

## RESPONSE OF SEASHORE PASPALUM TURF TO SOME FERTILIZATION TREATMENTS

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**ABSTRACT:** A study was consummated in the open field at the Experimental Farm of Hort. Res. Inst., ARC, Giza, Egypt during 2013 and 2014 seasons to explore the response of seashore paspalum (*Paspalum vaginatum* Swartz) turf plants cultivated in 40-cm-diameter plastic pots filled with about 6 kg of sand and clay mixture (1:1, v/v) to some fertilization treatments, viz., the humic acid liquid fertilizer at 20 ml/l, as well as diatomite powder and the commercial complete fertilizer (NPK + micronutrients) at 1 g/l for each, and also to the combined treatments between 20 ml/l humic acid and one of the abovenamed products at 1 g/l for each, when applied with irrigation water (fertigation), five times with one month interval. The obtained results showed that all individual fertigation treatments significantly improved means of all vegetative growth traits over control ones in the two seasons, but the highest means were attained by humic acid, moringa leaf powder and the commercial complete fertilizer treatments which gave averages closely near together with non-significant differences among themselves in most cases of the two seasons. However, the least improvement was found due to the sole application of diatomite powder at 1 g/l. On the other side, the combining between humic acid (20 ml/l) and any one of the other fertilizers (at 1 g/l for each) induced an additional improvement in all growth characters, with the prevalence of the connecting between humic acid at 20 ml/l and moringa leaf powder at 1 g/l, as such combination resulted the tallest plants, the highest No. plants/pot, the best coverage and the heaviest fresh and dry weights in most instances of both seasons. A similar trend was also observed as well regarding the content of chlorophyll a, b, carotenoids, N, P, K, total soluble sugars and total indoles. The opposite was the right concerning total phenols content, which was slightly affected by the most of individual and combined treatments applied in this study, except for 1 g/l complete fertilizer treatment, alone or in combination with 20 ml/l humic acid one that elevated such component to the maximum values in the two seasons, as well as the combination of humic acid at 20 ml/l + moringa leaf powder at 1 g/l that gave a contrary trend by reducing content of this constituent to the minimum values in both seasons.

So, it is advised to fertigate seashore paspalum turf grown in sand and clay mixture (1:1, v/v) with humic acid liquid fertilizer at 20 ml/l plus moringa leaf powder at 1 g/l, five times with one month interval to get the best growth performance, density, colour and quality.

**Key words:** Seashore paspalum, *Paspalum vaginatum* Swartz, humic acid, diatomite powder, moringa leaf powder, fertilization treatments or fertigation, turfgrass.

## INTRODUCTION

Seashore paspalum (*Paspalum vaginatum* Swartz) is a succulent warm-season turf type grass that belongs to Fam. Gramineae, but it retains a healthy appearance all year-round, unlike bermudagrass that tends to go off-colour during cooler months and short days (Huxley *et al.*, 1992). It is easily propagated by cuttings and pre-prepared rolls, and fast spreads with lateral growing stems called stolons. It makes an attractive perennial turf in tropical and subtropical areas and can tolerate irrigation water with high salinity levels, withstand mowing, treading as well as wear and tear (Morton, 1974).

Turfgrass plants usually undergo many stresses, i.e., they are crowded together and compete with each other for water and nutrients. They are regularly mowed and their clippings are often removed. So, they must be well fertilized to face these competition and the un-natural demands placed on them. With proper fertilization, the lawn will maintain good colour, density and vigour and will not easily succumb to insects, weeds or diseases (Peacock *et al.*, 1985). There are many types of fertilizers handling now in our local market, among of them is humic acid or humates which provide soil microbes with energy, improve nutrients retention in the soil and enhance the water holding capacity (Dorer and Peacock, 1997). In this regard, El-Sayed (2012) reported that humic acid liquid fertilizer at 20 ml/l greatly improved height, covering rate and herb fresh and dry weights of seashore paspalum plants, besides increasing the leaf content of chlorophyll a, b, carotenoids, total soluble sugars, indoles and phenols. Similar observations were also revealed by Abdel-Fattah *et al.* (2008) on Tifway turf.

