

## RESPONSE OF SOME GARDEN PLANTS TO FOLIAR SPRAYING WITH SOME NATURAL EXTRACTS

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### ABSTRACT

Two *Hibiscus* species namely *Hibiscus malvaviscus L.* and *Hibiscus rosa-sinensis L.* received foliar spraying of some natural extracts namely Moringa, liquorice, and fenugreek extracts each at 0.25 to 0.75% in the 2021-2022 and 2022/2023 seasons. Some growth aspects, namely plant height and number of branches, plant and root fresh and dry weights, stem girth, and leaf area were measured. Besides, plant pigments as well as the foliar content of N, P were determined in both plants.

Moringa, liquorice, and fenugreek extracts, in descending order, improved vegetative growth, leaf pigments, and N, P and K content. Moreover, these plant extract-related effects were concentration-dependent, with the best results achieved with spraying the two *Hibiscus* species with 0.75% of the extracts. The data obtained in both seasons showed that foliar spraying of *Hibiscus malvaviscus L.* and *Hibiscus rosa-sinensis L.* with moringa extract (0.75 %) resulted in the best plant height and number of branches, plant and root fresh and dry weights, stem diameter, and leaf area, in addition to higher concentrations of total chlorophylls, total carotenoids, N, P, and K of leaves,

**Keywords:** *Hibiscus malvaviscus L.*- *Hibiscus rosa-sinensis L.*- moringa extract, Liquorice extract- fenugreek extract- garden plants.

## INTRODUCTION

The highly prized plant *Hibiscus rosa-sinensis*, L. cv., sometimes known as Rose-of-Sharon, is renowned for its enormous flowers that bloom in the summer when few other shrubs do (Kim *et al.*, 2016). Its stiffly erect habit makes it a popular choice for a garden highlight. Rose-of-Sharon is a great choice for both formal and casual plantings because of its wide, loose branches and light green leaves. It may also be molded into an eye-catching tiny specimen tree with a little pruning. The plant does well in a variety of soil types and may thrive in either full sun or moderate shade. Rose-of-Sharon usually spreads 3-9 feet and grows 7-10 feet high with a growth rate varying from sluggish to moderate. Its transplantation is rather simple thanks to multiple shallow roots that are just below the soil surface (Akpan, 2007, BĀLA and SALA, 2020).

*Hibiscus syriacus* is a blooming species of the *Malvaceae* family. Although it originated in south-central and southeast China, it has been widely dispersed over other areas, including many eastern and western Asian regions (Gardens, 2015, El Shazly *et al.*, 2018). It was first taken from gardens in Syria, hence the epithet *syriacus* (Lawton, 2004; Walker, 1999 and Alice 1992).

The perennial flowering shrub *Malvaviscus arboreus* cvs (Syn. *Malvaviscus mollis* Aiton DC or *Hibiscus malvaviscus* L.) is in the *Malvaceae* family (Lim, 2014). Southern USA, Mexican woods, and Latin America are its natural habitats. Wax mallow, Drummond wax mallow, Turk's cap, and sleeping Hibiscus are popular names for *M. arboreus* (Lim, 2014; Tombde *et al.*, 2016).

*M. arboreus* grows to a one-meter height and branches freely in all directions with simple ovate to cordate leaves showing characteristic alternate phyllotaxis. The plant has bright red blossoms all season, making it beautiful (**Lim, 2014; Abdel Hafez et al., 2017**). The common name 'Sleeping Hibiscus' comes from *Malvaviscus arboreus*' pendulous stems and densely wrapped red corollas that remain closed (**Lim, 2014 and Abdelhafez et al., 2018**).

The flowers of *M. arboreus* feature a central column formed by the pistil and fused numerous stamens. This staminal tube protrudes prominently beyond the outer part of the flower. Besides, a hairy epicalyx and a small green calyx envelope the other floral parts adding to the ornamental value of the flowers (**Naskar and Mandal, 2014**).

