Improving Growth and Quality of *Merremia dissecta* (Jacq.) H. G. Hallier Twiner By Some Fertilization Treatments

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ABSTRACT

A trial was conducted in the open under full sun in the nursery of Hort. Res. Inst., ARC, Giza, EGYPT during 2012 and 2013 seasons to study the response of *Merremia dissecta* (Jacq.) H. G. Hallier twiner seedlings grown in 14-cm-diameter plastic pots filled with 1.3 Kg of washed sand + clay + organic matter compost mixture (1:1:1, v/v/v) to some fertilization treatments as follows: check (no fertilization), NPK mixture (2:1:1) at 2 g/pot, humic acid (10N: 10P: 10K) liquid fertilizer at 10 ml/l, either potassium-N (K-N) or potassium-P (K-P) at 5 ml/l for each, as well as combinations of NPK mixture (2 g/pot) plus either K-N or K-P (5ml/l for each) and that of K-N + K-P at 5 ml/l for each when applied as a soil drench, 3 times at one month interval.

The obtained results indicated that various fertilization treatments applied in this study increased means of the different vegetative and root growth measurements with various significance levels as compared to control means in the tow seasons. However, combined treatments gave better results than the other individual ones, with the mastery of humic acid at 10 ml/l + K-N at 5 ml/l combination, which recorded the utmost high means in both seasons. Humic acid alone at 10 ml/l registered better results than the other individual treatments in most cases of the two seasons. A similar trend was also attained regarding the leaf content of some active constituents, as the different fertilization treatments caused a marked increment in the leaf content of chlorophylls a and b, total soluble sugars, N, P and K, whereas carotenoids content was decreased. The highest content of the previous constituents, except carotenoids was also achieved by using 10 ml/l humic acid + 5 ml/l K-N combination relative to control and all other individual and combined treatments. Humic acid at 10 ml/l alone or in combination with K-P at 5 ml/l gave good results, but they occupied the second rank after the superior combination mentioned above.

Hence, it can be recommended to fertilize *Mirremia dissecta* twiner seedlings grown in 14-cm-diameter plastic pots under nursery conditions with a combination of humic acid at 10 ml/l and potassium-N at 5 ml/l, thrice with one month interval between for good growth and high quality.

Key words: Merremia dissecta- NPK- Humic acid- Potassein-P.

INTRODUCTION

Salinity is an adverse environmental factor and is *Merremia dissecta* (Jacq.) H. G. Hallier (*Ipomoea sinuata*), a perennial twiner of Convolvulaceae family up to 3.5 - 4 m long, of rampant, coarsely hirsute at first, becoming nearly glabrous, leaves deeply palmately 5-7 parted, segments lanceolate, to 10 cm long, coarsely sinuatly dentate, middle segments larger than lateral ones, corolla while, with purple or dull reddish throat, to 4 cm long, capsules globose, surrounded by enlarged sepals. Native from Texas to Argentina occasionally escapes from cultivation in tropical regions, propagating by seeds (Bailey, 1976).

It is a twining vine that climbs by warping itself around a support, so it needs a net, trellis or espalier for wall covers, arbors, pergolas, trees and carports. It is also used as an informal hedge or planted against a wall or a fence to create a screen. Extracted from the leaves essence used as food flavor. The leaves used as tea for relieving cold flu. It will grow in sunny or partially shady locations (Huxley *et al.,* 1992).

Photo: *Merremia dissecta*

Humic substances isolated from the different organic materials contained 45 -65 % C, 30 – 48 % O_2, 2 – 6 % N and about 58 % H. They are an extremely important soil additions as they constitute a stable fraction of carbon (C), thus regulating the C-cycle and release some of macro elements (such

as N, P, K and S) and micronutrients (such as Fe, Mn, Zn and Cu) necessary for healthy growth (Stevenson, 1994). The presence of humate improves nutrients retention in the soil, water-holding capacity, and pH buffering, thermal insulation and can provide soil microbes with energy (Dorer and Peacock, 1997). In this respect, Evans and Li (2003) found that humic acid at either 2500 or 500 ppm increased lateral roots number and length, as well as dry root weight of *Catharanthus roseus*, *Pelargonium hortorum, Tagetes patula* and *Viola tricolor*. On *Schefflera*, El-Sayed and El-Shal (2008) revealed that humic acid at 5 ml/l as a foliar spray,or 10 ml/l as a soil drench and both of them in combination every two weeks greatly improved plant height, basal stem diameter, leaf content of N, P, K, Zn, Fe and Mn. Likewise Abdel-Fattah et al. (2009) reported that a combination of humic acid at 5 ml/l as a foliar spray and at 10 ml/l as a soil drench recorded the utmost high means of plant height, stem diameter, leaf No./plant, root length and diameter, as well as fresh and dry weights of leaves, stem and roots of Dracaena and Ruscus plants. A marked increment in the leaf content of chlorophyll a, b, carotenoids, total carbohydrates, N, P and K was also observed by the previous combination.

