SUBSTRATE WITH ORGANOSUPER® FOR CUCUMBER SEEDLINGS FORMATION IN PROTECTED ENVIRONMENTS AND POLYSTYRENE TRAYS

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ABSTRACT: Culture environments, trays and doses of organic compost were evaluated in the formation of cucumber seedlings (*Cucumis sativus* L.). Five environmental conditions were tested: (A1) a greenhouse with height of 2.5 m, covered with polyethylene film, (A2) nursery with height of 2.5 m, monofilament fabric, 50% shading, (A3) nursery with height of 2.5 m, heat-reflective screen, 50% shading, (A4) nursery with a height of 1.8 m, covered with coconut tree straw and (A5) greenhouse with height of 4.0 m, covered with polyethylene film, with zenith opening and thermo-reflective cloth under the plastic. Trays of 72 (R1) and 128 (R2) cells were filled with 93% soil and 7% organic compound (S1), 86% soil and 14% organic compound (S2) and 79% soil and 21% organic compound (S3). It was used a randomized design in split-split-plot scheme, with five replicates (environments x trays x substrates). The greenhouses provide the best environments for the formation of cucumber seedlings. A tray of 72 cells is the best container, promoting more vigorous seedlings in substrate with soil and 7 or 14% organic compound.

KEYWORDS: environments of cultivation, containers, substrates, *Cucumis sativus.*

SUBSTRATO COM ORGANOSUPER® PARA FORMAÇÃO DE MUDAS DE PEPINEIRO EM AMBIENTES PROTEGIDOS E BANDEJAS DE POLIESTIRENO

RESUMO: Ambientes de cultivo, bandejas e doses de composto orgânico foram avaliados na formação de mudas de pepino (*Cucumis sativus* L.). Cinco ambientes de cultivo foram testados: (A1) estufa agrícola com altura de 2,5 m coberta com filme de polietileno; (A2) viveiro com altura de 2,5 m, tela de monofilamento com 50% de sombreamento; (A3) viveiro com altura de 2,5 m, tela termorrefletora, com 50% de sombreamento; (A4) viveiro com altura de 1,8 m, coberto com palha de coqueiro, e (A5) estufa agrícola com altura de 4,0 m, coberta com filme de polietileno, com abertura zenital e tela termorrefletora sob o filme. Bandejas de 72 (R1) e 128 (R2) células foram preenchidas com 93% de solo e 7% de composto orgânico (S1); 86% de solo e 14% de composto orgânico (S2), e 79% de solo e 21% de composto orgânico (S3). Utilizou-se um delineamento inteiramente casualizado, em esquema de parcelas subsubdivididas, com cinco repetições (ambientes x bandejas x substratos). As estufas agrícolas propiciam os melhores ambientes para a formação das mudas de pepino. A bandeja de 72 células é o melhor recipiente, promovendo plântulas mais vigorosas no substrato com solo e 7 ou 14 % de composto orgânico.

PALAVRAS-CHAVE: ambientes de cultivo, recipientes, substratos, *Cucumis sativus.*

INTRODUCTION

The cucurbitaceae contribute with approximately 25% of vegetables sold in Brazil. Among these, the cucumber features importance, as it is consumed raw, tanned in brine, and rarely mature (CAÑIZARES et al., 2002). In the upper South Pantanal of Mato Grosso and in the state itself, vegetable production is low and supply is conducted by the offer coming from other Brazilian states.

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The seedling has an important question in production systems, where the standard quality is crucial to the future performance of the plant field. A malformed seedling compromises the whole development of culture, increasing its cycle and leading to loss in production (ECHER et al., 2007). In the seedling, factors such as substrates, containers and crop environments are techniques that seek to maximize the productive potential and vigor of seedlings to be transplanted to the field.

The protected cultivation technology results in advances in the best conditions for the development of seedlings in both phytotechnical and phytosanitary aspects. The breakthrough in the production of vegetables seedlings was the use of trays with individual cells, where the trays of 288 cells are used for the production of lettuce, chicory, cabbage, cauliflower, and the trays of 128 cells for the production of seedlings of cucurbitaceae and solanaceous (SEABRA JR. et al., 2004).

