SINAI Journal of Applied Sciences 12 (6) 2023 915-930

Available online at www.sinjas.journals.ekb.eg

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SINAI Journal of Applied Sciences

Print ISSN 2314-6079
Online ISSN 2682-3527

ARU-EGYPT SJAS TrustScience | ItCreates

EFFECT OF DIFFERENT TYPES OF ORGANIC FERTILIZERS AND PLANTING DATES ON THE PRODUCTIVITY OF SEEDS, ROOTS AND THEIR MUCILAGE CONTENT OF *Althea rosea* PLANTS

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ARTICLE INFO

Article history:
Received: 25/11/2023
Revised: 02/12/2023
Accepted: 30/12/2023

Keywords:
Althea rosea, organic fertilizers, vermicompost, chicken manure, compost, mucilage.

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ABSTRACT

A field experiment was carried out during winter seasons of 2021-2022 and 2022-2023 at the Experimental Farm of Ornamental and Medicinal Plants, Faculty of Environmental Agriculture Science at El-Arish, Arish University, North Sinai, to study the effect of three types of organic fertilizers, *i.e.*, chicken manure (ChM), vermicompost (VC), compost (C) and there mixture as well as three sowing dates were as October 15^{th}, November 1^{st} and November 15^{th} for both seasons on growth, seeds, roots and mucilage yields of *Althea rosea* plant. The result showed that the highest values of all growth parameters: plant height, number of leaves and fresh and dry weight of leaves recorded at the first sowing date October 15^{th} with chicken manure fertilization at (5 t/fad.) plus of vermicompost (3 t/fad.). In addition, the highest increase in root length, fresh and dry weight of root, yield of root and seeds, percentage and yield of mucilage in root and seeds achieved in early sowing date mid-October and mix of vermicompost and chicken manure.

INTRODUCTION

The Malvaceae family includes a plant known as garden hollyhock or marshmallow (*Althea rosea*). This plant is native to China, Southern Europe, the Middle East, the Mediterranean, and Central Asia. The stem, which is either erect or sparsely branched, has stellate hairs, and can reach a height of 0.5-2.0 meters. The seeds receive coverage from stellate hairs as well **(Aslam *et al.*, 2012)**. *Althea rosea* has a history of traditional use in the treatment of various health conditions as managing fever, respiratory issues, gastrointestinal problems, sore throat, and skin burns. Additionally, it has demonstrated effectiveness against bacterial infections and inflammation (**Nawaz *et al.*, 2022**). The economic part of this plant is the root because it contains vitamin C (26.80 mg/100g), crud protein (7.49%), crud fibre (3.28%), ash (5.28%) and a high percentage of polysaccharides (83.94%) represented by starch (27.16%), pectin (10.22%) and mucilage (16%) which is considered the most important active substance in the plant.

Mucilage is synthesized in certain plants during their growth and its primary function inside the plant is to provide water, nutrients, and promote seed germination. The main sources for producing mucilage in the *Althea rosea* plant are the roots (20%), seeds (9%), leaves (4.3%), and flowers (1.6 MDa) (**Tomoda *et al.*, 1985; Classen and Blasheck, 1998; Niknam, 1999; Detersa *et al.*, 2010**). Mucilage is playing a crucial role in various medical applications in addition used in the food industry, as natural preservatives in juices and jams are contributed to improving the stability of some nutritional components while preserving their quality over time makes them a healthier option

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https://doi.org/ 10.21608/sinjas.2023.260784.1246

than synthetic preservatives (**Amini and Razavi, 2012; Husain *et al.*, 2019; Al Masum *et al.*, 2020; Maher, 2022**).

Sowing date is the most effected on the vegetative and reproductive phases, as well as on crop productivity and quality. The quality and components of chemicals within the plants are greatly affected by the day length, temperature, and relative humidity (**Ghasemi *et al.*, 2020**). The highest amount of mucilage and yield was achieved when cultivating okra early (**Rad *et al.*, 2022**). Early cultivation of the soybean crop also increased the number of pods in each plant and weighed 1,000 seeds and higher protein content in the seeds than late cultivation of soybean (**Jarecki and Bobrecka-Jamro, 2021**). Additionally, Overdue Agriculture was the cause of low productivity in the jute crop (**Saha *et al.*, 2015**).