Potassium (K) is an essential nutrient for plants as it involved in many biochemical and physiological process vital to plant growth, yield, quality and stress (Cakmak,2005). It is also involved in stomatal regulation of transpiration and photosynthesis, photophosphorylation, transportation of photoassimilates from source tissues via the phloem to sink tissues, enzyme activation, turgor maintenance and stress tolerance (Marchner, 1995 and Pettigrew, 2008).

The effect of K in improving growth and quality of plants was demonstrated by many workers, such as EL-Shekhs *et al.*(2002) who stated that increasing K level significantly improved height, number of branches/plant, leaf no./plant, flower diameter, flower stem length and dry weight of the cut flowers in *Dahlia pinnata*. Shahin *et al.*(2007) on *Hibiscus rosa-sinensis*, noted that combining between potassein-N (K-N) and potassein-P (K-P) at 5ml/l for each gave the highest means of plant height, no. of branches and leaves/plant, leaf area, fresh and dry weights of leaves, stem and roots, as well as first flower diameter, no. of flowers/plant and the leaf content of chlorophyll a, b, carotenoids ,N, P and K. However, flowering was significantly delayed. Similarly, EL-Sayed *et al.*(2008) postulated that K-N at 4 or 6 ml/l as a foliar spray greatly improved plant height, branching and leaf no,/plant, root length, fresh and dry weight of leaves and roots, as well as leaf content of pigments, total carbohydrates, N, P and K in *Ficus macrocarpa* var. Hawaii transplants.

Similar observations were also obtained by Mohamed and Naguib (2002) on Fenugreek, Naguib (2002) on thyme, Abdel-Galeil (2010) on date palm cv. Sokkoty and EL-Sayed (2012) on tuberose.

This work however was set out in order to investigate the response of Merremia twiner seedlings to some fertilization treatments.

MATERIALS AND METHODS

An investigation was established under a sunny place at the nursery of Hort. Res. Inst., Giza, Egypt throughout the two successive seasons of 2012 and 2013 to study the effect of some fertilization treatments on growth and chemical composition of Merremia twiner seedlings.

Therefore, seeds of *Merremia dissecta* (Jacq.) H.G. Hallier twiner vine were sown in cuppy foam tray on mid of March and incubated inside plastic house till germination. One month later, tray with new seedlings was moved out for one week in the shade and for another one in the sunlight. On May, 1st for each season, seedlings were transplanted in 14-cm-diameter plastic pots (one seedling per pot) filled with 1.3 kg of washed sand + clay + organic matter compost mixture at equal parts by volume (1:1:1, v/v/v). The physical and chemical properties of the used sand and clay are shown in Table (a), whereas analysis of the used compost exhibited the following: 0.05% carbon (C), 37.8% organic matter, C/N ratio 10.67, 1.52%N, 0.47%P, 1.38%K, 0.20%Ca, 0.16%Mg, 2460 ppm Fe and 2355 ppm Mn.

After one month from transplanting, the seedlings subjected to the following fertilization treatments, which drenched in the soil, thrice at one month interval:

1. No fertilization, referred to as a control.
2. A mixture of NPK (2:1:1) at 2g/pot. Ammonium sulphate (20.5%N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48.5% K_2O) fertilizers were used to obtain the required ratio of the NPK mixture.
3. A humic acid NPK (10:10:10) liquid organic fertilizer at 10ml/l (50ml from the humic acid solution/pot). The different constituents of the liquid humic acid fertilizer used in this study are averaged in Table (b).
4. Both potassein-N (K-N), a liquid fertilizer that contains 30% K_2O and 8% N or potassein-P (K-P), which also contains 30% K_2O, but 10% P_2O_5 were added individually at 5ml/l for each.
5. Combination of NPK mixture at 2 g/pot with either K- N or K- P at 5ml/l for each and that of K-N+K-P at 5ml/l for each were also applied.

All plants under various treatments were irrigated once every 3 days and the routine agricultural practices were accomplished as recommended for such plantation.