In recent years, there has been a shift towards using natural plant extracts instead of synthetic chemicals to improve plant production and storage. The increased use of plant extracts relies on their ability to improve plant resistance against pathogens such as fungi, without altering the ecosystem, unlike synthetic chemicals that contribute to environmental pollution (**Ahmed et al., 2016**).

Natural extracts rich in phenolic compounds, phyto-pigments, essential (volatile) oils, are believed to promote plant growth (**Ahmed et al., 2016**). Moreover, the continually expanding demand of organic agricultural products increased the use of natural products, including plant extracts, in horticultural practices by crop producers in recent years (**Dimitri and Oberholtzer, 2006**).

The use of natural or plant extracts, acting as antioxidants and free radical scavengers, has become a key protocol in plant husbandry and propagation studies. These extracts have the potential to regulate plant development and blooming, as shown by **Elad (1992)** and **Walker and Mckersie (1993)**.

This study aimed to investigate the response of *Hibiscus malvaviscus L.* and *Hibiscus rosa-sinensis L.* to the foliar application of moringa, liquorice, and fenugreek extracts.

## **MATERIALS AND METHODS**

This experimental study was completed in the 2021/2022 and 2022/ 2023 seasons at the research tropical farm of the Horticultural Research Institute (Kom Ombo, Aswan Governorate, Egypt). *Hibiscus rosa-sinensis L.* and *Hibiscus malvaviscus L.* plants (30-cm high) were individually potted in the first week of Sep. 2021 and 2022 in plastic pots filled with a sand and compost mixed at 1:1 (v/v) ratio.

All plants received foliar sprays with some natural extracts namely (Moringa, liquorice and fenugreek extracts) solution at 0.0 to 0.75 five times with one month interval until the solution was run off. Triton-B, a nonionic surfactant, was used in the mix as a wetting agent (0.5 ml/L). Control plants received only the vehicle (tap water + Triton-B). This experiment comprised 20 groups from two factors; the first (A) consisted of two *Hibiscus* species as follows:

a1) *Hibiscus malvaviscus* L.

a2) *Hibiscus rosa-sinensis* L.

while the second (B) contained ten different natural extract spray treatments, as follows:

B<sub>1</sub>- Control (Vehicle only).

B<sub>2</sub>- Moringa extract (0.25%).

B<sub>3</sub>- Moringa extract (0.50%).

B<sub>4</sub>- Moringa extract (0.75%).

B<sub>5</sub>- Liquorice extract (0.25%).

B<sub>6</sub>- Liquorice extract (0.50%).

B<sub>7</sub>- Liquorice extract (0.75%).

B<sub>8</sub>- Fenugreek extract (0.25%).

B<sub>9</sub>- Fenugreek extract (0.50%).

B<sub>10</sub>- Fenugreek extract (0.75%).

Each treatment was repeated three times, two transplant per each. A total of 120 transplants were used in this study.

Table (1): Physicochemical properties of potting compost.

Character	Content	Character	Content
Weight of 1 m <sup>3</sup> (kg.)	560.0	Carbon% (Organic)	17.9
H <sub>2</sub> O (%)	32.5	Ash%	65.5
pH (1: 15)	7.91	C/N ratio	1: 19
EC (1: 15) d <sup>2</sup> /m	3.77	Total P %	0.88

Total N%	1.05	Total K %	1.05
NH <sub>4</sub> –N (ppm)	700	Weed seed%	1
NO <sub>3</sub> -N (ppm)	-	Nematoda (pathogenic)	-
O.M.%	33.1	Nematode (non-pathogenic)	-

Table (2): Constituents of Moringa leaf extract (Dhekney, 2016)

Active ingredient	(mg/ 100 g D.W.)	Active ingredient	(mg/ 100 g D.W.)
<b><u>1-Vitamins</u></b>		K	49.9
Beta-Caretone	149.2	Mg	20.2
E	50.0	<b><u>3- Amino acids &amp; others</u></b>	
A	90.0	Leucine	9.3
B1	88.9	Lysine	8.3
B2	1.1	Tryptophan	3.3
C	19.0	Threonine	6.6
K	25.6	Isoleucine	6.3
<b><u>2-Minerals</u></b>		Cysteine	2.4
Cu	88.7	Methionine	3.6
N	89.9	Zeatine	0.94
P	12.9	Gibberllins	0.81

Table (3): chemical analysis for fenugreek seed extract (Dhekney, 2016).