Depending on the formulation, the commercial substrates showed different responses in the production of vegetable seedlings (CALVETE & SANTI, 2000). Normally, the substrates are made by farmers themselves, using various materials, pure or mixtures, available in their regions. In seedlings of hybrid Japanese cucumber, Hokuho, the base substrate of soil and nutrient solution (CAÑIZARES et al., 2002), as well as trays of 72 cells (SEABRA JR. et al., 2004) led to better characteristics to seedlings.

There is high importance of vegetables from other Brazilian states by the state of Mato Grosso do Sul, reaching about 85% consumed in the country (BOLETIM ANUAL, 2011). These data indicate the need for regional research, involving the production of vegetables, which could encourage greater activity in the Pantanal region, where there are small producers, which surround the urban centers and serving local markets.

Given the above, this study aimed to evaluate environmental conditions, polystyrene trays and substrates with organic compost in the formation of cucumber seedlings at Aquidauana region, in the state of Mato Grosso do Sul.

MATERIAL AND METHODS

The experiments for the formation of cucumber seedlings were conducted with Aladdin F1 (H1), Nikkei (H2), Sapphire (H2) and Noble F1 (H4) hybrids. The study was performed at the State University of Mato Grosso do Sul, Aquidauana Universitarian Unit, which is located at a 174 m altitude, -20°28'16" latitude and -55°47'14" longitude. The climate according to Köeppen is Aw, defined as humid tropical climate and average annual temperature of 29 °C.

Five protected ambient were used: (A1) greenhouse, type chapel, covered with a polyethylene film of low density, 150 microns thick, laterally and frontally closed with raffia shade cloth in black, mesh to 50% shading; (A2) nursery with locks on the front and side cover with monofilament shade cloth in black, mesh to 50% shade (Sombrite®); (A3) nursery, with locks on the front and side cover with thermo-reflective aluminized cloth (Aluminet®), mesh to 50% shade, (A4) nursery covered with coconut tree straw native to the region, popularly known as buriti, built of wood, in the dimensions of 3.0 m long by 1.20 m wide by 1.80 m tall; and (A5) arched greenhouse, galvanized steel structure, having 6.40 m wide by 18.00 m long, with a height under the gutter of 4.00 m, covered with polyethylene film of low density, 150 microns thick, with an zenith opening along the ridge, having in the side and front parts a monofilament cloth, mesh to 50% shade, and heat-reflecting cloth of 50% on the plastic. The environmental conditions (A1, A2 and A3) were of wood, having dimensions of 5.0 m long by 5.0 m wide by 2.50 m ceiling.

The seedlings were tested in polystyrene trays with different numbers of cells, R1 – trays of 128 cells (3.5 cm wide by 6.2 cm high and volume of 34.6 cm^3 per cell) and R2 – trays of 72 cells (5.0 cm wide by 12.0 cm and volume of 121.2 cm^3 per cell).

Three percentages of commercial organic compost were used, 7%, 14% and 21%, mixed with the soil of the region, classified as Alfissol (EMBRAPA, 2006), for the composition of the substrates, where they have been designated of: (S1) 93% of soil and 7% of organic compound, (S2)

86% of soil and 14% of organic compound, (S3) 79% of soil and 21% of organic compound, all based on volume (Table 1).

For the evaluation of the experiments, for each hybrid, it was used a completely randomized design (CRD), a split-split-plot scheme (five environments x two containers x three substrates = 30 treatments) with five replicates.