Non-target organisms, biological ecosystems, and soil microorganisms have been affected by the intensive use of chemical fertilizers **(Maddahi *et al.*, 2021)**. So, the current chemical application systems are replaced by organic fertilization, which enhances the soil's chemical, physical, and biological properties while preserving its ability to retain moisture by increasing the amount of organic matter in it. Consequently, crop growth is enhanced, and its quality and quantity are maintained. **(Ofosu-Anim *et al.*, 2006; Heidarzadeh *et al.*, 2022; Prisa and Testa, 2022)**. Organic fertilizers such as vermicompost, compost, and chicken manure are considered environmentally friendly ways to enhance soil fertility and production, which reduces the need for chemical fertilizers **(Khosravi Shakib *et al.*, 2019; Maddahi *et al.*, 2021)**. Animal manure can be used as organic sources of nutrients to achieve sustainable plant production. Improving soil fertility, structure, and water and air permeability of soils is achieved by increasing organic matter, which in turn enhances host plant growth and yield **(Rahimi *et al.*, 2019)**.

Compost is a process that uses aerobic or anaerobic fermentation to turn organic waste into a stable form **(Talyan *et al.*, 2008)**, its purpose is to enhance the soil's chemical and physical characteristics. The soil is made easier to grow by promoting the growth of roots and providing nutrients to the plant, increasing its potential for the roots to absorb them. Additionally, the compost aids in keeping moisture in the soil **(Lea Master *et al.*, 1998).**

Vermicompost is made up of microorganisms and earthworms, which are interacting to produce nutrient-rich organic matter. Sustainable agriculture could benefit from using it to enhance soil porosity, which would increase nutrient availability. Vermicompost contains microscopic organisms that produce a variety of organic acids, including humic acid 17-36% and fulvic acid 30-31% of the total amount of organic matter, thus enhance the solubility of minerals, particularly potassium and phosphorus **(Senesi *et al.*, 1992; Ievinsh *et al.*, 2020; Celikcan *et al.*, 2021)**. Compared to compost, Vermicompos has a higher quality because, vermicompost's higher organic matter decomposition rate and nutrient content in the final product are. Furthermore, vermicompost generated a greater quantity of hormones and enzymes that could enhance plant growth and discourage plant pathogens **(Wu *et al.*, 2014).** The microorganisms in vermicomposts and those in traditional composts were compared conventional compost had a lower population of bacteria (5.7 × 107), fungi (22.7 × 104) and actinomycetes (17.7 × 106) than vermicomposts **(Nair *et al.*, 1997)**.

This study aims to assess the influence of sowing dates and organic fertilizer treatments on the vegetative growth characteristics and mucilage percentage of the *Althea rosea* plant.

MATERIALS AND METHODS

Experimental Site

This experiment was conducted at Experimental Farm of Ornamental and Medicinal Plants, Faculty of Environmental Agriculture Science, Arish University, North Sinai (13˚07’33.3"N, 13˚49’22.3"E, 226 M above mean sea-level) during two consecutive winter seasons in 2021-2022 and 2022-2023 and the laboratories of the Faculty of Environmental Agriculture Science, Arish University. The chemical and physical analyses of the soil used. As well as organic fertilizer were tabulated in Tables 1 and 2 and irrigation water used in Table 3 which was analyzed at the National Research Centre. Seeds of *Althea rosea* were procured from the Agricultural Research Center. Chicken manure (ChM) was sourced from a poultry farm Faculty of Environmental Agriculture Science, Arish University, and vermicompost (VC) and compost (C) were procured from a nearby company. Meteorological data, temperature degrees (C°) and total rain (mm./month) for El-Arish region during (2021/2022 and 2022/ 2023) seasons are shown in Table 4 by the Center Laboratory for Agriculture Climate.

