

PRODUCTION OF PAULISTA GHERKIN USING TRELLIS NET SUPPORT

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ABSTRACT: Paulista gherkin is a new gherkin type obtained by crossing *Cucumis anguria* var. *anguria* x *C. anguria* var. *longaculeatus*. It differs from common gherkin in its fruits and leaves. Elite lines of Paulista gherkin present similar performance for total yield and fruit weight but some have distinctive characteristics, including fruit and leaf attributes. The combination of these characteristics through production of Paulista gherkin hybrids could be an alternative for fruit quality and/or yield improvement. The purpose of the present work was to compare the yield of Paulista gherkin lines and their hybrids grown on a trellis net under field conditions. Four lines and their six single-cross hybrids were evaluated for yield and fruit production using the trellised net production system. Seedlings were produced in polystyrene trays with 128 cells, and transplanted to the middle of 1.20 m wide beds. Plants were trained without pruning on netting having 0.1 x 0.1 m openings. The experiment was conducted in a randomized block design with four replicates and seven plants per plot. Yield was expressed as number of fruits and total weight of fruits per plot. Length, width and fruit flesh thickness were also evaluated, with five samples per plot in two harvesting times. Hybrids and their parental lines were similar in fruit yield and quality. The trellised net was suitable for Paulista gherkin production and provided adequate support to the plants. The trellis technique is suitable to make harvesting easier and to improve fruit quality.

Key words: *Cucumis anguria* var. *anguria*, vegetable crop, management, yield

PRODUÇÃO DE MAXIXE PAULISTA EM SUPORTE DE REDE AGRÍCOLA

RESUMO: Maxixe Paulista é um novo tipo de maxixe derivado originalmente do cruzamento de *Cucumis anguria* var. *anguria* x *Cucumis anguria* var. *longaculeatus*, com características distintas de fruto e folhas. Apesar das linhagens elite apresentarem comportamento semelhante em termos de produção total e peso médio de frutos, algumas características são peculiares a cada uma delas. A combinação dessas características através de produção de híbridos poderia ser uma alternativa para aumentar a qualidade e/ou a produção de frutos. O objetivo desta pesquisa foi comparar a produção de linhagens e híbridos de Maxixe Paulista cultivadas em campo, com práticas de tutoramento em rede agrícola. Foram avaliadas quatro linhagens e seis híbridos simples, quanto ao comportamento e produção de frutos no sistema de cultivo tutorado em rede agrícola. As mudas foram obtidas em bandejas de poliestireno expandido e transplantadas para linha central de canteiros de 1,20 m de largura. As plantas foram conduzidas sem poda e tutoradas em rede agrícola com malha de 0,10 x 0,10 m. O delineamento experimental foi em blocos casualizados, com quatro repetições e parcela de sete plantas. A produção foi expressa em número e massa total de frutos/parcela. Avaliaram-se características de fruto como comprimento, largura e espessura de polpa, em amostragem de cinco frutos/parcela, em duas colheitas. A produção e a qualidade dos frutos dos híbridos foram equivalentes à das linhagens. A rede agrícola se mostrou adequada para o cultivo de Maxixe Paulista na forma tutorada. Esta técnica de condução facilita a colheita e melhora a qualidade dos frutos.

Palavras-chave: *Cucumis anguria* var. *anguria*, prática cultural, poda, produção

INTRODUCTION

Paulista gherkin is a new gherkin type originally derived from the crossing of *Cucumis anguria* var. *anguria* x *C. var. longaculeatus*, with distinct characteristics of fruits and leaves. Fruit weight is the best characteristic to differentiate the Paulista gherkin from the common types (Modolo & Costa, 2001a; 2001b). Fruit

size can be 91% higher. Although Paulista gherkin elite lines present similar values for total yield and fruit weight, some lines have distinctive characteristics, including slow seed formation, greater fruit pulp thickness, prolificity and seed dormancy.