It was used soil of the 10-40 cm deep layer, air dried, sieved to 2 mm mesh and analyzed chemically. After preparation, the soil was mixed in accordance with each percentage, with the organic compound named Organosuper® (Table 1). The organic compound had the following composition: pH = 6.51; Organic carbon = 26.2%; Moisture = 4.56%; Nitrogen = 1.83%; Phosphorus = 0.96%; Potassium = 0.35%; Calcium = 6.24%; Magnesium = 0.88%; Sodium = 0.23% (Source: Laboratory of Embrapa, Dourados, state of Mato Grosso do Sul). All substrates received doses of 2.5 kg of superphosphate, 0.3 kg of potassium chloride and 1.5 kg of lime, this based on a volume of 1.0 m^3 of substrate. The system of seedling production used was trays suspended on benches, irrigated with manual irrigation twice a day, morning and afternoon.

TABLE 1. Chemical analysis of soil (SL) and substrates (S1, S2, and S3) used on the experiments. Aquidauana, state of Mato Grosso do Sul, UEMS, May/June of 2008.

	pH	OM	K	Ca	Mg	H + Al	SB	T	V
	$CaCl_2$	%	Cmol$_c$ dm^{-3}						%
SL	5.4	1.4	0.35	0.9	0.8	3.3	2.10	5.40	38.90
S1	6.0	3.2	0.64	2.3	1.5	3.0	4.44	7.44	59.68
S2	6.4	3.7	0.94	3.2	1.9	2.7	6.04	8.74	69.11
S3	6.5	4.7	1.53	3.3	2.4	2.2	7.23	9.43	76.67

(Source: Soil Analysis Laboratory from state agency of animal and vegetal sanitary defense of Mato Grosso do Sul.
pH = potential hydrogen ion; OM = organic matter; K = potassium; Ca = calcium; Mg = magnesium; H + Al = potential acidity; SB = sum of bases, T = cation exchange capacity, V = base saturation; SL = soil; S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.)

The substrate preparation and filling of the trays was held on April 9th, 2008. The substrates remained 30 days at rest, and once daily irrigation. Sowing took place on May 12th, germinating 6 days after sowing (DAS) by performing the thinning at 16 DAS. It was evaluated the plant height (cm), stem diameter (mm) and dry mass of aerial part and root (g).

Plant height (PH) was measured using a millimeter ruler and stem diameter (SM) with a digital caliper of Starrett brand. The dry masses were performed on an analytical balance, Bioprecisa brand, FA2104N model, accurate to four decimal places. The material was dried in an oven with forced circulation of air, Hydrosan brand, and the temperature of 65 °C.

Data on plant height, stem diameter and dry masses were subjected to analysis of variance and the means by Tukey test at 5% probability.

RESULTS AND DISCUSSION

Alladin Hybrid - H1

In the nursery (A2 and A3), the containers were similar for all parameters evaluated, except for plant height in the nursery with aluminized cloth (A3), which was higher in the tray with 72 cells (R2) (Table 2). In greenhouses (A1 and A5), the tray of 72 cells stood out, promoting more vigorous seedlings, as well as in the nursery covered with straw (A4) in height and dry mass of aerial part. For the tray of 128 cells (R1), the environments showed small differences in dry mass of aerial part and in plant height, however, for the container R2, the greenhouses led to better conditions for seedling development (Table 2). Probably, depending on the season (late fall and early winter), covers with polyethylene film (A1 and A5) were more conducive to the development of changes in container with greater volume. The polyethylene film is capable of retaining greater amount of energy in the environment and it possibly promoted better growth and biomass. The side cloths of these environments (A1 and A5) helped to minimize the strong draft of that period.

TABLE 2. Interactions between environments and containers (A x R) for dry mass of aerial part (MSF), dry mass of roots (MSR), stem diameter (SM) and plant height (PH), at 23 DAS, for H1 hybrid. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

