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إستجابة مسطح الباسبالم (شاطيء البحر) للمعاملة بالكريستالون و المنشط الحيوي (EM)

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الملخص العربي

أجري هذا البحث بمشتل معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠٠٩، ٢٠١٠ و ذلك لتحديد مدى إستجابة نباتات مسطح الباسبالم (شاطيء البحر) *Paspalum vaginatum*, Swartz. النامية في أصص بلاستيك قطرها ٤٠ سم ملأت بحوالي ٤ كجم من مخلوط الرمل و الطين (بنسبة ١:١ حجماً) للتسميد بالكريستالون كسماد كيماوي مركب (١٩ : ١٩ : ١٩ + عناصر صغرى) بمعدل ٢ جم/إصيص و المعاملة بالـ EM (كمنشط حيوي يحتوي على أكثر من ستون سلالة من الكائنات الحية الدقيقة المنشطة) بمعدل: صفر، ١، ٣، ٥ مل/لتر، بمفردها أو في توليفات، عند اضافتها تكبيشاً للتربة، خمس مرات خلال موسم النمو و بفاصل شهر بين كل مرتين متتاليتين.

و لقد أوضحت النتائج المتحصل عليها أن جميع المعاملات الفردية للكريستالون و المنشط الحيوي EM أحدثت زيادة معنوية في إرتفاع النبات، معدل التغطية، عدد النباتات/إصيص و الأوزان الطازجة و الجافة للعشب الناتج بعد القص مقارنة بالكنترول في معظم الحالات بكلا الموسمين . و لقد تم الحصول على إتجاه مشابه فيما يتعلق بمحتوى الأوراق من كلوروفيللي أ، ب و الكاروتينويدات، و كذلك محتوى العشب من السكريات الكلية و صصالإندولات و الفينولات. و بصفة عامة، فقد أعطى المنشط الحيوي EM بمفرده (عند أي مستوى من مستوياته التي إستخدمت في هذه الدراسة) نتائج أفضل من نتائج الكريستالون مع بعض الاستثناءات الطفيفة، إلا أن الجمع بينهما أحدث تحسناً إضافياً في جميع القياسات السابقة، مع تفوق المعاملة المشتركة بين الكريستالون بمعدل ٢ جم/إصيص و المنشط الحيوي EM بمعدل ١ مل/لتر و التي سجلت أعلى المتوسطات على الاطلاق.

و عليه، فإنه يمكن النصح بتسميد مسطح الباسبالم (شاطيء البحر) النامي في بيئة مكونة من مخلوط متساوي من الرمل و الطين بسماد الكريستالون المركب بمعدل ٢ جم/إصيص + المنشط الحيوي EM بمعدل ١مل/لتر كإضافات أرضية، خمس مرات عقب القص خلال موسم النمو و بفاصل شهر بين كل مرتين متتاليتين.

RESPONSE OF SEASHORE PASPALUM TURF TO TREATMENT WITH KRISTALON AND BIOSTIMULANT EM

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ABSTRACT: *An investigation was performed at the Nursery of Hort. Res. Inst., A.R.C., Giza, Egypt during 2009 and 2010 seasons to study the response of seashore paspalum (Paspalum vaginatum, Swartz.) plants grown in 40-cm-diameter plastic pots filled with about 4 kg of sand and clay mixture (1:1, v/v) to kristalon; a complete chemical fertilizer (19:19:19 + micronutrients) at 2g/pot and EM (a biostimulant contains more than 60 strains of effective microorganisms) at 0, 1, 3 and 5 ml/L, individually or in combinations, when applied as soil drench, five times through the growing season with one month interval.*

The obtained results indicated that all individual kristalon or EM treatments significantly increased plant height, covering rate, No. plants/pot and herb fresh and dry weights comparing with control in most instances of the two seasons. A similar trend was also gained concerning chlorophyll a, b and carotenoids content in the leaves, as well as total sugars, indoles and phenols in the herb. In general, EM biostimulant alone at any level gave better results than kristalon at 2 g/pot with few exceptions, but the collecting between them caused more improving in all previous measurments, with the dominance of 2g/pot kristalon+1ml/L EM combined treatment, which registered the highest records at all.

Hence, it could be recommended to fertilize seashore paspalum plants grown in 40-cm-diameter plastic pots filled with sand and clay mixture (1:1, v/v) with kristalon at 2g/pot and EM at 1 ml/L as soil drench, five times during the growing season with one month interval.