Active ingredient	(mg/ 100 g D.W.)	Active ingredient	(mg/ 100 g D.W.)
Vitamin A	1.0	Phytic acid	0.9
Vitamin C	2.0	Niacin	1.4
Vitamins B1	0.32	Aspartic acid	2.2
Vitamin B2	0.3	Arginine	2.1
Vitamin B6	1.0	Alanine	2.9
P	341	Isoleucine	2.1
K	469	Cysteine	1.9
Mg	371	Cysteine	1.8
Ca	220	Methionine	6.0
Fe	242	Lysine	5.1
		Glutamic acid	2.0

Table (4): Chemical composition of liquorice extract (*Glyrrhiza globra L.*) (Mousa *et al.*, 2002).

Constituents	Values	Constituents	Values
Humidity	3.72%	K	2.9%
Fat	1.0%	Mg	1.3%
Ash	35.61%	Ca	2.14%
Protein	4.0%	N	1.5%

Fiber	13.08%	Fe	220 ppm
Carbohydrate	42.59%	pH	7.2

### Data collection:

A number of plant vegetative development markers and chemical composition data have been obtained, including the following:

- The height of each plant in centimeters (cm).
- The diameter of the stem in millimeters (mm).
- The number of branches in each plant.
- The average surface area (cm<sup>2</sup>) of the leaf using planimeter.
- The average weight of fresh and dried plant (g).
- The average weight of fresh and dried roots (g).
- Leaf content of pigments: total chlorophylls and carotenoids as milligrams per gram foliar weight (mg/1.0 g F.W.) were determined according to **Moran (1982)**.
- The percentages of nitrogen (N), phosphorus (P), and potassium (K) in the leaves (**Wilde et al., 1985**).

Statistical analyses were carried out based on the methods outlined by **Mead et al. (1993)**; the mean values of each measured parameter were compared using ANOVA followed by the new L.S.D. at 5% significance level.



## RESULTS AND DISCUSSION

### 1- Vegetative growth characteristics:

Tables 5 to 8 show that varying Hibiscus species significantly affected the growth traits of the plant (Height, stem thickness, number of branches, leaf area, fresh and dry weights of the whole plant and roots). *Hibiscus rosa-sinensis* L. recorded the height values relative to the other *Hibiscus* species namely *Hibiscus malvaviscus* L.

Besides, the data (Tables 5-8) also illustrate that applying Moringa, liquorice, or fenugreek extracts, each at 0.25 to 0.75%, significantly increased plant height, stem thickness, branches count, leaf area, fresh and dry weights of the plant and its roots compared with the vehicle-treated plants. The positive effects on such characteristics were achieved by spraying the extracts of liquorice, fenugreek, and moringa, in descending order. However, increasing the concentration of any extract from 0.50 to 0.75% failed to significantly affect the measured growth aspects. Foliar spraying *Hibiscus rosa – sinensis* L. five times with moringa extract (0.75%) resulted in the best growth-related values. On the other hand, the untreated *Hibiscus malvaviscus* L. plants demonstrated the lowest values. These results were consistent in 2021/2022 and 2022/2023 seasons.

### 2- Leaf photosynthetic pigments:

The results of this study showed that the leaves of the two species of *Hibiscus* had significantly different concentrations of both total chlorophylls and carotenoids: *Hibiscus rosa-sinensis* L. demonstrated

higher levels of both pigments (**Table 9**). Moreover, the data revealed that treating the two species of *Hibiscus* five times with moringa, liquorice and fenugreek extracts (0.25% - 0.75%) significantly enhanced these foliar pigments compared with the untreated plants. This effect was best with moringa, followed by fenugreek and liquorice extracts.