Experiment Design

The experiment was planned in a split plot design with three replicates. The main plot consisted of three different sowing dates as 15th October, 1st November, and 15th November for both seasons. The subplots included applying three types of organic fertilizers: control = recommendation for using chicken manure at 10 tons per feddan, chicken manure at (5 t/fad.) mixture with vermicompost at (3 t/fed) and chicken manure at (5 t/fad.) mixture with compost at (3 t/fad.). Organic fertilizers were added during the soil preparation for cultivation.

A drip irrigation system was used, and *Althea rosea* seeds were directly planted in hill with a spacing of 1.0 m between rows and 50 cm between plants on the same row, where each plant contained an area of 50 cm^2 to again plot area of 12 m^2, containing 24 plants (8400 plants/fed). After one month, the plants were thinned to one plant/ hill and all natural agriculture practices were carried out as needed by the plants.

Vegetative growth parameters of *Althea rosea*

After planting, the plant's vegetative growth was recorded after 5 months for two seasons. And were taken the height of a plant from the soil surface to its highest point was taken, as well as the number of leaves/plants, the fresh and dry weights of leaves/plants (g), the length of the root (cm), the fresh and dry weights of roots/ plant (g). Furthermore, the plant's leaves and roots were dried at 70^{o}C until they reached a constant weight, and their dry weights were measured in (g).

Yield parameters of *Althea rosea*

The yield of seeds and roots were recorded on the *Althea rosea* plant at the end of both seasons (after 7 months of cultivation) in two seasons. Measurements were taken for the following parameters:

1- Seeds yield (kg/fed): = the weight of seeds per plant × number of plants per feddan/1000

2- Root yield (kg/fed.): = the weight of roots per plant × number of plants per feddan/1000.

3- Mucilage in root and seed (kg/ fed): = percentage of mucilage in root or seed × yield of root or seed/ 100

The process of extracting and estimating the percentage of mucilage:

After the end of both seasons (7 months after planting), Extraction of mucilage from *Althea rosea* roots and seeds according to **Le *et al.* (2020)**. The roots and seeds were washed to remove dirt and the roots were chopped to 5 mm, taken to dry at a temperature of 50^{o}c until constant weight. The extraction process was executed in two steps.

Table 1. Some initial chemical and physical characteristics of soil

	First season 2021-2022	Second season 2022-2023
Particles size distribution (%)		
Coarse sand%	58.3	58.4
Fine sand%	27.4	27.5
Silt%	12.3	12.0
Clay%	2.0	2.1
Soil texture	Sandy loam	Sandy loam
Bulk density (Mgm^{-3})	1662	1661
Chemical properties		
Ca+ (meq.$^{L-1}$)	10.37	10.37
Mg+ (meq.$^{L-1}$)	5.19	5.25
Na+ (meq.$^{L-1}$)	15.06	15.09
K+ (meq.$^{L-1}$)	0.07	0.07
$CO3^-$ (meq.$^{L-1}$)	-	-
$HCO3^-$ (meq.$^{L-1}$)	4.52	4.70
Cl^- (meq.$^{L-1}$)	20.63	20.57
SO4 (meq.$^{L-1}$)	5.54	5.51
EC (dSm-1)	3.11	3.15
pH	7.52	7.50
Organic matter %	0.153	0.160
CaCo3 %	22.43	22.48

Table 2. Organic fertilizer content of nitrogen, phosphorus and potassium

Organic fertilizers	N%	P%	K%
Chicken manure	1.20	0.45	0.80
Vermicompost	2.35	1.60	1.50
Compost	0.71	0.39	0.42

Table 3. Analyzing of the chemical composition of irrigation water

pH	EC (dSm^{-1})	Soluble ions (meq.$^{L-1}$)							
		Cations				Anions			
		Ca^{++}	Mg^{++}	Na^+	K^+	Cl^-	$HCO3^-$	$CO3^{--}$	$SO4^{--}$
First season (2021/2022)									
7.55	**5.56**	19.50	17.36	18.50	0.24	45.92	2.90	-	6.78
Second season (2022/2023)									
7.60	**5.71**	21.00	17.05	18.80	0.25	46.77	2.99	-	7.34

Table 3. Meteorological data: temperature degrees (C°) and total rain (mm. /month) for El-Arish region during (2021/2022 and 2022/2023) seasons