Cucurbitaceae plants do not show inbreeding depression after self-pollination (Robinson & Decker-Walters, 1997; Maluf, 2001). Hybrid seeds are widely

employed to establish cucumber crops (*Cucumis sativus* L.), allowing for the combination of high fruit quality and disease resistance, but with no clear advantage in terms of heterosis. Production of Paulista gherkin hybrids could provide advantage over parents in fruit yield and/or quality.

In the conventional cropping system, gherkin plants are grown prostrate on the soil, resulting in low fruit yield and quality (Martins, 1986). Paulista gherkin is a novel vegetable developed for fresh consumption, being brined for pickles or cooked like summer squash. To expand its use, there is a demand for improving production technology.

The use of trellises for vine crop production has some advantages, like easier disease control, better crop management, with higher fruit quality, increased plant longevity, and longer harvest period, resulting in higher yield (Filgueira, 2000). The disadvantage of trellis production includes increased labor and materials costs. Pruning and training are regularly used in horticultural crops, like cucumber, melon (*Cucumis melo* L.) and tomato (*Lycopersicon esculentum*), grown under high plastic tunnel. Trellised cucumber is known to be important for maximizing production and to improve fruit quality. This technique might result in three to fivefold yield increase as compared to the traditional, prostrate crop system (Alvarenga et al., 1982; Illescas & Vesperinas, 1989).

Shetty & Wehner (1998), evaluating Oriental trellis cucumber for production in North Carolina, observed an increase in the marketable yield of cultivars grown in this system. No positive response in yield was observed when the Paulista gherkin was grown under the cucumber pruning and management schemes (Modolo & Costa, 2001b). Pruning induced gherkin plants to a strong suppression of apical dominance, by stimulating the growth of basal shoots. There was greater fruit concentration in the secondary and tertiary basal shoots of the lower third of the plants. However, Leal et al. (2000) observed that, similarly to common gherkin trained on raffia strings, more uniform lighting of the entire fruit surface reduced the incidence of "white belly" disorder, resulting in increase fruit quality. Similarly, Marouelli et al. (2001), observed that trellised net for gherkin plant support resulted in 6.4% "white belly" fruits and only 0.1% discarded fruits.

Support on trellised net, without pruning, is an economical alternative for gherkin crop management. In this case, the trellised net would make the vertical and horizontal conduction of secondary and tertiary shoots easier, avoiding fruit contact with the soil, resulting in improved quality and making harvest easier. The purpose of the present work was to compare the production of Paulista gherkin inbreds and their hybrids, supported on trellised net under field conditions.

MATERIAL AND METHODS

The experiment was carried out from July to December, 2001, in Piracicaba, SP, Brazil (22°42'30"S, 47°39'00"W, altitude 543 m). According to Köppen, the climate in this region is classified as Cwa: subtropical humid, with three drier months (June, July and August), summer rainfalls and winter droughts, hottest month temperature above 22°C and average temperature of 21.4°C.

Elite gherkin inbreds were obtained through mass selection for higher fruit size followed by two inbreeding cycles. These elite Paulista gherkins are derived from an F₂ population evaluated by Koch & Costa (1991). The inbreds were evaluated by Modolo & Costa (2001a) and named as 'Paulista gherkin'. Compared to parental inbreds, they had greater fruit size, spineless fruit and non-lobular shaped leaves, similar to those of cucumber. Hybrid combinations were chosen from a diallel cross of four elite inbreds. Inbreds were named as L1, L2, L4 and L60 and, their respective hybrids as H3 (2x1), H5 (4x1), H6 (2x4), H61 (1x60), H62 (2x60) and H64 (60x4).

Seedlings were produced in 128-cell polystyrene trays and transplanted 33 days later to the field in the center of 1.20 m beds. Plants were grown on a 0.10 x 0.10 m trellised net supported on fence posts (1.5 m apart). Rows were on 0.10 m centers. There was no pruning and the plots were sprinkler-irrigated. Fertilization was made based on soil analysis and according to the recommendations for the cucumber crop.