Diatomite powder prepared from one-cell Algae that their membranes are saturated with silica, i.e., silicon dioxide (SiO<sub>2</sub>) is using now as a source for natural silica which provides the plants with energy and reinforces the plant's ability to protect itself against biotic and abiotic stresses, and soil treated with it will have optimal fertility through improving water physical and chemical properties and by

allowing nutrients in the soil to remain available for plants. It can restores heavy metals and hydrocarbon-polluted areas and decreases mortality (Nathan and Morgan, 2009). On woody plants, Kozalowski and Davies (1975) mentioned that silica significantly reduced transpiration, with a positive effect on plant water potential.

The dry powder of moringa leaves (*Moringa oleifera* Lam.) are widely used for food, medication and industrial purposes and also for organic production of crops due to its content of proteins, fats, fibers, carbohydrates, amino acids, vitamins and minerals (Price, 2007). In a recent study, Moyo *et al.* (2011) found that the dried leaves of moringa contain the following minerals: Ca (3.65%), P (0.3%), Mg (0.5%), K (1.5%), Na (0.17%), S (0.63%), Cu (8.25%), Fe (490 ppm), Zn (13.03 ppm), Mn (86.8 ppm) and Se (363 ppm). In this concern, Youssef and El-Sayed (2012) postulated that 1 g/l of moringa extract as a foliar spray significantly improved vegetative and root growth of *Euonymus japonicus* cv. Aureus transplants and increased the content of chlorophyll a, b, carotenoids, total indoles and total phenols in the leaves. Furthermore, Khenizy *et al.* (2014) noticed that a holding solution containing moringa extract (25%) + sucrose (2%) + salicylic acid (150 ppm) increased flower longevity of *Gypsophila paniculata* cut flowers, as well as fresh weight %, total carbohydrates % and water uptake, but decreased water loss, maintained quality rate, water balance and decreased No. of bacteria in the solution. On maize, Emmanuel *et al.* (2011) stated that cakes of moringa seeds increased the mineral content of the soil, and this in turn increased the yield.

The purpose of this study was to explore the effect of some fertilization treatments on growth and quality of seashore paspalum turf.

## MATERIAL AND METHODS

A trial was performed in the open field at the Experimental Farm of Hort. Res. Inst., ARC, Giza, Egypt through 2013 and 2014 seasons in order to examine the role of some

fertilization treatments on improving growth, density and color of paspalum sod.

Thus, circle pieces from pre-prepared rolles of seashore paspalum (*Paspalum vaginatum* Swartz) at a radius of 10 cm (their fresh weights ranged between 90-100 g) were carefully taken and planted on April, 1<sup>st</sup> for each season in the center of 40-cm-diameter plastic pots (one piece/pot) filled with about 6 kg of an equal mixture of sand and clay. The physical and chemical analysis of the used sand and clay in the two seasons are shown in Table (1).

The pieces were gently pressed with hand to be more contact with the soil mixture and were then daily irrigated with about 300 ml of a tap water/pot during the first 2 weeks after planting, while afterwards were irrigated 2 times a week with 400 ml of water/pot till the end of experiment. After one month from planting (on first of May), the planted pieces received the following fertilization treatments with irrigation water (fertigation), monthly for 5 times till the first of September of each season:

- 1- No fertilization, referred to as control.
- 2- The humic acid liquid fertilizer (10 N:10 P<sub>2</sub>O<sub>5</sub>:10 K<sub>2</sub>O) at the rate of 20 ml/l.
- 3- The diatomite powder, as a source of natural silica (SiO<sub>2</sub>) at the rate of 1 g/l.
- 4- The dried leaf powder of *Moringa oleifera* Lam. at the rate of 1 g/l.
- 5- The commercial complete fertilizer at the rate of 1 g/l.
- 6- The humic acid treatment was combined with each one of the other treatments to form the following 3 combinations:
  - a. Humic acid at 20 ml/l + diatomite powder at 1 g/l.
  - b. Humic acid at 20 ml/l + moringa leaf powder at 1 g/l.
  - c. Humic acid at 20 ml/l + commercial complete fertilizer at 1 g/l.