	A1 [2]	A2	A3	A4	A5
MSF (g) – H1					
Tray of 128 cells	0.064 Bb [1]	0.083 Aab	0.100 Aab	0.096 Bab	0.117 Ba
Tray of 72 cells	0.309 Aa	0.118 Ab	0.124 Ab	0.145 Ab	0.310 Aa
MSR (g) – H1					
Tray of 128 cells	0.040 Ba	0.031 Aa	0.030 Aa	0.033 Aa	0.030 Ba
Tray of 72 cells	0.081 Aa	0.031 Ab	0.027 Ab	0.033 Ab	0.070 Aa
SM (mm) – H1					
Tray of 128 cells	2.770 Ba	2.349 Aa	2.243 Aa	2.600 Aa	2.547 Ba
Tray of 72 cells	3.798 Aa	2.334 Abc	2.443 Ac	2.699 Ab	3.573 Aa
PH (cm) – H1					
Tray of 128 cells	3.09 Bbc	3.88 Aa	3.12 Bbc	2.87 Bc	3.55 Bab
Tray of 72 cells	5.43 Ab	4.19 Ac	3.90 Acd	3.51 Ad	6.01 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m.

The tray of 72 cells stood out in the biomass, height and diameter of seedlings grown in greenhouses, in agreement with the results of SEABRA JR. et al. (2004), in the seedlings of Japanese cucumber 'Hokuho' who observed that the seedlings reduced their force when carried in containers with smaller volume of substrate, causing losses in fruit/plant production if transplanting occurs later.

The cucumber seedlings in different substrates showed no major difference in aerial and root biomass in nurseries (Table 3). In lower greenhouse conditions (A1), the substrate with 7% of organic compound (S1) increased the concentration of root biomass; however, the substrate with 14% (S2) resulted in higher accumulation of aerial biomass in both smaller and larger greenhouse (A5). The cucumber seedlings formed in greenhouses had best results, with higher aerial and root biomass on all substrates, as observed with the largest volume in the container (Table 3). Probably 14% of organic compound and the mineral fertilizer promoted greater amount of available nutrients and favorable physical conditions to greater dry matter accumulation, besides promoting better aeration and moisture retention.

TABLE 3. Interactions between environments and substrate (A x S) for dry mass of aerial part (MSF) and dry mass of roots (MSR), at 23 DAS for hybrid H1. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

[2]	A1	A2	A3	A4	A5
MSF (g) – H1					
S1	0.156 Bab [1]	0.077 Bc	0.112 Abc	0.1328 Ab	0.209 ABa
S2	0.228 Aa	0.141 Ab	0.108 Ab	0.120 Ab	0.246 Aa
S3	0.175 Ba	0.082 Bb	0.117 Ab	0.109 Ab	0.185 Ba
MSR (g) – H1					
S1	0.080 Aa	0.026 Ac	0.035 Abc	0.031 Ac	0.052 Ab
S2	0.055 Ba	0.035 Ab	0.023 Bb	0.032 Ab	0.047 Aa
S3	0.047 Bab	0.032 Ac	0.029 ABc	0.036 Abc	0.050 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m; S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

For all types of substrates, the tray of 72 cells promoted the best results of aerial and root biomass than the tray of 128 cells. For the container R1, the substrate S1 stood in the accumulation of root biomass, as well as the substrate S2 stood out for leaf biomass in the container R2 (Table 4). By having larger cells, the container R2 allowed the seedlings permanence in a longer period inside the protected environment, prior to transplanting to the field. For the substrates used, the container R2 provided the best results. As for the R1, it was observed that the substrate S1 showed a significant accumulation of root biomass, as well as the S2 stood out for the leaf biomass in R2 (Table 4). These results were corroborated by literature (CHAGAS et al., 2006), by the fact that R2 has a higher volume of substrate in relation to R1, making available, then, a greater surface of contact with the roots, thus increasing the absorption of water and nutrients.

TABLE 4. Interactions between containers and substrate (R x S) for dry mass of aerial part (MSF) and dry mass of roots (MSR), at 23 DAS for hybrid H1. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

	MSF (g) – H1		
	S1 [(2)]	S2	S3
Tray of 128 cells	0.084 Ba [(1)]	0.098 Ba	0.094 Ba
Tray of 72 cells	0.191 Ab	0.240 Aa	0.173 Ab
	MSR (g) – H1		
Tray of 128 cells	0.040 Ba	0.029 Bb	0.030 Bb
Tray of 72 cells	0.047 Aa	0.050 Aa	0.048 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

The treatment with 14% of organic compound in the tray with larger cell volume (72 cells) within the greenhouses may be suitable for the formation of the Alladin hybrid seedlings. To this hybrid SEABRA JR et al. (2004) observed that seedlings from trays of 72 cells obtained early harvesting of fruit seedlings than trays of 128 cells.