Yield was expressed as total number of fruits and fruit weight per plot. Fruit length, fruit diameter and flesh thickness were measured with caliper rule, using 5 fruits per plot in two harvesting stages. Flesh (mesocarp) thickness was measured from the skin (exocarp) to the seed cell (endocarp) as an average of two fruits. Fruit length (L) and diameter (D) was converted to L/D ratio. Fruit shape with L/D value close to 1 indicate round shape while values higher than 1 indicate elongated shape.

Harvesting started 80 days after sowing and lasted for six weeks. A randomized block experimental design was used, with four replicates and seven plants per plot. Analysis of variance was carried out and means compared using the Tukey test ($P = 0.05$).

RESULTS AND DISCUSSION

One of the major hybrid advantages over cultivars is related to early yield heterosis (Maluf, 2001). For Paulista gherkin, no early yield heterosis was observed when hybrids were compared with the gherkin inbreds (Figures 1 and 2). Parental inbreds and their hybrids had similar performance, not only related to the number of fruit but also to the total fruit weight per plot at the harvest stages. Both, inbreds and hybrids, presented two pro-

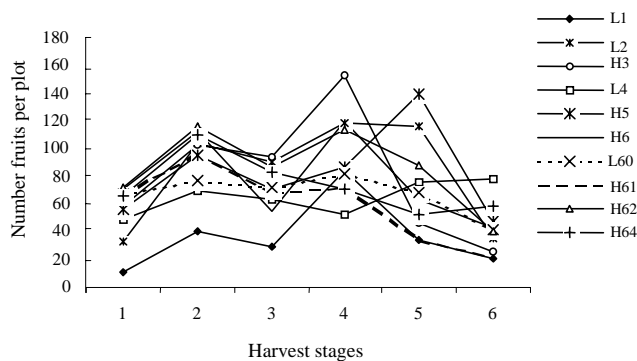


Figure 1 - Total number of fruit per plot from inbreds (L1, L2, L4 and L60) and hybrids (H3, H5, H6, H61, H62 and H64) of Paulista gherkin, at six harvesting stages.

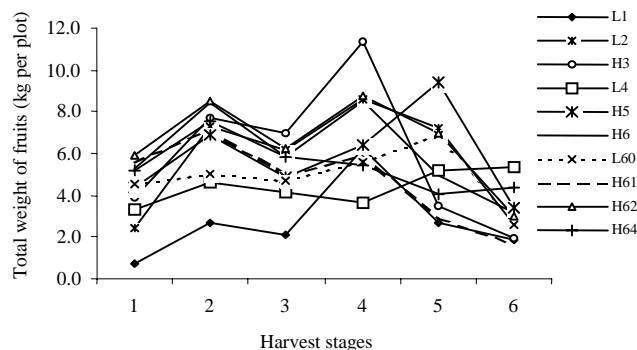


Figure 2 - Total weight of fruit per plot from inbreds (L1, L2, L4 and L60) and hybrids (H3, H5, H6, H61, H62 and H64) of Paulista gherkin, at six harvesting stages.

duction peaks, the first during the second harvest and the second in the fourth and fifth harvest periods (Figures 1, 2).

Hybrids and inbreds were similar for fruit yield characteristics. The hybrids H3, H5 and H62, and inbred L2, were more prolific regarding to total production in number of fruits, only when compared to L1 (Table 1). Hybrids H3 and H62 were superior for the total fruit weight when compared to inbred L1. No difference was observed among hybrids and inbreds for the total fruit weight. No differences between hybrids and inbreds were observed for mean fruit weight, length, width and L/D ratio (Table 2). The L/D ratio is an important characteristic for pickle brining and to process either whole or cut fruits. For cucumber, the ideal fruit shape for brining would be elongated and with L/D ratio around 3.0 (Ribeiro & Melo, 1989). The L/D ratio depends on the right fruit immature stage at harvest time. The ideal harvesting point for the processing of Paulista gherkin fruits was determined according to their seed maturation stage (Modolo & Costa, 2000). However, no relationship was established between this parameter and the L/D ratio. Paulista gherkin fruits are more rounded than elongated, as compared to most cucumber cultivars. Therefore, additional studies are needed to establish the ideal L/W ra-

tio for gherkin fruit pickle processing. Fruit with thicker flesh are desirable to be consumed as fresh or cut as salad.

