying the plants with chicken manure caused a significant increase in branch number comparing to untreated plants. The maximum number of flowers was detected by application of chicken manure as reached 64 and minimum flower/ plant belonged to control treatment as reached 10.11 flower/ plant.

In general, increasing the use of chicken fertilizer causes to use more nitrogen by plant, increase nutrient absorption and therefore increase the number of flowers per plant (Ameri et al., 2009). However these results are in accordance with those obtained by Qadri et al., (2011) by use of organic fertilizers (compost) but this study covers a wider range of organic fertilizers include chicken, ostrich and cow manure.

Table 4. Morphological Features of Calendula in Response to Animal Fertilizers Applied.

Treatment	PH (cm)	LL (cm)	WL (cm)	NF	NL	NKP	NSK	W1000S (gr)
Control	16.88d	8.05a	1.70a	10.11d	42.44c	20.44b	23.78c	9.32c
Chicken manure	38.33a	7.94a	1.99a	64.00a	167.89a	62.00a	39.11a	15.24a
Ostrich manure	28.88b	7.94a	2.1a	24.89b	71.11b	22.00b	31.78b	12.13b
Cow manure	22.66c	8.11a	1.99a	17.00c	42.89c	23.89b	24.00c	11.39b
LSD (5%)	4.86	2.20	0.65	3.64	15.87	5.41	2.77	1.985

Different lower case letters within the same column indicate significant difference at the 5% level (Duncan's new multiple range test).

The number of leaf/plan in *Calendula officinalis* was significantly affected by organic manure treatments. The maximum number of the leaf/plant belonged to chicken treatment and the minimum leaf/plant belonged to control treatment by 167.89 and 42.44, respectively (Table 4). The Number of leaf/ plant in chicken manure treatment was almost four times greater compared to the control. These results are in accordance with those obtained by Tahami et

al. (2010) on Basil (*Tagetes minuta* L.). In addition, ANOVA results indicate that the effect of fertilizer on plant marigold seeds is highly statistically significant (Table 3). This comparison suggests that treatments generally had a positive impact on the number of Capitula per plant and also seeds per Capitula. Plant under chicken manure had the highest number of Capitula per plant with the about 3 times more than for the treatment control. Moreover, the numbers of seeds per Capitula in mentioned treatment were 34% more than the control treatment. It would seem that improving the nutritional condition and

available water due to improved soil physical properties through the use of organic fertilizers can increase plant growth, number of capitol/plant, number of seeds/Capitol and therefore the number of seeds per plant.

The 1000-seed mass represents the relation between the weight and number of seeds. The significant differences were detected between organic treatments for 1000-seed mass (Table 3). Mean comparisons showed that the highest weight for 1000 seed belonged to chicken manure treatments, which increased 61.3% compared to control (Table 4). Since, the 1000-seed mass is one of the effective components on seed yield therefore, it can effect on the increasing of Calendula' seed yield. The results are similar to those reported by Saeidnejad et al., (2011), who cites a significant difference for 1000 seed for Cuminum cyminum by using organic fertilizers that include vermicompost, sheep, and cow manures. These results are also in accordance with those obtained by Saeidnejad et al., (2011) and Majd Nassiri et al., (2003) on Carthamus tinctorius L. The means and standard errors for the variables and 1,000 seed weight are shown in Table 4.

V. CONCLUSIONS

Calendula officinalis is one of the most important medicinal herbs in Iran. The use of organic fertilizers in the cultivating of Calendula can improve its pharmacological prosperities without worrying about their negative effects on the environment and its pharmaceutical quality. In addition, animal manure is an organic source of nutrients for leafy vegetable production among resource poor farmers. Cow, chicken, and ostrich manures are the common types of animal manure used as nutrient sources in Zabol.

This study highlights that chicken manure contains essential nutrients required by plants. Animal manure is heterogeneous in nature and its quality as fertilizer is affected by many factors. Chicken manure contains a higher concentration of nutrient than cow and ostrich manure, particularly nitrogen. Manures have positive effects on many of the plant' components and had also a considerable seed yield. However, the effects of other animal manures are also noticeable. Therefore, the use of chicken manures in cultivating of Calendula can amend and improve the majority of quantitative properties of Calendula.

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