Like their effect on vegetative growth, the positive effects on leaf pigments were concentration dependent. However, the observed increases in total chlorophylls or total carotenoids upon changing any extract concentrations from 0.50% to 0.75% were statistically insignificant. The *Hibiscus rosa-sinensis* L. transplants sprayed with moringa extract at 0.75% displayed the highest leaf pigments. On the contrary, the untreated *Hibiscus malvaviscus* L. transplants registered the lowest concentrations in this study (**Table 9**). The same trend was achieved in both seasons.

### **3- Leaf content of nitrogen, phosphorus, and potassium:**

Tables **10** and **11** show that *Hibiscus rosa-sinensis* L. leaves contain significantly higher percentages of N, P and K than those of *Hibiscus malvaviscus* L. Moreover, the leaf content of these elements was significantly enhanced when the plants received foliar sprays of Liquorice, fenugreek, or moringa, in ascending order, when compared to the untreated controls. Although the change in foliar N, P and K % was concentration dependent (0.25 to 0.75%) for any extract treatment, increasing the concentration of either extract from 0.50 to 0.75% had no significant implications.

The highest levels of NPK were reported in Hibiscus transplants that received five sprays of 0.75% moringa extract, while the untreated transplants of *Hibiscus malvaviscus* L. showed the lowest NPK levels. Both 2021/ 2022 and 2022/ 2023 seasons showed similar results.

### **Discussion**

Natural extracts are utilized to enhance the growth and chemical composition of garden plants, including Hibiscus species, as an alternative to using synthetic, possibly harmful, chemicals. This shift towards natural extracts is driven by the development of pathogen resistance to fungi by the plants, not to mention the need to protect the environment from chemical pollution (**Ahmed et al., 2016**).

It has long been recognized that the secondary metabolites of higher plants possess antioxidant activity. Phenolics, phyto-pigments, and essential oils may support plant development and disease resistance (**Ahmed et al., 2016**). Thus, the recent years witnessed a significant shift in crop production toward the use of natural products, including plant extracts (**Dimitri and Oberholtzer, 2006**). These natural extracts are balanced rich supplements of nutrients, vitamins, amino acids, and natural hormones, in addition to being environmentally friendly (**Abd El-Hamied and El-Amary, 2015; Kamra et al., 2012; Alagbe, 2020**).

The effects of natural or plant extracts on orchard tree growth and nutrition are consistent with those obtained by previous studies (**Hanafy, et al., 2012; Ezz-Thanaa et al., 2014; Basiri, et al., 2011; El-Khawaga and Mansour, 2014; Hagazy, 2015 and Akl et al., 2018**).

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Table (5): Effect of some natural extract on height of plant and diameter of stem of Hibiscus malvaviscus L. and Hibiscus rosa- sinensis L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	Height of plant (cm.)						Diameter of stem (mm.)					
	2021/2022			2022/2023			2021/2022			2022/2023		
	Hibiscus Sp. (A)											
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)
b <sub>1</sub> - Control	56.60	61.20	58.90	58.50	63.20	60.85	7.20	8.30	7.82	7.30	8.50	7.90
b <sub>2</sub> - Moringa extract at 0.25%	65.30	70.73	68.01	67.50	72.60	70.05	8.70	9.80	9.31	8.90	9.80	9.35
b <sub>3</sub> - Moringa extract at 0.50%	68.40	73.40	70.90	70.50	75.60	73.05	9.60	10.50	10.11	9.80	10.20	10.00
b <sub>4</sub> - Moringa extract at 0.75%	71.30	77.00	74.15	73.60	78.80	76.520	10.20	11.30	10.82	10.40	11.10	10.75
b <sub>5</sub> - Liquorice extract at 0.25 %	58.77	63.80	61.29	60.80	65.90	63035	7.60	8.50	8.11	7.70	8.80	8.25
b <sub>6</sub> - Liquorice extract at 0.50 %	60.00	65.20	62.60	62.20	67.70	64.95	7.95	8.80	8.38	8.10	9.00	8.55
b <sub>7</sub> - Liquorice extract at 0.75 %	62.33	67.40	64.87	64.50	69.20	66.85	8.11	9.00	8.56	8.25	9.20	8.73
b <sub>8</sub> - Fenugreek	61.55	67.00	64.28	63.60	68.50	66.05	8.00	9.00	8.50	8.15	9.10	8.63