Paulista gherkin hybrid yield was equivalent to their respective parental inbreds. This lack of heterosis might be the result of the elite inbreds that were employed in the crosses for hybrid production, which had similar genetic background.

Table 1 - Total fruit number (TFN), total fruit weight (TFW), and mean fruit weight (FW) per plot containing seven plants from inbreds L1, L2, L4 and L60 and hybrids H3, H5, H6, H61, H62 and H64 of Paulista gherkin, considering six harvests.

Paulista gherkin	TFN	TFW	
		kg	g
L1	221 b	16.29 b	74.59 a
L2	497 a	34.40 ab	69.52 a
H3 (L1 x L2)	480 a	37.84 a	72.63 a
L4	461 ab	31.23 ab	67.79 a
H5 (L4 x L1)	496 a	35.28 ab	71.98 a
H6 (L4 x L2)	465 ab	36.05 ab	77.20 a
L60	410 ab	29.34 ab	71.13 a
H61 (L60 x L1)	360 ab	28.18 ab	77.13 a
H62 (L60 x L2)	517 a	39.35 a	76.27 a
H64 (L60 x L4)	443 ab	32.50 ab	72.70 a
LSD (5%)	244.14	18.00	18.51
CV (%)	23.02	27.71	10.40

Mean values in same column not followed by the same letter differ by Tukey's multiple range test ($P = 0.05$).

Table 2 - Length (L), diameter (D), length/diameter ratio (L/D) and flesh thickness (FT) for inbreds (L1, L2, L4 and L60) and hybrids (H3, H5, H6, H61, H62 and H64) of Paulista gherkin.

Paulista gherkin	L	D	FT	L/D
L1	7.25 a	4.71 a	0.57 a	1.54 a
L2	6.85 a	4.75 a	0.46 ab	1.44 a
H3 (L1 x L2)	6.19 a	4.65 a	0.53 abc	1.44 a
L4	7.01 a	4.82 a	0.50 abc	1.46 a
H5 (L4 x L1)	6.98 a	4.75 a	0.50 abc	1.47 a
H6 (L4 x L2)	7.26 a	4.76 a	0.50 abc	1.52 a
L60	6.86 a	4.69 a	0.45 c	1.46 a
H61 (L60 x L1)	7.24 a	4.86 a	0.53 ab	1.49 a
H62 (L60 x L2)	7.13 a	4.83 a	0.49 bc	1.47 a
H64 (L60 x L4)	7.22 a	4.87 a	0.51 abc	1.48 a
LSD (5%)	1.10	0.42	0.07	0.14
CV (%)	6.48	3.66	5.98	3.94

Mean values in the same column not followed by the same letter differ by Tukey's multiple range test ($P = 0.05$).

Seed companies produce some cucumber and squash monoecious hybrids using growth regulators. Ethephon applied in monoecious cucumber plants with two true leaves induced pistillate flowers, to make hybrid seed production easier (Castro, 1998). Abreu (1988) reported pistillate flower induction effect from ethephon on gherkin plants only when applied at the cotyledonary stage and up to the fourth true leaf stage.

Cucumber yield increased three to five times when grown on trellis as compared to the prostrate cropping system (Alvarenga et al., 1982; Illescas & Vesperinas, 1989). On the other hand, Leal et al. (2000) compared prostate versus trellised systems for common gherkin and found no yield differences. However, the fruit quality was higher when trellises were used. Modolo & Costa (2001b) found average yield when using plastic mulching beds. In the present work, for both, hybrids and inbreds of the Paulista gherkin, an average yield of 36.5 t ha⁻¹ fruits was estimated for a 40-day harvesting period, at a density of 6,500 plants ha⁻¹.