The main characteristics of humic acid fertilizer and chemical analysis of both dried leaf powder of moringa and commercial complete fertilizer are shown in Tables (2), (3)

and (4), respectively. The pots were arranged for each season in a completely randomized design (Mead *et al.*, 1993), with 3 replicates for each treatment, as each replicate contained 5 pots. All agricultural practices necessary for such plantation were carried out whenever needed.

The first cut was handly done after two months from planting (on June, 1<sup>st</sup>) using a very sharp stainless steel cutter leaving stubbles with 1 inch long. Other four cuts were monthly undertaken thereafter. Before each cut in the two seasons, plant height (cm) was recorded, while number plants/pot and fresh and dry weights (g) of the resulted clippings after mowing were determined after each cut. Moreover, the covering rate as percentage was evaluated using the method described by Mahdi (1953). However, the means of each parameter abovenamed in the five taken cuts were collected and expressed in the tables as an average for all cuts. In fresh leaf samples taken from the last cut (on October, 1<sup>st</sup>), photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.), as well as total indoles and total phenols (mg/100 g f.w.) were measured according to the methods of Saric *et al.* (1967), A.O.A.C (1980) and William *et al.* (1965), respectively, while in dry samples, the percentages of nitrogen (Pregl, 1945), phosphorus (Cottenie *at al.*, 1982), potassium (Jackson, 1973) and total soluble sugars (Dubois *et al.*, 1956) were measured.

Data were then tabulated and subjected to analysis of variance using SAS Institute program (1994), according to Duncan's Multiple Range Test (Duncan, 1955), to detect the significancy among means of various treatments.

## RESULTS AND DISCUSSION

### Effect of fertilization treatments on:

#### Vegetative growth parameters:

Data presented in Tables (5 and 6) show that all individual fertilization treatments significantly improved all vegetative growth characters over control in the two seasons, but the best means were attained by humic acid,

**Table 1. The physical and chemical analyses of the used sand and clay during 2013 and 2014 seasons.**

Soil type	Seasons	Particle size distribution (%)				S.P.	pH	E.C. (dS/m)	Cations (meq/l)				Anions (meq/l)		
		Coarse sand	Fine sand	Silt	Clay				Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	K <sup>+</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>
Sand	2013	89.03	2.05	0.40	8.52	23.00	7.92	3.72	7.50	1.63	33.60	0.50	3.20	22.00	18.03
	2014	90.10	1.95	0.50	7.45	22.86	7.89	3.75	19.42	8.33	7.20	0.75	1.60	7.00	27.10
Clay	2013	7.54	22.28	30.55	39.63	55.00	8.17	2.26	7.82	2.12	15.40	0.75	6.60	8.20	11.29
	2014	7.64	22.50	30.15	39.71	51.00	8.09	2.38	7.50	2.20	15.50	0.75	6.78	8.02	11.15

**Table 2. Main characteristics of the liquid humic acid fertilizer used in both seasons.**

Component	Value	Component	Value	Component	Value
Humic acid (%)	2.90	E.C. (dS/m)	3.50	B (ppm)	70.0
Organic matter /total solid (%)	42.51	N (%)	10.00	Fe (ppm)	900.0
Total HA / total solid (%)	65.80	P (%)	10.00	Mn (ppm)	90.0
Organic carbon (%)	24.64	K (%)	10.00	Zn (ppm)	90.0
C/N ratio	2.46	Ca (%)	0.06	Cu (ppm)	90.0
pH	8.20	Mg (%)	0.05	Mo (ppm)	Traces

**Table 3. Chemical analysis of the dried leaf powder of *Moringa oleifera* Lam. used in the two seasons per 100 grams of dry matter (From Price, 2007).**