Table a: Some physical and chemical properties of the used sand and clay during 2012 and 2013 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^{-}
Sand	2012	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
	2013	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
clay	2012	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
	2013	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

Table b: Main characteristics of the used liquid fertilizer during the two seasons.

components	value	components	value	components	value
Humic acid (%)	2.9	EC(ds/m)	59.3	H (mg/L.)	70.00
Organic matter / total solids (%)	42.51	N (%)	10.00	Fe (mg/L.)	900.0
Total humic acids / total solids (g/l)	165.8	P (%)	10.00	Mn (mg/L.)	90.00
Organic carbon (%)	24.64	K (%)	10.00	Zn (mg/L.)	90.00
C/N ratio	2.46	Ca (%)	0.06	Cu (mg/L.)	90.00
pH	8.20	Mg (%)	0.05		

The layout of the experiment in the two seasons was a complete randomized design (Mead *et al*. 1993) with 3 replicates, as each replicate contained 5 plants. At the end of each season (30th of October), data were recorded as follows: plant length (cm), number of branches and leaves/plant, root length (cm), number of root branches/plant, as well as fresh and dry weights of vegetative growth and roots (g). In fresh leaf samples taken from the middle parts of the plants, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g F.W.) were determined according to Saric *et al*. (1976), while in dry leaf samples, the percentage of total soluble sugars (Dubois *et al.* 1966), nitrogen (Pregl, 1945), phosphorus (Luatanab and Olsen, 1965) and potassium using flamephotometer set (Jachson, 1973) were measured.

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

RESULTS AND DISCUSSION

Effect of fertilization treatments on:

1-Vegetative and root growth parameters:

Data in Tables (1and 2) exhibit that means of plant length (cm), number of branches or leaves/plant, root length (cm), number of root branches/plant and fresh and dry weights of vegetative growth and roots (g) were increased in response to the different fertilization treatments applied in this work with various significance levels relative to the means of control in the two reasons. In general combined treatments gave better results than the individual ones, with the superiority of humic acid at 10 ml/l + K-N at 5ml/l combined treatments which recorded the utmost high means in both reasons. It was noticed from data that differences among lengths of plants and no. leaves/plant were more pronounced than the other characters, while those of no. branches/plant and root lengths were less pronounced. Drenching humic acid alone to the soil at 10ml/l gave better results than the individual application of K-N or K-P at 5ml/l for each in most cases of the two seasons.

Table 1: Effect of fertilization treatments on vegetative growth of Merremia dissecta (Jacq.) H.G. Hallier plant during 2012 and 2013 seasons.

Fertilization treatments	Plant length (cm)	No. Branches per plant	No. leaves per plant	Root length (cm)	No. Root branches per plant
first season : 2012					
control	28.33 e	3.67 b	30.00 e	12.38 c	32.00 e
NPK mixture at 2 g/plant	38.00 d	4.10 ba	40.71 d	15.50 ab	38.10 d
Humic acid at 10ml/L (A)	51.46 c	5.00 a	51.63 c	13.97 b	46.00 b
Potassein-N at 5 ml/L (B)	48.31 c	3.76 b	33.48 ed	12.50 c	38.73 d
Potassein-P at 5 ml/L(c)	87.19 b	4.33 ab	73.06 b	13.79 bc	42.00 c
A+B	112.47 a	5.67 a	92.68 a	17.50 a	62.36 a
A+C	92.10 b	4.41 ab	74.38 b	14.00 b	42.78 c
B+C	89.00 b	5.00 a	73.20 b	13.90 b	42.00 c
Second season : 2013					
control	30.00 f	4.00 c	32.80 e	13.11 c	33.90 d
NPK mixture at 2 g/plant	40.28 e	4.35 bc	43.15 de	16.43 ab	40.40 c
Humic acid at 10ml/L (A)	50.93 d	5.00 b	50.00 d	13.90 c	48.76 b
Potassein-N at 5 ml/L (B)	50.88 d	4.00 c	35.51 e	13.21 c	43.13 cb
Potassein-P at 5 ml/L(c)	73.22 c	4.33 bc	62.33 c	13.58 c	45.87 bc
A+B	103.50 a	6.00 a	85.67 a	17.10 a	56.50 a
A+C	97.52 ab	5.00 b	78.03 b	14.78 b	44.52 cb
B+C	95.34 b	5.00 b	77.92 b	14.95 b	45.00 bc

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 fertilization treatments on fresh and dry weights of vegetative and root growth of Merremia dissecta (Jacq.) H.G.Hallier plant during 2012 and 2013 seasons.