The trellised system could be an excellent choice for the Paulista gherkin support. Most fruit production was concentrated in lateral shoots as a result of the strong suppression of apical dominance. As the trellised net had vertical and horizontal strings, secondary and tertiary shoots were well distributed along the net. The trellised net avoids fruit contact with the soil, improving its quality and making harvesting easier, without pruning, and consequently, reducing labor costs. Paulista gherkins are spineless and have larger fruit than common gherkins, but are more sensitive to damage and bruise, presenting undesirable gum exudation. Gherkins grown on a trellised net are easier to harvest than those grown prostrated, avoiding damage during harvest.

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REFERENCES

- ABREU, C.L.M. Efeitos do ethephon (ácido 2-cloro-etil-fosfônico) em maxixe (*Cucumis anguria* L.) Piracicaba, 1988. 86p. Dissertação (Mestrado) - Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo.
- ALVARENGA, M.A.R.; PEDROSA, J.F.; FERREIRA, F.A. Pepino: cultivares e métodos culturais. **Informe Agropecuário**, v.8, p.33-34, 1982.
- CASTRO, P.R.C. **Utilização de reguladores vegetais na fruticultura, na olericultura e em plantas ornamentais**. Piracicaba, 1998. 92p. (Série Produtor Rural, n. esp.)
- FILGUEIRA, F.A.R. **Novo manual de olericultura: agrotecnologia moderna na produção e comercialização de hortaliças**. Viçosa: UFV, 2000. 402p.
- ILLESCAS, E.S.; VESPERINAS, E.S. **Tratado de horticultura herbácea**. I. Hortaliças de flor e fruto. Barcelona: Aedos, 1989. 352p.
- KOCH, P.S.; COSTA, C.P. Herança de caracteres de planta e fruto em maxixe. **Horticultura Brasileira**, v.9, p.73-77, 1991.
- LEAL, F.R.; SANTOS, V.B.; SALVIANO, A.A.C. Sistemas de condução e aplicação de cal extinta na cultura do maxixe. **Horticultura Brasileira**, v.18, p.542-543, 2000. Suplemento.
- MALUF, W.R. Heterose e emprego de híbridos F₁ em hortaliças. In: NASS, L.L.; VALOIS, A.C.C.; MELO, I.S.; VALADARES-INGLIS, M.C. (Ed.) **Recursos genéticos e melhoramento - plantas**. Rondonópolis: Fundação MT, 2001. p.327-355.
- MARQUELLI, W.A.; SOUZA, A.F.; SILVA, W.L.C.; CARRIJO, O.A. Efeito residual de fontes de N na produção de maxixe em ambiente protegido. (Compact disc). **Horticultura Brasileira**, v.19, 2001. Suplemento.
- MARTINS, M.A.S. **Maxixe (*Cucumis anguria* L.) e seu cultivo em São Luís do Maranhão**. São Luís: EMAPA, 1986. (Documento, 8).
- MODELO, V.A.; COSTA, C.P. da. Condução de maxixe paulista sob ambiente protegido. (Compact disc). **Horticultura Brasileira**, v.19, 2001a. Suplemento.
- MODELO, V.A.; COSTA, C.P. da. Avaliação de linhagens de maxixe paulista. (Compact disc). **Horticultura Brasileira**, v.19, 2001b. Suplemento.
- MODELO, V.A.; COSTA, C.P. da. Caracterização e ponto de colheita em maxixe. **Horticultura Brasileira**, v.18, p.476-478, 2000. Suplemento.
- RIBEIRO, A.; MELO, P.C.T. **A moderna tecnologia na cultura do pepino**. Paulínia: Estação Experimental de Pesquisas de Hortaliças, 1989. 26p.
- ROBINSON, R.W.; DECKER-WALTERS, D.S. **Cucurbits**. New York: CAB International, 1997. 225p.
- SHETTY, N.V.; WEHNER, T.C. Evaluation of oriental trellis cucumbers for production in North Calorina. **HortScience**, v.33, p.891-896, 1998.

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