Component	Value	Component	Value	Component	Value
Moisture (%)	7.50	Cu (mg)	0.57	Arginine (mg)	1325
Calories	205	Fe (mg)	28.20	Histidine (mg)	613
Protein (g)	27.10	S (mg)	87.00	Lysine (mg)	1325
Fat (g)	2.30	Oxalic acid (mg)	1600	Tryptephan (mg)	425
Carbohydrates (g)	38.20	Vit. A-B carotene (mg)*	16.30	Phenylalanime (mg)	1388
Fiber	19.20	Vit.B1-thiamin (mg)	2.64	Methionine (mg)	350
Ca (mg)	2.003	Vit. B2-riboflavin (mg)	20.50	Threonine (mg)	1188
Mg (mg)	368	Vit. B3-nicotinic acid (mg)	8.20	Leucine (mg)	1950
P (mg)	204	Vit. C-ascorbic acid (mg)	17.30	Isoleucine (mg)	825
K (mg)	1.33	Vit. E. tocopherol acetata (mg)	113	Valine (mg)	1063

\* The B-carotene found in moringa is a precursor to retinol (Vit. A).

There are about 25 rinds of B-carotene in moringa leaves.

**Table 4. Chemical analysis of the commercial complete fertilizer used in the two seasons.**

Component	Value	Component	Value	Component	Value	Component	Value
Total N (%)	22.00	Ca (%)	5.50	Fe (%)	0.05	Mo (%)	0.002
Available P <sub>2</sub> O <sub>5</sub> (%)	5.00	Mg (%)	0.24	Mn (%)	0.07	Citric acid (%)	0.50
K <sub>2</sub> O (%)	11.00	Zn (%)	0.07	Cu (%)	0.05	Sucrose (%)	0.30

**Table 5. Effect of fertilization treatments on plant height, number of plants/pot and covering rate of *Paspalum vaginatum* Swartz plants during 2013 and 2014 seasons.**

Treatments	Plant height (cm)		No. of plants/pot		Covering rate (%)	
	2013	2014	2013	2014	2013	2014
Control	44.33c	43.60d	20.33d	21.33d	61.00e	64.10d
HA at 20 ml/l (A)	46.78b	49.17b	26.67bc	28.33bc	80.10c	85.00bc
DP at 1 g/l (B)	45.10c	47.25c	23.33c	25.00c	69.89d	73.50c
MLP at 1 g/l ( C )	47.36b	49.73b	28.00b	30.00b	84.00b	88.33b
CCF at 1 g/l (D)	46.67b	49.03b	27.00bc	28.36bc	80.76c	84.90bc
A + B	46.93b	49.25b	27.82b	30.00b	83.50b	90.69b
A + C	50.00a	52.67a	32.00a	35.61a	100.00a	100.00a
A + D	48.79ab	51.56ab	32.00a	33.96ab	96.00ab	98.47a

- HA = humic acid, DP = diatomite powder, MLP = moringa leaf powder and CCF = commercial complete fertilizer.

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

**Table 6. Effect of fertilization treatments on fresh and dry weights of *Paspalum vaginatum* Swartz clippings/pot during 2013 and 2014 seasons.**

Treatments	Fresh weight (g)		Dry weight (g)	
	2013	2014	2013	2014
Control	33.45e	32.91e	15.39d	15.09d
HA at 20 ml/l (A)	58.50bc	61.20bc	22.78bc	23.81bc
DP at 1 g/l (B)	41.75d	44.00d	20.15c	21.26c
MLP at 1 g/l ( C )	60.33bc	63.10b	24.50b	25.07b
CCF at 1 g/l (D)	56.87c	58.50c	23.98bc	24.68bc
A + B	61.58b	64.33b	27.11b	29.00b
A + C	81.39ab	87.30a	38.76a	41.62a
A + D	86.47a	85.25a	41.23a	39.69a

- HA = humic acid, DP = diatomite powder, MLP = moringa leaf powder and CCF = commercial complete fertilizer.