Fertilization treatments	Fresh weight (g)				Dry weight (g)			
	Vegetation growth		Roots		Vegetation growth		Roots	
	2012	2013	2012	2013	2012	2013	2012	2013
control	5.60c	5.93c	0.86d	0.91d	1.42d	1.51d	0.20d	0.21d
NPK mixture at 2 g/plant	6.33cb	6.71bc	1.03c	1.10c	1.56cd	1.67cd	0.31cd	0.33cd
Humic acid at 10ml/L (A)	6.80bc	6.73bc	0.97cd	0.98d	1.79c	1.78c	0.32cd	0.33cd
Potassein-N at 5 ml/L (B)	5.71c	5.98c	0.87d	0.92d	1.44d	1.51d	0.21d	0.22d
Potassein-P at 5 ml/L(c)	7.80b	6.55bc	2.30b	2.10b	2.38b	2.00b	0.70b	0.64b
A+B	11.46a	10.53a	3.00a	2.91a	3.03a	2.75a	0.98a	0.94a
A+C	6.07c	6.35cb	0.99cd	1.05cd	1.68cd	1.76c	0.35c	0.38cd
B+C	6.80bc	7.30b	1.10c	1.18c	1.83c	1.97b	0.40c	0.44c

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

This may indicate the role of humic acid in providing soil microbs with energy and improving nutrients retention in the soil (Dorer and Peacock, 1997), besides regulating C-cycle in the soil, improving water-holding capacity, pH buffering and containing NPK plus some micronutrients necessary for healthy growth (as shown in table, b). Potassium, on the other hand is involved in many physiological and biochemical process vital to plant growth (Cakmak, 2005), and also in stomatal regulation of transpiration and photosynthesis, photophosphorylation, transportation of assimilates from source tissues to sink tissues, enzyme activation, turgor maintenance and stress tolerance (Pettigrew, 2008).Lumping the beneficial effects of both humic acid and potassium usually leads to better growth.

The previous findings are in good agreement with those postulated by Evans and Li (2003) on *Catharanthus roseus*, *Pelargonium hortorum*, *Tagetes patula* and *Viola tricolor*, Shahin *et al*.(2007) *on Hibiscus rosa-sinensis*, El-Sayed and El-Shal(2008) on Schefflera and Abdel-Fattah *et al.* (2009) on Dracaena and Ruscus.

2. Chemical composition:

A similar trend to that of vegetative and root growth parameters was also obtained concerning the effect of fertilization treatments used in this trial on some active constituents in the leaves of fertilized plants, where data in Table (3) cleared that various fertilization treatments caused a marked increment in the leaf content of chlorophylls a and b (mg/g F.W.) and the percentages of total soluble sugars, N, P and K, while carotenoids content was decreased. Decrement of carotenoids made leavs appear more greening. The highest content of the previous constituents, with the exception of carotenoids was also attained by the combined treatment between 10ml/l humic acid and 5ml/l K-N which scored the greatest content of the measured constituents, except carotenoids over control and all other individual and combined treatments. Humic acid at 10 ml/l alone or in combination with K- P at 5ml/l gave good results, but coming in the second rank after the superior combination.

The previous gains may indicate the role of humic acid for improving nutrients retention in the soil, beside its role in providing soil microbes with energy necessary for their activity, so more nutrients will be release from the bulk of organic substances present in the soil (Dorer and Peacock, 1997). Moreover, potassium fertilizer provides the plants with k that involved in many vital physiological and biochemical processes in plant tissues (Marschner, 1995), and also either N or P according to the type of potassium.

Table 3: Effect of fertilization treatments on some active constituents in the leaves of *Merremia dissecta* (Jacq.) H.G.Hall plant.

Fertilization treatments	Pigments content (mg/g F.W.)			Soluble sugars (%)	N (%)	P (%)	K (%)
	Chloro.a	Chloro.b	Carotenoids				
Control	1.310	0.340	0.369	0.938	0.907	0.108	0.818
NPK mixture at 2g/ pot	1.561	0.446	0.317	1.075	1.330	0.156	1.195
Humic acid at 10ml/L (A)	1.632	0.566	0.240	1.511	1.538	0.181	1.384
Potassein-N at 5 ml/L (B)	1.524	0.418	0.234	1.270	1.280	0.153	1.081
Potassein-P at 5ml/L (C)	1.400	0.386	0.230	1.165	1.096	0.130	0.979
A+B	1.737	0.585	0.276	1.663	1.768	0.197	1.601
A+C	1.690	0.580	0.242	1.564	1.503	0.176	1.350
B+C	1.617	0.561	0.240	1.341	1.273	0.150	1.170

On the same line, those results were observed by El-Sayed *et al.* (2008) on *Ficus macrocarpa* var.Hawaii and El-Sayed and Boshra (2012) on tuberose.