extract at 0.25%												
b <sub>9</sub> - Fenugreek extract at 0.50%	64.61	69.80	67.21	66.50	71.60	69.05	8.50	9.60	9.05	8.70	9.50	9.10
b <sub>10</sub> - Fenugreek extract at 0.75%	66.70	72.00	69.35	68.80	73.00	70.90	8.80	9.90	9.35	9.00	9.90	9.45
Mean (A)	63.56	68.75		65.65	70.61		8.47	9.47		8.63	9.51	
New L.S.D. at 5%	A	B	AB	A	B	AB	A	B	AB	A	B	AB
	2.11	2.90	3.91	2.32	3.11	4.54	1.13	1.88	2.22	1.15	1.19	2.35

Table (6): Effect of some natural extract on number of branches per plant and leaf area of *Hibiscus malvaviscus* L. and *Hibiscus rosa-sinensis* L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	Number of branches / plant						Leaf area (cm) <sup>2</sup>					
	2021/2022			2022/2023			2021/2022			2022/2023		
	Hibiscus Sp. (A)											
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin.	Mean (B)
b <sub>1</sub> - Control	6.50	7.20	6.85	6.55	7.30	6.93	37.0	39.2	38.1	37.2	40.0	38.6
b <sub>2</sub> - Moringa extract at 0.25%	8.20	8.90	8.55	8.30	9.00	8.65	43.0	46.2	44.6	43.4	47.0	45.2
b <sub>3</sub> - Moringa extract at 0.50%	8.60	9.25	8.93	8.80	9.30	9.05	46.5	50.5	48.5	46.9	51.2	49.1
b <sub>4</sub> - Moringa extract at	9.00	9.60	9.30	9.30	9.90	9.60	48.3	52.5	50.4	48.8	53.4	51.1

0.75%												
b <sub>5</sub> - Liquorice extract at 0.25 %	7.20	7.85	7.53	7.50	8.10	7.80	37.9	39.9	38.9	38.3	40.2	39.3
b <sub>6</sub> - Liquorice extract at 0.50 %	7.60	8.20	7.90	7.85	8.40	8.13	38.8	41.3	40.1	39.5	42.0	40.8
b <sub>7</sub> - Liquorice extract at 0.75 %	7.80	8.40	8.10	8.00	8.60	8.30	40.0	44.5	42.3	41.2	45.3	43.3
b <sub>8</sub> - Fenugreek extract at 0.25%	7.70	8.30	8.00	8.00	8.50	8.25	40.0	44.0	42.0	41.1	45.0	43.1
b <sub>9</sub> - Fenugreek extract at 0.50%	8.00	8.50	8.25	8.20	8.80	8.50	42.1	46.0	44.1	43.5	46.8	45.2
b <sub>10</sub> - Fenugreek extract at 0.75%	8.30	8.80	8.55	8.50	9.20	8.85	43.3	47.5	45.4	44.2	48.2	46.2
Mean (A)	7.92	8.50		8.10	8.71		41.6	45.1		42.4	45.9	
New L.S.D. at 5%	A 0.71	B 0.85	AB 1.41	A 0.73	B 0.91	AB 1.46	A 2.0	B 2.7	AB 3.9	A 2.2	B 3.1	AB 4.1