Months	2021-2022		2022-2023	
	Average Temperature(°C)	Precipitation (mm)	Average Temperature (°C)	Precipitation (mm)
October	23.76	5.80	24.06	16.30
November	21.25	5.40	20.03	10.10
December	15.64	25.10	17.10	13.90
January	11.86	107.50	14.50	38.40
February	13.06	21.90	12.93	33.30
March	13.06	30.80	17.21	23.90
April	19.57	2.20	19.06	29.20
May	22.05	2.40	22.33	2.70
June	25.86	1.70	25.21	5.60
Average and Sum	18.46	202.80	19.16	173.40

Table 4. Effect of chicken manure, vermicompost, compost and sowing date as well as interaction treatments on plant height, number of leaves, fresh and dry weights of leaves of *Althea rosa* plant

Treatments		Plant height (cm)		Number of leaves/plant		Fresh weight of leaves/plant (g)		Dry weight of leaves/plant(g)	
		First season	Second season	First season	Second season	First season	Second season	First season	Second season
15th October	ChM	160.73 cd	169.50 de	43.33 c	53.33 d	98.08 d	176.24 b	40.07 bc	50.37 ab
	ChM +VC	213.30 a	223.40 a	64.33 a	77.33 a	149.56 a	228.54 a	45.24 a	55.41 a
	ChM+C	208.80 a	216.50 b	62.33 a	69.66 b	148.98 a	226.50 a	44.57 ab	54.86 a
1st November	CM	143.20 e	156.53 f	27.66 e	34.66 fg	74.70 e	125.09 e	26.13 f	35.26 d
	ChM+VC	169.30 b	176.23 c	52.33 b	61.00 c	124.55 b	161.86 c	42.61 ab	51.58 a
	ChM+C	165.06 bc	167.36 e	43.00 c	58.66 cd	124.29 b	160.12 c	33.49 de	42.67 c
15th November	ChM	124.16 f	145.40 g	27.00 e	31.66 g	67.14 f	114.61 f	23.76 f	28.82 e
	ChM+VC	156.53 d	173.20 cd	33.33 d	41.33 e	106.30 c	131.80 d	30.78 e	37.52 d
	ChM+C	139.06 e	154.90 f	28.66 de	38.00 ef	110.07 c	135.42 d	37.44 cd	46.27 bc

ChM= chicken manure, VC= vermicompost, C= compost

Step 1: mucilage separation, Dried roots or dried seeds were mixed with distilled water (ration 1:8 *W/V*) and heated at 60°C in water bath for 1.0 hour (the mixture was stirred regularly). After that, the mixture was taken out and cooled at room temperature within 1 hour to increase the amount of mucilage dissolved in distilled water. Thereafter, the mixture wase filtered through 8 layers of muslin cloth to collect the filtrate containing the mucilage.

Step 2: mucilage precipitation and collection. The mucilage was precipitated from the filtration by acetone with the volume ration of 3:1 and it was dried at a temperature of 40°C until a constant weight according to **Lia and Liang (2011) and Prabakran *et al.* (2011)**. The mucilage yield was calculated as:

$$\text{Mucilage (\%)} = \frac{weight\ of\ dried\ mucilage\ (g)}{weight\ of\ dry\ root\ or\ seeds\ (g)} \times 100$$

Experiment Design and Statistical Analysis

The complete randomized block design (RCBD) in a split plot design system was used experiment with three replicates. All collected data were analyzed with *analysis* variance (ANOVA) procedure using MSTAT.C statistical software package **(Michigan State University, 1983)**. Differences between means were compared by using Duncan multiple range test at 0.05 **(Duncan, 1955)**

RESULTS AND DISCUTION

Effect of Chicken Manure, Vermicompost, Compost and Sowing Date As Well as Their Interaction Treatments on Plant Height, Number of Leaves, Fresh and Dry Weights of Leaves of *Althea rosa* Plant

Data presented in Table 5 show that chicken manure at (5 t/fad.) mixture with vermicompost at (3 t/fad.) treatments generally increased plant height (213.30 cm and 223.40 cm), number of leaves (64.33 and 77.33), fresh and dry weights of leaves (149.56 g, 228.54 g, 45.24g and 55.41 g), respectively during the first sowing date at 15^{th} October compared with those of chicken manure ones alone or chicken manure mixed with compost during the second and third sowing date.