Nikkey Hybrid - H2

The trays of 72 cells induced greater seedling and greater biomass accumulation in all environments evaluated. In the container R1, environments were similar to the dry biomass of root and aerial part and stem diameter, as for plant height, A2 and A5 environments stood out. For the container R2, greenhouses (A1 and A5) and monofilament cloth (A2) resulted in greater biomass and plant height (Table 5).

TABLE 5. Interactions between environments and containers (A x R) for dry mass of aerial part (MSF), dry mass of roots (MSR), stem diameter (SM) and plant height (PH), at 23 DAS, for hybrid H2. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

	MSF (g) – H2				
	A1 [(2)]	A2	A3	A4	A5
Tray of 128 cells	0.098 Ba [(1)]	0.116 Ba	0.114 Ba	0.127 Bab	0.162 Ba
Tray of 72 cells	0.309 Aa	0.199 Ab	0.188 Ab	0.177 Ab	0.289 Aa
	MSR (g) – H2				
Tray of 128 cells	0.023 Ba	0.024 Ba	0.023 Ba	0.026 Ba	0.030 Ba
Tray of 72 cells	0.077 Aa	0.070 Aa	0.034 Ac	0.037 Abc	0.051 Ab
	SM (mm) – H2				
Tray of 128 cells	2.579 Ba	2.761 Aa	2.569 Ba	2.739 Aa	2.937 Ba
Tray of 72 cells	4.273 Aa	2.754 Ac	2.917 Ac	2.928 Ac	3.722 Ab
	PH (cm) – H2				
Tray of 128 cells	3.113 Bc	4.473 Ba	3.400 Bbc	3.273 Ac	4.013 Bab
Tray of 72 cells	5.680 Aab	5.380 Aab	5.093 Ab	3.687 Ac	6.020 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m.

These results indicate that in addition to the greenhouses, which led to better environments for hybrid H1 (Aladdin), the monofilament cloth (A2) also promoted satisfactory conditions of development of Nikkei Hybrid (H2). The results obtained for the tray of 72 cells (R2) is in agreement with the results in literature in respect of seedlings grown in containers with greater volume of substrate, most probably for providing more nutrients.

The substrate with 14% of organic compound (S2) resulted in higher accumulation of root biomass than the other substrates, only on monofilament mesh (A2). The greenhouses (A1 and A5) stood out for the three substrates in the accumulation of root biomass, however, for the S1 and S2 they did not differ from monofilament mesh and for the S3 they did not differ from the nursery with straw (A4). The largest stem diameters were obtained in greenhouses for the substrates S1 and S2, and for the S3, the environments were similar (Table 6). This may be due to environmental conditions in greenhouses that can be better managed than the mesh, because on these the conformation of mesh allows the entry of rainwater.

TABLE 6. Interactions between environments and substrate (A x S) for dry mass of roots (MSR) and stem diameter (SM), at 23 DAS for hybrid H2. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

			MSR (g) – H2		
(2)	A1	A2	A3	A4	A5
S1	0.053 Aa (1)	0.052 Ba	0.029 Ab	0.033 Ab	0.040 Aab
S2	0.052 Aab	0.065 Aa	0.029 Ac	0.031 Ac	0.046 Ab
S3	0.045 Aa	0.024 Cb	0.027 Ab	0.031 Aab	0.035 Aab
			SM (mm)		
S1	3.540 Aa	2.748 Ab	2.612 Ab	2.849 Ab	3.428 Aa
S2	3.550 Aa	2.676 Ab	2.806 Ab	2.702 Ab	3.530 Aa
S3	3.189 Aa	2.848 Aa	2.812 Aa	2.949 Aa	3.031 Ba

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m; S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

On all substrates, the tray of 72 cells (R2) resulted in higher biomass. In this container, the substrate S2 provided seedlings with greater dry mass than the seedlings of other substrates and less root biomass for seedlings of S3 (Table 7).