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

moringa leaf powder and commercial complete fertilizer treatments which gave records closely near together with non-significant differences among themselves in most cases of both seasons. The least improvement, however was ascribed to the individual application of diatomite powder at 1 g/l. On the other hand, the combining between humic acid (20 ml/l) and the other fertilizers (1 g/l) caused an additional improvement in all growth parameters, with the superiority of the combined treatment between humic acid at 20 ml/l and moringa leaf powder at 1 g/l which gave, in general the tallest plants, the highest No. plants/pot, the best coverage and the heaviest fresh and dry weights in most instances of the two seasons and followed by the combination of 20 ml/l HA + 1 g/l commercial complete fertilizer that gave records greatly near to those of the super combined treatment previously stated with non-significant differences among themselves in the 1<sup>st</sup> and 2<sup>nd</sup> seasons.

This may be attributed to lump the role of humic acid in increasing the availability of nutrients in the soil through influence on soil microbes activity, besides it contains NPK and some micronutrients necessary for good growth (Dorer and Peacock, 1997), and the role of either moringa leaf powder as a natural source of minerals, amino acids, vitamins and antioxidants (Price, 2007) or the complete fertilizer that contains different macro-and micro-nutrients in providing the plants with nutrients necessary for healthy growth.

The above results are supported by those obtained by El-Sayed (2012) on seashore paspalum, Abdel-Fattah *et al.* (2008) on Tifway sod, Youssef and El-Sayed (2012) on *Euonymus japonicus* cv. Aureus and Khenizy *et al.* (2014) on *Gysophila paniculata*.

#### **Chemical composition:**

It is clear from data averaged in Tables (7, 8 and 9) that fertigation with both humic acid and other fertilizers, alone or in combinations induced significant increments in the leaf content of chlorophyll a, b and carotenoids (mg/g f.w.) and the percentages of N, P, K and

total soluble sugars relative to their contents in the leaves of control plants with few exceptions in the two seasons. However, the least increasing in such components were registered by the sole fertigation with diatomite powder at 1 g/l, but the mastership in both seasons was for the combined treatments, especially between 20 ml/l humic acid and 1 g/l moringa leaf powder, as such combination scored the utmost high content of the different constituents mentioned above and followed by the combination of 20 ml/l HA + 1 g/l commercial complete fertilizer that gave means occupied the second rank. This may indicate the role of humic acid in enhancing the metabolic activity of soil microorganisms and acting as a source of N, P, K and S for plants (Higa and Wididana, 1991). Moreover, moringa leaf powder and complete fertilizer provide the plants with their requirements of minerals which activate biosynthesis processes in plant tissues.

A similar trend was also observed as well regarding the content of total indoles (mg/100 g f.w.), as it was significantly increased in response to the different sole or combined treatments employed in this work except for diatomite powder (1 g/l) treatment, to reach the maximum by combining between HA at 20 ml/l and moringa leaf powder at 1 g/l in the two seasons. The opposite was the right concerning total phenols content which was stable in most cases of both seasons, with the exception of 1 g/l complete fertilizer treatment, alone or combined with 20 ml/l humic acid that elevated such component to the maximum values in the first and second seasons, as well as the combination of 20 ml/l HA + 1 g/l moringa leaf powder that gave an opposite trend by reducing this component to the minimum values in the two seasons. This may be the direct reason for the excellence of such combination over all other treatments.

Similar observations were also elicited by El-Sayed *et al.* (2008) on Tifway turfgrass and Emmanuel *et al.* (2011) on maize.