Using previous results, the highest values for plant height, number of leaves, and both fresh and dry weights of leaves were attained in early sowing dates (mid-October). In Table 2, the average air temperature for the mid-October planting season under El-Arish conditions was 23.76 and 24.06°C in the first and second seasons, respectively. For seed germination and vegetative growth of marshmallow plants, this temperature is more favorable. **Abuo El-Kasem *et al.* (2017); Wafaa *et al.* (2017) and Hasanvand *et al.* (2018)** found that the most significant growth parameters were recorded on the early sowing date of October 15^{th} in *Pisum sativum*, *Foeniculum vulgare* and *Borago officinalis*, respectively. The early sowing date in October was reported by **El-Mekawy (2012)** in *Nigella sativa*; **Megawer *et al.* (2017)** in Faba bean and **Islam *et al.* (2010)** in *Capsicum annum*) have caused an increase in plant height, number of leaves, and fresh and dry weight of plants compared to the later sowing date. The plant's increased growth may have been influenced by the appropriate weather conditions during developmental stages, which may have led to an increase in cell division and elongation. On the other hand, plants that are sowing late may be subjected to unfavorable environmental conditions, which could result in a short duration of vegetable growth, as high temperatures accelerate growth stages.

The increase in plant height, number of leaves, fresh weight of leaves and dry weight of leaves resulting from using vermicompost and chicken manure together. These results agree with those obtained by **Abha *et al*. (2019)** reported that okra vegetable growth significantly increased after using vermicompost 2.5 t/ha combination with 2.5 t/ha of poultry manure. Also, **Jamkatel *et al.* (2020)** found that vermicompost and chicken manure were most effective in increasing the height of okra plants. Furthermore, organic manure, particularly vermicompost, had a positive impact on plant height compared of the other organic fertilizer **(Gutiérrez *et al*., 2007; Adhikari and Piya, 2012; Muqtadir *et al*., 2019; Masud *et al*., 2022)**, whilst **Naseer *et al.* (2017)** observed an increase in plant biomass and number of *Abelmoschus esculentus* plant leaves when vermicompost was applied at a rate of 5 tons/acre. Whereas, **Bhandari *et al.* (2019), Qulsum *et al.* (2020) and Samanhudi *et al.* (2021)** in different plants

Table 5. Effect of chicken manure, vermicompost, compost and sowing date as well as interaction treatments on root length, fresh and dry weights of root, yield of roots and seeds of Althea rosa plant

Treatments		Root length (cm)		Fresh weight of root/plant (g)		Dry weight of root/plant (g)		Yield of roots/ feddan (kg)		Yield of seeds/feddan (kg)	
		First season	Second season	First season	Second season	First season	Second season	First season	Second season	First season	Second season
15th October	ChM	38.63 d	43.33 d	99.88 b	116.15 c	45.52 b	53.06 b	382.37 b	445.73 b	848.09 c	965.65 c
	ChM+VC	59.53 a	68.13 a	112.69 a	145.89 b	53.09 a	65.81 a	445.98 a	552.83 a	1172.86 a	1350.19 a
	ChM+C	50.50 b	57.63 b	115.42 a	157.36 a	49.57 a	55.04 b	416.41 a	462.33 b	859.12 c	962.40 c
1st November	ChM	33.83 e	35.16 e	55.33 d	65.61 f	23.06 e	30.12 de	193.73 e	253.03 de	676.19 e	737.98 e
	ChM+VC	42.56 c	50.66 c	55.85 d	83.40 e	30.70 c	41.94 c	257.93 c	352.35 c	906.35 b	1137.16 b
	ChM+C	51.76 b	56.70 b	76.90 c	94.66 d	27.48 cd	33.80 d	230.83 cd	283.92 d	772.91 d	857.95 d
15th November	ChM	25.10 f	31.53 f	39.69 f	53.47 g	17.53 f	23.92 e	147.25 f	200.93 e	342.19 g	459.63 g
	ChM+VC	34.83 e	36.93 e	47.60 e	64.07 f	24.39 de	26.82 de	204.93 de	225.34 de	664.38 e	741.7 e
	ChM+C	39.33 d	42.73 d	54.17 d	64.37 f	21.49 e	25.77 e	180.51 e	216.46 e	546.85 f	642.10 f