Key words: *Paspalum turf, chemical fertilization, biostimulants*

INTRODUCTION

The importance of lawns, as the major part of gardens and public grounds, and as the basis of landscape design is doubtless now well known. Many types of amenity grasses are now widely used for greening the lawns all over the year. Among of them may be seashore paspalum (*Paspalum vaginatum*, Swartz.) that belongs Fam. Gramineae. It is a succulent warm-season turf type grasses, but it retains a healthy appearance all year-round, unlike bermudagrass that tend to go off-colour during cooler months and short day lengths (Huxley *et al.,* 1992). It is easily propagated by cuttings and pre-prepared rolls, and fast spreading with lateral growing stems called stolons. It makes an attractive perennial turf in tropical and subtropical areas and can tolerate irrigation water with high salt content, withstand mowing, treading, as well as wear and tear (Morton, 1974).

Growth of turfgrass is greatly dependent on good nutrition, which is directly done by dressing with highly-soluble complete fertilizers, or indirectly by applying biostimulants, which play a major role in releasing nutrients necessary for plants to grow well. In this regard, Munshaw *et al.* (2006) found that application of seaweed extract (0.54 kg/ha), N (49 kg/ha) and Fe (1 kg/ha) improved colour, density and cold tolerance of Tifway, Midiron, Princess-77 and Riviera bermudagrasses. Cold tolerance indicators proline and linolenic acid were highest in Tifway and Midiron followed by Princess-77 and Riviera cvs. Similar observations were also attained by

Rodriguez *et al.* (2002) on Floradwarf, Tifdwarf, TifEagle and Tifway bermudagrass cvs., Pessarakli and Kopec (2004) on bermudagrass cv. Tifway-419 and seashore paspalum cv. Sea Isle-2000 and Menzel and Broomhall (2006) who reported that *Paspalum notatum* (bahiagrass-38824) sod fertilized with complete fertilizer (72 kg N/ha, 31 kg P/ha, 84 kg K/ha, 48 kg Ca/ha, 30 kg S/ha and 7.2 kg Mg/ha) every month from May to September resulted better colour and density, and gave the heaviest fresh and dry weights. There were also increases in the shoot content of N, P, K, Ca, S and Mg.

A commercial Japanese product, EM is a biostimulant that contains more than 60 selected strains of "Effective Microorganisms", viz., photosynthetic bacteria, lactic acid bacteria, yeast, actinomyetes and various fungi that improve growth and health of plants (Primavesi, 1999). Although orchids are slow-growing plants, treatment with EM led to larger stems, darker green leaves and accelerated flowering in Dendrobium plants (Thach *et al.,* 1999). In addition, Janas (2009) revealed that Effective Microorganisms (EM) is characterized by a wide spectrum of activity and complex effect on plants living environment. Thus, it may be used as foliar treatments, on the seeds or in-soil application. Its effects inducing plant disease resistant, yield creating and protective were observed in many industrial, medicinal and ornamental species. It is also creating humus and regulates basic relations in the soils. Therefore, the EM biopreparation is used in many countries, on a large scale, in organic production of agricultural crops.

The aim of this study is determine the role of both chemical fertilization and EM biopreparation in improving growth and performance of seashore paspalum turf under Egyptian environmental conditions.

MATERIALS AND METHODS

Two pot experiments were performed at the Nursery of Hort. Res. Inst., ARC, Giza, Egypt through the two consecutive seasons of 2009 and 2010 to detect the response of seashore paspalum grass to kristalon and biostimulant EM.

So, pieces from pre-prepared rolls of seashore paspalum (*Paspalum vaginatum*, Swartz.) at a diameter of 10 cm (their fresh weights ranged between (45-50 g) were carefully taken and planted on April, 1st for each season in the center of 40-cm-diameter plastic pots filled with about 4 kg of an equal mixture of sand and clay. The physical and chemical analysis of the used sand and clay in both seasons are shown in Table (a). Then, these pieces were gently pressed with handpalm to be more contact with the soil mixture and were daily irrigated with 250 ml of fresh water/pot during the first two weeks after planting. The pots were afterwards irrigated once every three days with 400 ml of fresh water/pot throughout the course of this study.

Table (a): Some physical and chemical properties of the used sand and loam during the two seasons.