Table (7): Effect of some natural extract on fresh and dry weight of plant of Hibiscus malvaviscus L. and Hibiscus rosa-sinensis L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	Fresh weight of plant (g.)						Dry weight of plant (g.)					
	2021/2022			2022/2023			2021/2022			2022/2023		
	Hibiscus Sp. (A)											
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)
b <sub>1</sub> - Control	60.5	66.0	63.3	60.9	66.5	63.7	20.2	23.5	21.9	20.8	23.8	22.3
b <sub>2</sub> - Moringa extract at 0.25%	70.0	75.8	72.9	71.2	76.2	73.7	23.4	26.0	24.7	24.0	26.4	25.2
b <sub>3</sub> - Moringa extract at 0.50%	74.5	79.8	77.2	75.0	80.4	77.7	24.8	27.5	26.2	25.2	27.8	26.5
b <sub>4</sub> - Moringa extract at 0.75%	77.0	84.0	80.5	78.2	85.2	81.7	25.2	28.8	27.0	25.8	29.2	27.5
b <sub>5</sub> - Liquorice extract at 0.25 %	62.4	68.0	65.2	63.5	68.8	66.2	21.0	23.9	22.5	21.4	24.2	22.8
b <sub>6</sub> - Liquorice extract at 0.50 %	66.5	71.2	68.9	68.0	72.0	70.0	22.2	25.0	23.6	22.8	25.5	24.2
b <sub>7</sub> - Liquorice extract at 0.75 %	68.0	73.5	70.8	69.5	74.0	71.8	22.8	25.9	24.4	23.4	26.4	24.9
b <sub>8</sub> - Fenugreek extract at 0.25%	67.5	73.0	70.3	68.8	73.8	71.3	22.4	25.6	24.0	23.0	26.0	24.5

b <sub>9</sub> - Fenugreek extract at 0.50%	69.5	75.8	72.7	71.0	76.2	73.6	23.2	26.8	25.0	24.0	27.2	25.6
b <sub>10</sub> - Fenugreek extract at 0.75%	70.5	76.4	73.5	72.2	77.0	74.6	24.4	27.5	26.0	25.0	28.0	26.5
Mean (A)	68.6	74.4		69.8	75.0		23.0	26.1		23.5	26.5	
New L.S.D. at 5%	A 1.9	B 2.7	AB 3.7	A 2.1	B 2.9	AB 3.8	A 1.1	B 1.8	AB 2.1	A 1.3	B 1.9	AB 2.2

Table (8): Effect of some natural extract on fresh and dry weight or roots of *Hibiscus malvaviscus* L. and *Hibiscus rosa-sinensis* L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	Fresh weight of roots (g.)						Dry weight of roots (g.)					
	2021/2022			2022/2023			2021/2022			2022/2023		
	Hibiscus Sp. (A)											
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)
b <sub>1</sub> - Control	27.5	33.0	30.3	28.0	34.2	31.1	11.8	13.0	12.4	12.0	13.2	12.6
b <sub>2</sub> - Moringa extract at 0.25%	39.0	44.5	41.8	39.5	45.2	42.4	16.0	19.2	17.6	16.5	19.5	18.0
b <sub>3</sub> - Moringa extract at 0.50%	44.5	49.0	46.8	45.2	50.1	47.7	18.4	21.0	19.7	18.9	21.5	20.2
b <sub>4</sub> - Moringa extract at 0.75%	48.5	53.2	50.9	49.2	54.0	51.6	19.5	22.2	20.9	20.0	22.7	21.4