ChM= chicken manure, VC= vermicompost, C= compost

at Malvaceae family they reported increased vegetable growth by improving plant height, number of leaves, and fresh and dry weight of leaves after applied the poultry fertilizer treatment. Also, **Agustanto *et al.* (2022)** in *Abelmoschus esculentus* found that vegetative growth was enhanced when chicken manure was applied at a rate of 20 t/ha.

This increase of vegetative growth parameters reflects that richness vermicompost and poultry manure with N, P, K, micronutrients, and amino acids which a play many important roles as formation of DNA, RNA, cell building, cell division, cell enlargement, formation the coenzyme, synthesis proteins and bud differentiation as well as branching **(El-Agrodi *et al*., 2011; Mistry *et al*., 2015; Dume *et al*., 2023**).

Effect of Chicken Manure, Vermicompost, Compost and Sowing Date As Well As Interaction Treatments on Root Length, Fresh And Dry Weights of Root As Well As Yield of Roots and Seeds of *Althea rosa* Plant

Results in Table 6 data show that root length, fresh and dry weight of root and yields of roots as well as seeds per plant gradually increased in mid-October by using the treatments of chicken manure (5 t/fad.) plus vermicompost (3 t/fad.). Moreover, addition these treatments gave the highest values of root length (59.53 cm and 68.13 cm), (540.15 kg and 682.64 kg) and (1172.86 kg and 1350.19 kg) in the first and second seasons, respectively and showed significant increase compared to other treatments under study. The advantage of planting early could be linked to the favorable temperature and day length, which could result in better vegetative growth of *Althea rosea* plants. These findings agree with those reported by **(El-Hosary *et al.*, 2010)** that the root length and root yield of sugar beet significantly increased with early sowing on October 15th as compared to other sowing dates. According to **Abuo El-Kasem *et al.* (2017), Wafaa *et al.* (2017) and Hasanvand *et al.* (2018),** the early sowing date on October 15th resulted in the greatest yields. In *Pisum sativum*, *Foeniculum vulgare* and *Borago officinalis* respectively**.** The early sowing date in October was reported by **(Megawer *et al.*, 2017 and Islam *et al.*, 2010)** have caused an increase yield in Faba bean and *Capsicum annum* respectively.

Table 6. Effect of chicken manure, vermicompost, compost and sowing date as well as interaction treatments on mucilage % and yield in seeds and roots of *Althea rosa* plant

Treatments		Mucilage in seeds (%)		Mucilage in roots (%)		Yield of mucilage in seeds/feddan (kg)		Yield of mucilage in roots/feddan (kg)	
		First season	Second season	First season	Second season	First season	Second season	First season	Second season
15th October	ChM	3.60 cde	4.38 bcd	11.83 ab	16.53 b	30.51 cd	42.31 cd	45.36 b	73.24 c
	ChM+VC	5.80 a	6.93 a	13.99 a	20.93 a	68.14 a	93.66 a	62.33 a	115.66 a
	ChM+C	4.32 bc	5.24 abc	13.72 ab	19.86 a	37.30 c	50.21 c	57.18 a	92.01 b
1st November	CM	3.01 de	3.53 cd	7.97 de	10.38 d	20.41 e	26.21 de	15.59 ef	26.24 e
	ChM+VC	5.07 ab	6.24 ab	11.82 ab	15.92 b	45.94 b	71.04 b	30.45 c	56.33 d
	ChM+C	3.12 de	4.90 bc	11.28 bc	11.72 cd	24.02 de	42.08 cd	26.03 cd	33.02 e
15th November	ChM	2.49 e	2.99 d	7.26 e	9.59 d	8.60 f	13.93 e	10.81 f	19.45 e
	ChM+VC	4.30 bc	5.19 abc	9.96 cd	13.82 bc	28.60 cde	38.46 cd	20.19 de	31.37 e
	ChM+C	3.98 bcd	4.49 bcd	8.46 de	10.50 d	21.72 de	28.81 de	15.22 ef	22.55 e

ChM= chicken manure, VC= vermicompost, C= compost.