Soil type	Seasons	Particle size distribution (%)				S.P	E.C. (ds/m)	pH	Cations (meq/l)				Anions (meq/l)		
		Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sandy	2009	89.03	2.05	0.40	8.52	23.01	3.56	7.90	7.50	1.63	33.60	0.50	3.20	22.00	18.03
	2010	84.76	6.29	1.50	7.45	21.87	3.71	7.80	19.42	8.33	7.20	0.75	1.60	7.80	26.30

Loamy	2009	10.18	46.17	19.53	24.12	35.00	3.48	8.27	17.50	9.42	20.00	0.79	3.80	10.00	33.91
	2010	10.30	46.54	18.88	24.28	33.07	3.36	7.96	18.00	8.95	20.50	0.85	3.65	10.20	34.45

After one month from planting (on May, 1st), the following fertilization treatments were applied:

1. No fertilization, referred to as control.
2. Kristalon, as a complete chemical fertilizer (19:19:19 + micronutrients, manufactured by DSM Agropecialists, Holland) was added monthely after each cut as a soil drench at the rate of 2g/pot.
3. A commercial Japanese product as a biostimulant contains more than 60 strains of Effective Microorganisms (EM), viz., photosynthetic bacteria, lactic acid bacteria, yeast, actinomyetes and various fungi was also added as a soil drench after each cut at the rates of 0, 1, 3 and 5 ml/L.
4. Kristalon at 2g/pot was combined with each level of EM to form the following 3 combined treatments:
   a. Kristalon at 2g/pot + EM at 1 ml/L.
   b. Kristalon at 2g/pot + EM at 3 ml/L.
   c. Kristalon at 2g/pot + EM at 5 ml/L.

After two months from planting (on June, 1st), the first cut was handily done with very sharp stainless steel cutter leaving stubbles with 1 inch long. Other four cuts were carried out monthly thereafter. The pots were arranged in a completely randomized design (Mead *et al.,* 1993) with three replicates for each treatment, as each replicate contained five pots.

Before each cut in the two seasons, plant height (cm) was recorded, while number of plants/pot and fresh and dry weights (g) of the resulted herb after mowing were monitored after each cut. Moreover, the covering rate as percentage was calculated from the following equation:

Covering rate (%)= No. plants per pot/pot area (cm^2)×100

However, means of each parameter mentioned above 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, photosynthetic pigments content (chlorophyll a, b and carotenoids, mg/g F.W.) was measured according to the method described by Moran (1982), while in dry samples taken also from herb of the last cut, the percentage of total sugars (Herbert *et al.,* 1971), as well as total indoles and total phenols (A.O.A.C., 1990) as mg/100 g F.W. were assessed. The obtained data were statistically analyzed according to SAS Program (1994) using Duncan's Multiple Range Test (1955) for elucidating the significant differences among means of various treatments.

RESULTS AND DISCUSSION

Effect of kristalon, EM and their combinations on:

1- Vegetative growth parameters:

It is clear from data presented in Tables (1) and (2) that all vegetative growth parameters, i.e. plant height (cm), covering rate (%), No. plants/pot and herb fresh and dry weights (g) were markedly increased as a result of applying the individual treatments of either kristalon or EM with various significant differences in the two seasons.

Table (1): Effect of EM, kristalon and their combinations on some growth parameters of *Paspalum vaginatum* Swartz. plants during 2009 and 2010 seasons.

Treatments	Plant height (cm)		Covering rate (%)		No. plants/pot	
	2009	2010	2009	2010	2009	2010
Control	10.17e	11.10e	45.00e	48.15f	30.00e	28.76f
Kristalon at 2 g/pot (A)	12.78e	13.50ed	61.33ed	63.37e	46.00d	44.19e
EM at 1 ml/L (B)	16.40d	16.73d	65.67d	68.55d	50.67cd	48.56d

EM at 3 ml/L (C)	21.67c	22.33c	67.00cd	69.89d	52.17c	53.00c
EM at 5 ml/L (D)	23.50bc	24.56bc	70.33c	73.90c	55.10b	53.30c
A + B	31.76a	32.93a	87.00a	90.18a	60.33a	71.50a
A + C	33.71a	32.00a	83.78ab	85.60ab	54.86b	63.45b
A + D	25.36b	26.90b	71.50c	74.96c	45.28d	52.33c

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

Table (2): Effect of EM, kristalon and their combinations on fresh and dry weights of *Paspalum vaginatum* Swartz. herb during 2009 and 2010 seasons.