From the foregoing, it is concluded that drenching the soil with 10ml/l of humic acid solution plus 5ml/l of potassein-N is one of the ways preferred for the best growth and quality of *Merremia dissecta* twiner seedlings cultivated in 14-cm-diameter plastic pots under nursery conditions.

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الملخص العربى

تحسين نمو وجودة متسلق المريميا ديسيكتا ببعض معلاملات التسميد

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[٢]قسم بحوث الزينة، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر.

اجريت هذه التجربة فى مكان مشمس بمشتل معهد بحوث البسالتين، الجيزة، مصر خلال موسمى ٢٠١٢، ٢٠١٣ وذلك لدراسة استجابة شتلات متسلق المريميا (*Merremia dissecta* (Jacq.) H. G. Hallier) النامية فى اصص بلاستيك قطرها ١٤ سم، مملوءة بحوالى ١.٣ كجم من مخلوط متساوى من الرمل المغسول + الطين+ كومبوست المادة العضوية(١:١:١ بالحجم) لمعاملات التسميد التالية: مقارنة(بدون تسميد)، مخلوط (2N:1P:1K) بمعدل ٢ جم لكل اصيص، السماد العضوى السائل لحمض الهيوميك(10N: 10P: 10K) بمعدل ١٠ مل/ لتر ماء، بوتاسين- ن (K-N) او بوتاسين- فو (K-P) بمعدل ٥ مل/ لتر ماء لكل منهما على حده، وكذلك توليفات مخلوط (NPK) بمعدل ٢ جم / اصيص مع K-N او مع K-P بمعدل ٥ مل/ لتر لكل منهما على حده، وذلك عند اضافتها للتربة فى صورة محلول، ثلاث مرات خلال موسم النشاط وبفاصل شهر بين كل مرتين متتاليتين.

ولقد اوضحت النتائج المتحصل عليها ان جميع معاملات التسميد المطبقة بهذه الدراسة احدثت زيادة فى متوسطات جميع قياسات النمو الخضرى والجذرى وبمستويات معنوية مختلفة عند مقارنتها بالكنترول فى كلا الموسمين. الا ان المعاملات المشتركة اعطت نتائج افضل من المعاملات الفردية، مع تفوق المعاملة المشتركة بين حمض الهيوميك بمعدل ١٠ مل/ لتر وبوتاسين- ن بمعدل ٥ مل/ لتر والتى سجلت اعلى المتوسطات على الاطلاق بكلا الموسمين. كما سجل حمض الهيوميك بمفرده عند اضافته بمعدل ١٠ مل/ لتر نتائج افضل من المعاملات الفردية الاخرى فى معظم الحالات بكلا الموسمين. امكن ايضا الحصول على اتجاه مشابه فيما يتعلق بمحتوى الاوراق من كلوروفيللى أ، ب، السكريات الذائبة الكلية، النيتروجين، الفوسفور والبوتاسيوم، بينما انخفض محتواها من الكاروتينويدات. ايضا، فان اعلى محتوى للمكونات النشطة سالفة الذكر (ماعدا الكاروتينويدات) حققته المعاملة المشتركة من حمض الهيوميك(١٠ مل/ لتر) وبوتاسين– ن (٥ مل/ لتر) مقارنة بالكنترول وجميع المعاملات الفردية والمشتركة الاخرى. ولقد اعطى حمض الهيوميك (١٠ مل/لتر) بمفرده او فى توليفة مع بوتساين – فو (٥ مل/ لتر) نتائج جيدة، لكنها جاءت فى المرتبة الثانية بعد التوليفة السائدة سالفة الذكر.

من هذه النتائج، يمكن التوصية بتسميد شتلات المريميا المنزرعة فى اصص بلاستيك قطرها ١٤ سم تحت ظروف المشتل، حيث الشمس الساطعه، بتوليفة من سماد حمض الهيوميك السائل(بمعدل ١٠ مل/ لتر)+ سماد بوتاسين– ن السائل (بمعدل ٥ مل/ لتر) كاضافة ارضية ، ثلاث مرات وبفاصل شهر بين كل مرتين للحصول على افضل نمو واعلى جودة.