These findings agree with those reported by **Singh *et al.* (2016)** in *Raphanus sativus* and **Abha *et al.* (2019)** in okra, they reported that all aspects of vegetative and root growth and yield parameters were greatly improved by combining 50% vermicompost and 50% poultry manure. **Abul-Soud *et al.* (2014)** reported that the utilization of vermicompost at the rate of 15 to 25 m^3/fad. can result in an improvement in the total yield, number of pods/plants, seed yield, weight of 100 dry seeds, and number of dry seeds per plant in peas plant. The highest rates of chicken manure applied (10 and 20 t/ha) resulted in a significantly substantial high yield of pods and a significantly higher yield fresh and dry weight in *Corchorus olitorius* plant **(Naim *et al.*, 2015)**.

The use of vermicompost in conjunction with chicken manure is responsible for the increase in root length and fresh weight of root, dry weight root, yield of root and seeds, because the mixture enhances the soil's physical structure, these include things like porosity, ventilation, drainage, corrosion resistance, and infiltration **(Lim *et al.*, 2014; Sha *et al.*, 2023)** Thus providing a better medium for root growth. According to **Edwards and Bohlen (1996)** vermicompost is rich in polysaccharides. Polysaccharide's role as a cementing substance in the soil resulted in aggregate stability. Humic acid and fulvic acids have been found in vermicompost, as reported by **(Arancon *et al.*, 2006; Singh *et al.*, 2008; and Hussain *et al.*, 2017a,b)**. Promotes plant growth and causes an increase in cell division, which leads to the absorption of nutrients, the retention of water, the formation of microbial aggregations with soil, the potential to elongate side roots and improve root activity. Moreover, poultry fertilizer has a substantial amount of phosphorus. The activity of phosphorus involves growing roots, increasing root mass, and increasing the absorption of nutritional staples. and is also part of many enzymes and co-enzymes and ATP-rich energy, which increases the growth of roots, increase crop productivity **(Mangal, 1985)**.

Effect of Chicken Manure, Vermicompost, Compost and Sowing Date As Well As Interaction Treatments on Mucilage % and Yield in Seeds and Roots of *Althea rosa* Plant

The data of mucilage percentage and their yields in dried seeds and roots were shown in Table 7. The results clearly demonstrated that chicken manure at (5 t/fad.) plus vermicompost (3 t/fad.) caused a slight increase in the percentage of mucilage constituents in seeds and roots during both seasons. However, the differences between chicken manure plus vermicompost treatments and other treatments were a high significant in the first and second seasons during the first sowing date. Data also reveal that there were significant differences among treatments in the two seasons. Also, the superior treatment which increased yield of mucilage in seeds and roots per plant and per feddan, yield of mucilage in seeds (68.14 kg and 94.80 kg) and yield of mucilage in roots (93.70 kg and 118.34 kg) during the first sowing date and two seasons respectively.

When plants are grown early (in winter), differences in daytime length and relative daytime temperature system provide better conditions for growing and creating more robust plants. As such, their seed productivity is enhanced. Its spring growth also starts early and shortens the period from sowing to flowering, avoiding the synchronization of the seed filling period with higher environmental temperatures, lower plant height and loss of seed crop This is reflected in the productivity of mucilage in seeds and roots As such, it was found that delayed sowing reduced seed yield and mucilage yield since the growth period was shortened and the flowering and seed filling periods coincided with hot summer temperatures **(Ghasemi *et al.*, 2020)**. According to **Hekmat *et al.* (2002) and Ebrahimi *et al.* (2010),** the earlier sowing date caused a rise in mucilage percentage and yield in *Plantago ovata* and *Borago officinalis* respectively.