From the foregoing, it can be concluded that fertigation seashore paspalum (*Paspalum vaginatum* Swartz) plants grown in sand and

**Table 7. Effect of fertilization treatments on pigments content (mg/g f.w.) in the leaves of *Paspalum vaginatum* Swartz plants during 2013 and 2014 seasons.**

Treatments	Chlorophyll (a)		Chlorophyll (b)		Carotenoids	
	2013	2014	2013	2014	2013	2014
Control	0.765d	0.806d	0.359e	0.376f	0.241d	0.255e
HA at 20 ml/l (A)	0.912b	0.959b	0.365c	0.669cd	0.432bc	0.414bc
DP at 1 g/l (B)	0.815c	0.858c	0.417d	0.440e	0.281d	0.306d
MLP at 1 g/l ( C )	0.969ab	1.021ab	0.648c	0.683c	0.434bc	0.421bc
CCF at 1 g/l (D)	0.829c	0.875c	0.565c	0.601d	0.373c	0.380c
A + B	0.933b	0.987b	0.658c	0.698c	0.445b	0.469b
A + C	1.031a	1.086a	0.797a	0.840a	0.536a	0.567a
A + D	0.973ab	1.027ab	0.721b	0.797b	0.463b	0.501ab

- HA = humic acid, DP = diatomite powder, MLP = moringa leaf powder and CCF = commercial complete fertilizer.

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5 % level.

**Table 8. Effect of fertilization treatments on nitrogen, phosphorus and potassium % in the leaves of *Paspalum vaginatum* Swartz plants during 2013 and 2014 seasons.**

Treatments	N (%)		P (%)		K (%)	
	2013	2014	2013	2014	2013	2014
Control	1.31c	1.17d	0.09c	0.09c	1.09d	1.15d
HA at 20 ml/l (A)	1.87b	1.90bc	0.18b	0.14b	1.33bc	1.41c
DP at 1 g/l (B)	1.41c	1.47cd	0.11bc	0.10c	1.17cd	1.28cd
MLP at 1 g/l ( C )	1.60bc	1.78c	0.18b	0.16b	1.22c	1.32c
CCF at 1 g/l (D)	1.89b	2.04b	0.18b	0.18ab	1.26c	1.36c
A + B	2.13ab	2.10b	0.21ab	0.21a	1.50b	1.62b
A + C	2.41a	2.63a	0.29a	0.25a	1.76a	1.90a
A + D	2.23a	2.38ab	0.24a	0.23a	1.59b	1.70b

- HA = humic acid, DP = diatomite powder, MLP = moringa leaf powder and CCF = commercial complete fertilizer.

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

**Table 9. Effect of fertilization treatments on total soluble sugars, indoles and phenols in the leaves of *Paspalum vaginatum* Swartz plants during 2013 and 2014 seasons.**

Treatments	Total soluble sugars (%)		Total indoles (mg/100 g f.w.)		Total phenols (mg/100 g f.w.)	
	2013	2014	2013	2014	2013	2014
Control	7.12e	7.70d	0.001d	0.001c	0.020b	0.021b
HA at 20 ml/l (A)	9.47bc	10.23b	0.003c	0.002bc	0.021b	0.021b
DP at 1 g/l (B)	8.00d	8.76c	0.001d	0.001c	0.021b	0.020b
MLP at 1 g/l ( C )	9.33c	9.40bc	0.005ab	0.003b	0.020b	0.020b
CCF at 1 g/l (D)	9.26c	10.00b	0.004b	0.003b	0.029a	0.023a
A + B	9.56bc	10.33ab	0.003c	0.003b	0.020b	0.021b
A + C	10.49a	10.96a	0.006a	0.005a	0.016c	0.015c
A + D	9.88b	10.50ab	0.005ab	0.004ab	0.023ab	0.023a

- HA = humic acid, DP = diatomite powder, MLP = moringa leaf powder and CCF = commercial complete fertilizer.

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

clay mixture (1:1, v/v) with HA liquid fertilizer at 20 ml/l + the dry leaf powder of moringa at 1 g/l, five times with one month interval may be one of the best practical way to establish the best lawn of such grass.