TABLE 7. Interactions between container and substrate (R x S) for dry mass of aerial part (MSF) and dry mass of roots (MSR), at 23 DAS for hybrid H2. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

		MSF (g) – H2	
	S1 (2)	S2	S3
Tray of 128 cells	0.112 Ba (1)	0.124 Ba	0.134 Ba
Tray of 72 cells	0.226 Ab	0.265 Aa	0.206 Ab
		MSR (g) – H2	
Tray of 128 cells	0.025 Ba	0.024 Ba	0.026 Ba
Tray of 72 cells	0.058 Aa	0.065 Aa	0.039 Ab

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

For the hybrid Nikkei an alternative treatment for the best seedling formation could be the use of greenhouses or monofilament mesh, with a tray of 72 cells filled with the base substrate of soil and 14% of organic compound.

It was expected that higher doses of organic compound to the substrate would promote better plant growth, which was not observed, possibly due to non-uniformity of the commercial organic.

PEREIRA et al. (2008) observed that doses of kaolin from 22%, mixed to substrates, promoted slower growth of papaya. In genipap seedlings, the base substrate of organic (cattle manure) and black earth, in a 1:1 ratio, provided higher dry matter accumulation, revealing the possibility of using 50% of organic compound (COSTA et al. , 2005), unlike what occurred in this experiment. Probably the materials constituting the commercial organic compound (Organosuper ®) and the type of composting allowed its use in up to 14%, mixed with the soil of the region.

Safira Hybrid – H3

In the environment A4, the containers were similar in the seedling, with no interference from the substrate volume, however, in other environments, the container R2 stood out. For the R2, greenhouses showed to be more prone environments to the seedling growth, as well as for R1 in aerial biomass and plant height (Table 8).

TABLE 8. Interactions between environments and containers (A x R) for dry mass of aerial part (MSF), dry mass of root (MSR), stem diameter (SM) and plant height (PH), at 23 DAS, for Hybrid H3. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

	A1 [2]	A2	A3	A4	A5
MSF (g) – H3					
Tray of 128 cells	0.106 Bab [1]	0.092 Ab	0.107 Aab	0.092 Ab	0.144 Ba
Tray of 72 cells	0.393 Ab	0.108 Ac	0.139 Ac	0.126 Ac	0.489 Aa
MSR (g) – H3					
Tray of 128 cells	0.032 Ba	0.030 Ba	0.032 Ba	0.031 Aa	0.034 Ba
Tray of 72 cells	0.096 Aa	0.041 Ab	0.047 Ab	0.037 Ab	0.091 Aa
SM (mm) – H3					
Tray of 128 cells	2.682 Ba	2.432 Aa	2.397 Aa	2.511 Aa	2.752 Ba
Tray of 72 cells	4.061 Aa	2.451 Ab	2.462 Ab	2.453 Ab	4.169 Aa
PH (cm) – H3					
Tray of 128 cells	3.147 Bb	4.080 Ba	3.253 Bb	3.420 Ab	3.740 Bab
Tray of 72 cells	6.113 Aa	5.180 Ab	4.727 Ab	3.820 Ac	6.380 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m.

Only in the smaller greenhouse (A1), the substrates with lower percentage of organic compound (S1 and S2) stood out, but for the three substrates, the environments A1 and A5 promoted higher accumulation of root biomass (Table 9). The use of S1 and S2 promotes economy of organic compound, providing the lowest cost to the producer. In guanandi seedlings (*Calophyllum brasiliense* Cambèss.), ARTUR et al. (2007) found no positive effect of organic fertilizer (manure) in a substrate composed of sand and soil.