The use of 20 ton/ha of manure had a significant impact on the mucilage content of *Plantago ovata*, according to **Mirshekari and Forouzandeh (2015)**. Whereas **Shahbazi *et al*. (2019a)** in *Borago officinalis,* **Shahbazi *et al*. (2019b)** in *Borago officinalis* and **Sadeghi *et al*. (2014)** in *Althea officinalis*) suggest that utilizing 10 t/ha of vermicompost is the best way to obtain the greatest amount of mucilage.

An increase in the proportion of nutrients in the soil can be attributed to both the increase of mucilage percentage on seeds and roots as well as the increase of mucilage yield in seeds and roots. According to **Shahbazi *et al.* (2019a)**, the plant may have used mucilage as an energy source, which is why mucilage decreased that is comprised of polysaccharides that are specific to plants or long chains of sugar molecules. Based on these findings, Mycorrhiza in has been suggested to increase the availability of water and nutrients for plants and likely plays a significant role in promoting the plant's photosynthesis. According to **Pouryousef *et al.* (2012),** organic fertilizers cause an increase in the mucilage percentage of Plantago psyllium. Nitrogen absorption, phytohormone synthesis, and mineral solubility can be organic fertilizer, which it is possible for plant production to experience a significant influence **(Goswami *et al.*, 2017; Shakib *et al.*, 2019)**. By increasing mineral uptake, manure application can improve growth, biomass production, and seed yield, it enhances the efficiency of the leaf water supply, photosynthetic efficiency, transpiration rate, and water uptake of the root tissues of plants **(Askary *et al.*, 2018).** Thus, it will be reflected in productivity of mucilage yield.

Conclusion

The result showed that the highest values of all growth parameters: plant height, number of leaves, fresh and dry weight of leaves recorded at the first sowing date October 15th with using chicken manure (5 t/fad.) plus vermicompost (3 t/fad.), in addition to the increase in root length, fresh and dry weight of root, root and seeds yield, percentage and yield of mucilage in root and seeds achieved in early sowing date mid-October and mix of vermicompost and chicken manure. Therefore, we recommend planting *Althea rosea* plants on October 15th using organic fertilizer consisting of chicken manure (5 t/fad.) and vermicompost (3 t/fad.).

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الملخص العربي

تـأثيـــر أنــواع مــختلفــة مــن الأسمـــدة العضـــوية ومـــواعيـــد الـــزراعـــة على إنتـــاجيـــة البـــذور والجـذور ومحتـويـاتهـا من الـمـيوسـيـلاج لنبـــات الخـطميـة

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تم إجراء تجربة حقلية خلال موسم الشتاء لعامي 2021-2022 و 2022-2023 في المزرعة التجريبية، كلية العلوم الزراعة البيئية بالعريش، جامعة العريش، شمال سيناء، لدراسة تأثير ثلاثة أنواع من الأسمدة العضوية: معاملة الكنترول وتم إستخدام الكمية الموصي بها من سماد الدواجن بمعدل 10 ط/فدان، ومعاملة سماد الدواجن بمعدل 5 ط/فدا +سماد الفيرميكمبوست بمعدل 3 ط/فدان، و معاملة سماد الدواجن بمعدل 5 ط/فدان + سماد الكمبوست بمعدل 3 ط/فدان، بالإضافة إلى ثلاثة مواعيد زراعة (15 أكتوبر، 1 نوفمبر و 15 نوفمبر) على نمو نبات الخطمية ومحصول البذور والجذور ومحتوي الميوسيلاج. وأظهرت النتائج أن أعلى قيم لجميع مقاييس نمو النبات مثل: ارتفاع النبات، وعدد الأوراق، والوزن الطازج والجاف للأوراق والتي تم تسجيلها عند الزراعة في 15 أكتوبر واستخدام السماد العضوي المكون من سبلة الدواجن بمعدل (5 ط/فدان) + الفيرميكومبوست بمعدل (3 ط/فدان)، كما أدى الى زيادة معنوية في طول الجذر، والوزن الطازج والجاف للجذر ومحصول الجذور والبذور ومحصول الميوسيلاج.

الكلمات الإسترشادية: الخطمية، الأسمدة العضوية، زرق الدواجن، الكمبوست، الفرميكمبوست، والميوسيلاج.

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