b <sub>5</sub> - Liquorice extract at 0.25 %	29.0	33.0	31.0	30.0	33.5	31.8	12.5	15.0	13.8	13.0	15.6	14.3
b <sub>6</sub> - Liquorice extract at 0.50 %	31.5	34.5	33.0	32.0	35.2	33.6	13.2	16.4	14.8	13.8	17.0	15.4
b <sub>7</sub> - Liquorice extract at 0.75 %	33.5	37.0	35.3	34.0	38.1	36.1	14.6	17.5	16.1	14.9	17.9	16.4
b <sub>8</sub> - Fenugreek extract at 0.25%	33.0	36.5	37.8	33.8	37.8	35.8	14.2	17.1	15.7	14.5	17.6	16.1
b <sub>9</sub> - Fenugreek extract at 0.50%	36.5	39.5	38.0	37.8	40.0	38.9	15.5	18.4	17.0	16.0	19.0	17.5
b <sub>10</sub> - Fenugreek extract at 0.75%	39.0	42.0	40.5	40.0	42.5	41.3	16.3	19.5	17.9	16.8	20.0	18.4
Mean (A)	36.2	40.2		37.0	41.1		15.2	17.9		15.6	18.4	
New L.S.D. at 5%	A 1.2	B 1.9	AB 2.3	A 1.3	B 2.0	AB 2.5	A 1.1	B 1.7	AB 2.0	A 1.0	B 1.6	AB 1.8

Table (9): Effect of some natural extract on total chlorophylls and total carotenoids of Hibiscus malvaviscus L. and Hibiscus rosa- sinensis L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	Total chlorophylls (mg/ 1.0 g F.W.)						Total carotenoids (mg/ 1.0 g F./W.)					
	2021/2022			2022/2023			2021/2022			2022/2023		
	Hibiscus Sp. (A)											
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)
b <sub>1</sub> - Control	3.55	4.00	3.78	3.60	4.10	3.85	1.05	1.16	1.11	1.07	1.18	1.23
b <sub>2</sub> - Moringa extract at 0.25%	4.30	4.60	4.45	4.40	4.75	4.58	1.30	1.42	1.36	1.33	1.45	1.39
b <sub>3</sub> - Moringa extract at 0.50%	4.65	4.90	4.78	4.75	5.00	4.88	1.49	1.58	1.54	1.52	1.62	1.52
b <sub>4</sub> - Moringa extract at 0.75%	4.90	5.30	5.10	5.00	5.50	5.25	1.55	1.66	1.56	1.58	1.68	1.63
b <sub>5</sub> - Liquorice extract at 0.25 %	3.70	4.20	3.95	3.80	4.40	4.10	1.11	1.20	1.16	1.14	1.25	1.19
b <sub>6</sub> - Liquorice extract at 0.50 %	3.95	4.35	4.15	4.05	4.50	4.28	1.19	1.30	1.25	1.22	1.33	1.28
b <sub>7</sub> - Liquorice extract at 0.75 %	4.10	4.50	4.30	4.15	4.60	4.38	1.22	1.42	1.32	1.28	1.45	1.37
b <sub>8</sub> - Fenugreek extract at 0.25%	4.05	4.40	4.23	4.10	4.50	4.30	1.20	1.40	1.30	1.26	1.42	1.34

b <sub>9</sub> - Fenugreek extract at 0.50%	4.22	4.60	4.41	4.30	4.70	4.50	1.28	1.50	1.39	1.31	1.55	1.43
b <sub>10</sub> - Fenugreek extract at 0.75%	4.35	4.70	4.53	4.45	4.80	4.36	1.35	1.60	1.48	1.40	1.65	1.53
Mean (A)	4.18	4.56		4.26	4.69		1.27	1.42		1.31	1.46	
New L.S.D. at 5%	A 0.71	B 0.93	AB 1.33	A 0.82	B 0.99	AB 1.71	A 0.19	B 0.23	AB 0.37	A 0.21	B 0.29	AB 0.41