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### استجابة مسطح الباسبالم (شاطئ البحر) لبعض معاملات التسميد

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أجريت هذه التجربة بالحقل المكشوف بالمزرعة التجريبية لمعهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠١٣، ٢٠١٤ للوقوف على مدى استجابة نباتات مسطح الباسبالم (شاطئ البحر) (*Paspalum vaginatum* Swartz) المنزرعة في أصص بلاستيك قطرها ٤٠ سم، مملوءة بحوالي ٦ كجم من مخلوط الرمل والطين (بنسبة ١:١ حجماً) لبعض معاملات التسميد وهي: السماد السائل لحمض الهيوميك بمعدل ٢٠ مل/لتر، مسحوق الدياتومات (كمصدر طبيعي للسيليكا) بمعدل ١ جم/لتر، مسحوق أوراق المورنجا المجففة (كمصدر طبيعي للعناصر المعدنية، الأحماض الأمينية، الفيتامينات، مضادات الأكسدة وبعض المكونات الأخرى) بمعدل ١ جم/لتر والسماد التجاري الكامل بمعدل ١ جم/لتر وكذلك للمعاملات المشتركة بين السماد السائل لحمض الهيوميك (٢٠ مل/لتر) مع كل منتج من الأسمدة المذكورة سابقاً (بمعدل ١ جم/لتر لكل منها على حدة) عند إضافتها مع ماء الري خمس مرات وبفاصل زمني شهر بين كل مرتين.

أوضحت النتائج المتحصل عليها أن جميع معاملات التسميد الفردية أحدثت تحسناً معنوياً في متوسطات جميع قياسات النمو الخضري مقارنة بالكنترول في كلا الموسمين، لكن أعلى المتوسطات حققتها معاملات حمض الهيوميك، مسحوق أوراق المورنجا والسماد التجاري الكامل والتي أعطت جميعها قيماً قريبة من بعضها وبدون أية فروق معنوية فيما بينها في معظم الحالات بكلا الموسمين. بينما أحدثت معاملة مسحوق الدياتومات بمعدل ١ جم/لتر أقل تحسناً. على الجانب الآخر، أدى الجمع بين معاملة حمض الهيوميك (٢٠ مل/لتر) والمنتجات السمادية الأخرى (بمعدل ١ جم/لتر لكل منها على حدة) إلى إحداث تحسن إضافي في جميع قياسات النمو الخضري، مع تفوق معاملة الجمع بين حمض الهيوميك (٢٠ مل/لتر) ومسحوق أوراق المورنجا (١ جم/لتر) والتي أعطت أطول النباتات، أكبر عدد للنباتات/أصيص، أفضل معدل للتغطية وأثقل الأوزان الطازجة والجافة في معظم الحالات بكلا الموسمين. تم الحصول أيضاً على اتجاه مشابه فيما يتعلق بمحتوى الأوراق من كلورفيللي أ، ب، والكاروتينويدات، ن، فو، بو، السكريات الكلية الذائبة والأندولات الكلية، بينما كان العكس صحيحاً فيما يتعلق بمحتواها من الفينولات الكلية والذي تأثر قليلاً بمعظم المعاملات الفردية والمشتركة المطبقة بهذه الدراسة، باستثناء معاملة السماد التجاري الكامل (١ جم/لتر)، بمفردها أو مع حمض الهيوميك (٢٠ مل/لتر) والتي رفعت محتوى هذا المكون في الأوراق إلى أعلى القيم في الموسمين وكذلك توليفة حمض الهيوميك (٢٠ مل/لتر) + مسحوق

أوراق المورنجا ( ١ جم/لتر) والتي أعطت إتجاهاً معاكساً بخفض محتوى هذا المكون إلى أدنى القيم على الإطلاق بكلا الموسمين.

من هذه النتائج يمكن النصح بتسميد مسطح الباسالم (شاطئ البحر) المنزرع في مخلوط متساوي من الرمل والطين بالسماذ السائل لحمض الهيوميك بمعدل ٢٠ مل/لتر ومسحوق أوراق المورنجا المجففة بمعدل ١ جم/لتر مع ماء الري، خمس مرات وبفاصل شهر بين كل مرتين للحصول على أفضل نمو، تغطية، لون وجودة للمسطح الناتج.