TABLE 9. Interactions between environments and substrate (A x S) for dry mass of roots (MSR) and stem diameter (SM), at 23 DAS for hybrid H3. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

[2]	A1	A2	A3	A4	A5
MSR (g) – H3					
S1	0.072 Aa [1]	0.039 Ab	0.043 Ab	0.035 Ab	0.062 Aa
S2	0.067 Aa	0.041 Ab	0.039 Ab	0.030 Ab	0.060 Aa
S3	0.052 Bab	0.027 Ac	0.037 Abc	0.037 Abc	0.066 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m; S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

The use of organic compost of 7 and 14% mixed with the soil of the region (S1 and S2) are favorable for the formation of Sapphire hybrid (H3) seedlings, concomitant with the use of trays of

72 cells (R2) in greenhouses (A1 and A5). Substrates based on fertilized steep bank 7.7 kg.m^{-3} of simple superphosphate and 40% of poultry litter (organic fertilizer) per 1.0 m^3 led vigorous seedlings of yellow passion fruit (DAVID et al., 2008).

Nobre Hybrid – H4

For the stem diameter in environments A1 and A5 and the other variables in all environments, the container R2 gave better seedlings. For container R1, the environments practically promoted development similar to the seedlings, but the container R2 for the greenhouses (A1 and A5) emerged as the best environment (Table 10).

TABLE 10. Interactions between environments and containers (A x R) for dry mass of aerial part (MSF), dry mass of root (MSR), stem diameter (SM) and plant height (PH), at 23 DAS, for Hybrid H4. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

	A1 [2]	A2	A3	A4	A5
			MSF (g) – H4		
Tray of 128 cells	0.105 Bab [1]	0.081 Bb	0.109 Bab	0.106 Bab	0.123 Ba
Tray of 72 cells	0.329 Aa	0.107 Ac	0.165 Ab	0.147 Ab	0.365 Aa
			MSR (g) – H4		
Tray of 128 cells	0.034 Bb	0.030 Ba	0.031 Ba	0.027 Ba	0.032 Ba
Tray of 72 cells	0.089 Aa	0.059 Ac	0.052 Acd	0.042 Ad	0.075 Ab
			SM (mm) – H4		
Tray of 128 cells	3.195 Ba	2.496 Ab	2.773 Aab	2.823 Aab	2.756 Bab
Tray of 72 cells	4.199 Aa	2.817 Ab	2.831 Ab	2.748 Ab	4.221 Aa
			PH (cm) – H4		
Tray of 128 cells	3.120 Bab	3.533 Ba	2.933 Bab	2.880 Bb	3.380 Bab
Tray of 72 cells	6.000 Aa	4.100 Ab	4.013 Ab	3.387 Ac	5.707 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m.

In the environment A1, the substrate S1 showed higher MSF, SM, and PH than the substrate S2, and in the environment A5, the substrate S2 was higher than the S3 for biomass and stem diameter. The greenhouses stood out for the three substrates tested (Table 11).

TABLE 11. Interactions between environments and substrate (A x S) for dry mass of aerial part (MSF), dry mass of roots (MSR), stem diameter (SM) and plant height (PH) to 23 DAS for hybrid H4. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

[2]	A1	A2	A3	A4	A5
			MSF (g) – H4		
S1	0.241 Aa [1]	0.058 Bc	0.133 Ab	0.126 Ab	0.241 ABa
S2	0.183 Bb	0.107 ABc	0.138 Abc	0.110 Ac	0.293 Aa
S3	0.227 ABa	0.117 Ac	0.140 Abc	0.144 Abc	0.198 Bab
			MSR (g) – H4		
S1	0.062 Aa	0.066 Aa	0.0434 Abc	0.034 Ac	0.053 ABab
S2	0.065 Aa	0.024 Cb	0.0398 Ab	0.037 Ab	0.064 Aa
S3	0.058 Aa	0.042 Bb	0.0402 Ab	0.034 Ab	0.044 Bab
			SM (mm) – H4		
S1	4.065 Aa	2.487 Ac	3.060 Abc	2.660 Ac	3.590 Aab
S2	3.367 Ba	2.615 Ab	2.714 ABb	2.677 Ab	3.747 Aa
S3	3.660 ABa	2.867 Ab	2.632 Bb	3.020 Ab	3.128 Bab
			PH (cm) – H4		
S1	4.960 Aa	3.430 Ab	3.590 Ab	3.130 Ab	4.710 Aa
S2	3.800 Bab	3.980 Aab	3.400 Abc	2.940 Ac	4.380 Aa
S3	4.920 Aa	4.040 Abc	3.430 Ac	3.330 Ac	4.540 Aab