Table (10): Effect of some natural extract on percentages of N and P in the leaves of *Hibiscus malvaviscus* L. and *Hibiscus rosa-sinensis* L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	N %						P %					
	2021/2022			2022/2023			2021/2022			2022/2023		
	Hibiscus Sp. (A)											
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa- sin.	Mean (B)
b <sub>1</sub> - Control	1.66	1.71	1.69	1.68	1.72	1.70	0.12	0.14	0.13	0.13	0.15	0.14
b <sub>2</sub> - Moringa extract at 0.25%	2.00	2.05	2.03	2.05	2.07	2.06	0.27	0.29	0.28	0.28	0.30	0.29
b <sub>3</sub> - Moringa extract at 0.50%	2.11	2.16	2.14	2.16	2.18	2.17	0.31	0.35	0.33	0.33	0.36	0.35
b <sub>4</sub> - Moringa extract at 0.75%	2.20	2.25	2.23	2.23	2.28	2.26	0.33	0.36	0.35	0.35	0.38	0.37



b <sub>5</sub> - Liquorice extract at 0.25 %	1.72	1.80	17.6	1.75	1.82	1.79	0.16	0.19	0.18	0.17	0.21	0.19
b <sub>6</sub> - Liquorice extract at 0.50 %	1.78	1.86	1.82	1.81	1.88	1.85	0.19	0.22	0.21	0.21	0.24	0.23
b <sub>7</sub> - Liquorice extract at 0.75 %	1.83	1.90	1.86	1.85	1.92	1.89	0.22	0.25	0.24	0.23	0.26	0.25
b <sub>8</sub> - Fenugreek extract at 0.25%	1.80	1.89	1.85	1.90	1.91	1.91	0.20	0.24	0.22	0.21	0.26	0.23
b <sub>9</sub> - Fenugreek extract at 0.50%	1.96	2.02	1.99	2.00	2.04	2.02	0.25	0.29	0.27	0.26	0.31	0.29
b <sub>10</sub> - Fenugreek extract at 0.75%	2.05	2.10	2.08	2.08	2.12	2.10	0.28	0.31	0.30	0.29	0.33	0.31
Mean (A)	1.91	1.97		1.95	1.99		0.23	0.26		0.25	0.28	
New L.S.D. at 5%	A 0.08	B 0.11	AB 0.14	A 0.09	B 0.12	AB 0.16	A 0.04	B 0.06	AB 0.08	A 0.05	B 0.07	AB 0.09

Table (11): Effect of some natural extract on K % in the leaves of Hibiscus malvaviscus L. and Hibiscus rosa- sinensis L. plant during 2021/ 2022 and 2022/ 2023 seasons.

Treatment some natural extracts (B)	K %					
	2021/2022			2022/2023		
	Hibiscus Sp. (A)					
	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin	Mean (B)	a <sub>1</sub> Hibiscus malva.	a <sub>2</sub> Hib.rosa-sin	Mean (B)
b <sub>1</sub> - Control	0.95	1.00	0.98	0.98	0.99	0.99
b <sub>2</sub> - Moringa extract at 0.25%	1.20	1.25	1.23	1.22	1.27	1.25
b <sub>3</sub> - Moringa extract at 0.50%	1.30	1.36	1.33	1.33	1.38	1.36
b <sub>4</sub> - Moringa extract at 0.75%	1.35	1.41	1.38	1.38	1.43	1.41
b <sub>5</sub> - Liquorice extract at 0.25 %	1.05	1.11	1.08	1.08	1.13	1.11
b <sub>6</sub> - Liquorice extract at 0.50 %	1.10	1.15	1.13	1.12	1.18	1.15
b <sub>7</sub> - Liquorice extract at 0.75 %	1.13	1.18	1.16	1.15	1.21	1.18
b <sub>8</sub> - Fenugreek extract at 0.25%	1.10	1.16	1.13	1.13	1.19	1.16

b <sub>9</sub> - Fenugreek extract at 0.50%	1.18	1.23	1.21	1.21	1.25	1.23
b <sub>10</sub> - Fenugreek extract at 0.75%	1.21	1.25	1.23	1.23	1.27	1.25
Mean (A)	116	1.21		1.18	1.23	
New L.S.D. at 5%	A 0.07	B 0.09	AB 0.12	A 0.08	B 0.11	AB 0.14