Treatments	Fresh weight (g)		Dry weight (g)	
	2009	2010	2009	2010
Control	29.80e	27.00g	10.40e	10.43f
Kristalon at 2 g/pot (A)	38.04d	31.58f	15.11d	15.31e
EM at 1 ml/L (B)	41.65cd	39.80e	20.68c	21.50d
EM at 3 ml/L (C)	47.76c	45.03d	22.50c	22.56d
EM at 5 ml/L (D)	58.53b	60.00c	27.41b	26.63c
A + B	73.00a	72.61a	31.80a	32.30a
A + C	71.36a	69.88ab	31.00a	30.73ab
A + D	66.71ab	65.83b	27.71b	28.55b

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

In general, all vegetative growth traits were progressively improved with increasing the level of EM, and the different levels of EM gave better results than those of kristalon treatment in both seasons. On the other hand, the combining between kristalon and EM caused an additional increment in all previous characters to reach the maximum in plants treated with the combination of kristalon (2 g/pot)+EM (1 ml/L), which registered the highest means when compared to all other individual or combined treatments. This may indicate the role of both kristalon, as a complete fertilizer in providing the plants with macro and micro-nutrients necessary for good and healthly growth and EM, as a biopreparation activating growth, inducing plant disease resistance, creating humus and regulates basic relations in the soil (Janas, 2009). Furthermore, it may play a role in enhancing the enzymatic systems in the plant tissues, and consequently enhancing growth (Thach *et al.,* 1999).

These results gain, however are in harmony with those postulated by Primavesi (1999) on gladiolus and sunflower, Rodriguez *et al.* (2002) on 4 bermudagrass cultivars, Menzel and Broomhall (2006) on *Paspalum notatum* and Janas (2009) on industrial, medicinal and ornamental plants.

2- Chemical composition:

Data averaged in Table (3) indicate that drenching the soil with either kristalon or EM, individually or in combinations significantly increased the leaf content of chlorophyll a, b and carotenoids (mg/g F.W.) over control means with few exceptions in the two seasons. The maximum values, however were due to the combined treatments between kristalon at 2 g/pot and EM at either 1 or 3 ml/L, with the mastery of 2 g/pot kristalon + 1 ml/L EM combination, which gave the utmost high content of various pigments in both seasons.

Data also showed that pigments content in the leaves of plants drenched with EM alone was higher than that of plants fertilized with kristalon alone, except for EM treatment at 1 ml/L which gave a lesser content of chlorophyll a and carotenoids in the first and second seasons. This may ascribed to the role of EM biostimulant on promoting stroma lamella formation and grana and chlorophyll appearance during normal leaf growth (Primavesi, 1999).Similarly, were those results of total sugars (%), as well as total indoles and total phenols (mg/100 g F.W.) in

the two seasons (Table, 4), as their content was significantly increased in the herb of treated plants in comparison to content of untreated ones. The superiority in content of the previous constituents was also for the combined treatment between 2 g/pot kristalon and 1 ml/L EM, as it gave the highest values over all other individual or combined treatments, with the exception of total phenols content which was lesser than that recorded by the other two combined treatments in the second season only. This may be reasonable, because the presence of EM, as a biostimulant reinforce the beneficial effects of kristalon, as a highly-soluble complete fertilizer supplies the plants with the different elements necessary for good and healthy growth.

Table (3): Effect of EM, kristalon and their combinations on pigments content (mg/100g F.W.) in the leaves of *Paspalum vaginatum* Swartz. plants during 2009 and 2010 seasons.

Treatments	Chlorophyll (a)		Chlorophyll (b)		Carotenoids	
	2009	2010	2009	2010	2009	2010
Control	1.63d	1.58e	0.26e	0.29e	1.47e	1.43d
Kristalon at 2 g/pot (A)	1.95c	1.90ed	0.77ed	0.76de	1.83d	2.00c
EM at 1 ml/L (B)	1.78c	1.72d	0.99d	0.98d	1.55ed	1.48d
EM at 3 ml/L (C)	2.81cb	2.96c	1.33cd	1.19cd	2.75c	2.00c
EM at 5 ml/L (D)	3.16b	3.70b	1.48c	1.43c	3.03b	2.97b
A + B	4.33a	5.10a	2.47b	3.15a	4.02a	3.95a
A + C	3.67ab	3.78b	3.21a	2.43b	3.54ab	3.46ab
A + D	3.32b	3.76b	1.56c	2.27b	3.12b	3.00b

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

Table (4): Effect of EM, kristalon and their combinations on total sugars, endoles and phenols content in the herb of *Paspalum vaginatum* Swartz. plants during 2009 and 2010 seasons.