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) A1 = greenhouse with side height of 2.50 m; A2 = nursery with Sombrite® of 50% and 2.50 m high; A3 = nursery with Aluminet® of 50% and a 2.50 m high; A4 = nursery covered with buriti straw and 1.80 m high; A5 = greenhouse with side height of 4.00 m; S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

In the studied substrates, the tray of 72 cells (R2) promoted better seedlings, however, only the substrate S1 produced greater root in this container (Table 12). Even with higher volume and resulting in higher costs with substrates, the tray of 72 cells for the region of Aquidauana is the best because, as it is a hot region and has high evapotranspiration, especially in greenhouses.

TABLE 12. Interactions between container and substrate (R x S) for dry mass of aerial part (MSF), dry mass of roots (MSR) and plants height (PH), at 23 DAS for hybrid H4. Aquidauana, Mato Grosso do Sul, UEMS, May/June 2008.

	MSF (g) – H4		
	S1 [2]	S2	S3
Tray of 128 cells	0.086 [1] Ba	0.117 Ba	0.112 Ba
Tray of 72 cells	0.234 Aa	0.216 Aa	0.218 Aa
	MSR (g) – H4		
Tray of 128 cells	0.031 Ba	0.030 Ba	0.032 Ba
Tray of 72 cells	0.072 Aa	0.062 Ab	0.056 Ab
	PH (cm) – H4		
Tray of 128 cells	3.128 Ba	3.160 Ba	3.220 Ba
Tray of 72 cells	4.800 Aa	4.240 Ab	4.884 Aa

(1) Same uppercase letters in the columns and lowercase letters in the rows do not differ by Tukey test at 5% probability. (2) S1 = 93% of soil and 7% of organic compost; S2 = 86% of soil and 14% of organic compound; S3 = 79% of soil and 21% of organic compound.

SEABRA JR. et al. (2004) studied two volumes of cell of expanded polystyrene trays (34.6 and 121.2 cm^3), in the production of Japanese cucumber 'Hokuho' under protected environment, found that seedlings produced in large volume of substrate obtained early fruit harvest in the field. Seedlings of sugar beet (ECHER et al., 2007), castor bean (LIMA et al., 2006) and passion fruit (COSTA et al., 2009), formed in containers of greater volume, are more vigorous as those observed in this work.

In summary, during the period in which the experiment was conducted, the seedlings of hybrids were better adapted to environments that had polyethylene film on the roof, in the container with higher volume and lower percentages of commercial organic compound. The largest amount of organic matter (Table 1) of this substrate possibly increased the C/N ratio, which immobilized the nitrogen (SAMPAIO et al., 2008) and required a longer biological stabilization. These results are consistent with those found by RODRIGUES et al. (2010) for tomato seedlings, which were found better seedling in substrates containing smaller (7%) percentages of the compound when compared to larger (14 and 21%). Just like COSTA et al. (2010), in passion fruit seedlings, and COSTA et al. (2011), in papaya, found that smaller percentages of this compound (7%, 14% and 21%) provided better seedlings than the dose of 28%.

CONCLUSIONS

The greenhouses provide better environments for the formation of cucumber seedlings.

The cucumber seedlings are more vigorous in a tray of 72 cells and substrates with soil and 7 or 14% of organic compound.

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