Treatments	Total sugars (%)		Indoles (mg/100g F.W.)		Phenols (mg/100g F.W.)	
	2009	2010	2009	2010	2009	2010
Control	34.03f	33.50f	0.097f	0.093f	0.011g	0.011g
Kristalon at 2 g/pot (A)	42.10e	43.37e	0.521d	0.510d	0.033e	0.031e
EM at 1 ml/L (B)	35.26f	34.50f	0.280e	0.273e	0.023f	0.023f
EM at 3 ml/L (C)	41.33e	49.71d	0.547d	0.518d	0.033e	0.042c
EM at 5 ml/L (D)	49.05d	48.38d	0.755c	0.709c	0.038d	0.037d
A + B	68.90a	67.76a	1.279a	1.210a	0.061a	0.045c
A + C	59.90b	58.91b	1.077b	1.056b	0.046c	0.060a
A + D	54.23c	53.33c	1.030b	1.042b	0.051b	0.050b

- EM= Effective microorganisms

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

On the same line, were those results obtained by Thach *et al.* (1999) on orchid (Dendrobium), Pessarakli and Kopec (2004) on seashore paspalum cv. Sea Isle, Munshaw *et al.* (2006) on bermudagrass and Janas (2009) on industrial, medicinal and ornamental plants.

According to the aforementioned results, it could be recommended to fertilize seashore paspalum (*Paspalum vaginatum*, Swartz.) sods cultivated in a mixture of sand and clay (1:1, v/v) with 2 g kristalon/pot and 1 ml EM/L as soil drench, five times throughout the growing season with one month interval to get the best growth and high quality.

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إستجابة مسطح الباسبالم (شاطيء البحر) للمعاملة بالكريستالون و المنشط الحيوي (EM)

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الملخص العربي

أجري هذا البحث بمشتل معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠٠٩، ٢٠١٠ و ذلك لتحديد مدى إستجابة نباتات مسطح الباسبالم (شاطيء البحر) *Paspalum vaginatum*, Swartz. النامية في أصص بلاستيك قطرها ٤٠ سم ملأت بحوالي ٤ كجم من مخلوط الرمل و الطين (بنسبة ١:١ حجماً) للتسميد بالكريستالون كسماد كيماوي مركب (١٩ : ١٩ : ١٩ + عناصر صغرى) بمعدل ٢ جم/إصيص و المعاملة بالـ EM (كمنشط حيوي يحتوي على أكثر من ستون سلالة من الكائنات الحية الدقيقة المنشطة) بمعدل: صفر، ١، ٣، ٥ مل/لتر، بمفردها أو في توليفات، عند اضافتها تكبيشاً للتربة، خمس مرات خلال موسم النمو و بفاصل شهر بين كل مرتين متتاليتين.

و لقد أوضحت النتائج المتحصل عليها أن جميع المعاملات الفردية للكريستالون و المنشط الحيوي EM أحدثت زيادة معنوية في إرتفاع النبات، معدل التغطية، عدد النباتات/إصيص و الأوزان الطازجة و الجافة للعشب الناتج بعد القص مقارنة بالكنترول في معظم الحالات بكلا الموسمين . و لقد تم الحصول على إتجاه مشابه فيما يتعلق بمحتوى الأوراق من كلوروفيللي أ، ب و الكاروتينويدات، و كذلك محتوى العشب من السكريات الكلية و صصالإندولات و الفينولات. و بصفة عامة، فقد أعطى المنشط الحيوي EM بمفرده (عند أي مستوى من مستوياته التي إستخدمت في هذه الدراسة) نتائج أفضل من نتائج الكريستالون مع بعض الاستثناءات الطفيفة، إلا أن الجمع بينهما أحدث تحسناً إضافياً في جميع القياسات السابقة، مع تفوق المعاملة المشتركة بين الكريستالون بمعدل ٢ جم/إصيص و المنشط الحيوي EM بمعدل ١ مل/لتر و التي سجلت أعلى المتوسطات على الاطلاق.

و عليه، فإنه يمكن النصح بتسميد مسطح الباسبالم (شاطيء البحر) النامي في بيئة مكونة من مخلوط متساوي من الرمل و الطين بسماد الكريستالون المركب بمعدل ٢ جم/إصيص + المنشط الحيوي EM بمعدل ١مل/لتر كإضافات أرضية، خمس مرات عقب القص خلال موسم النمو و بفاصل شهر بين كل مرتين متتاليتين.