

## Breeding new F<sub>1</sub> hybrids cucumber for the Southeastern market in Vietnam

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### ABSTRACT

The objective of this study was to create new F<sub>1</sub> cucumber varieties that would meet the demands of the regional market, in term of higher yield and reasonable cost. The study was conducted using 8 hybrid combinations: C2 x C44; C4 x C37; C12 x C44; C20 x C40; C31 x C44; C35 x C44; C41 x C52; C44 x C52 and a control variety Hunter 1.0. The growth time of hybrid combinations ranged from 64.3 to 66.7 days after sowing. The yield of the hybrid combinations ranged from 37.2 to 39.8 tons/ha. The hybrid combinations C20 x C40; C31 x C44, and C44 x C52 had a higher yield than Hunter 1.0 control. The fruit was from 17.9 to 19.7 cm long and the average weight per fruit was 156.7 - 193.3 g. The fruit flesh hardness of the hybrid combinations ranged from 30.9 to 32.0 lbf and was equal to or higher than that of the control variety.

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## 1. Introduction

Cucumber is a popular vegetable in Vietnamese people's daily meals. It is used to eat fresh or cooked, combining with salads, stir-fried dishes, etc. (Malepszy, 1988). With an ingredient that accounts for more than 95% of water, cucumber provides water, detoxification and moisture supply for the body (Liang et al., 2014). Moreover, cucumber also works to beautify the skin, help to lose weight, regulate cholesterol in the

blood, cure constipation, etc. In addition, cucumber products are also processed canned in industry and export (Calbom & Calbom, 2008). According to the GOS (2010), the total cucumber growing area is 31,570 ha in Vietnam with an average yield of 18.3 ton/ha, which is higher than the average yield of the world.

The Southeastern in Vietnam has a favourable geographical location, concentrating on many major provinces and cities which is an important point of exchange and trade between the

Southern region with the whole country and the world (Dang et al., 1997). Agricultural land is a strong point of the region with a total land bank of 27.1% being used for agricultural purposes, of which cucumber is a strong crop (Duc, 2009). Based on the suitable climate and soil conditions, and skilled farmers with deep experience in growing cucumbers, the Southeast is the region that supplies a large number of cucumbers to the country and especially Ho Chi Minh City, where has the highest demand in the consumption of fruit and vegetables (Cadilhon et al., 2006).

Currently, farmers in the Southeast are mainly cultivating by a cucumber variety of Hunter 1.0 with outstanding features of good growth. The morphological characteristics of the fruit are suitable to regional tastes. This is the seed imported by East-West Seed Company, Vietnam, with a high selling price. However, the yield of this variety is not high, and the seed quality is not stable. The rate of infection with powdery mildew is high in the rainy season. Stemming from these situations, the market needs to have domestic cucumber varieties that are improved to replace this variety, providing high yield, good quality, strong plants, and well adapted to the natural conditions of the region.

Besides, in order to meet the needs of domestic production and consumption of seedlings, in September 2016, the People's Committee of Ho Chi Minh City decided to approve the "Program on developing high-quality variety and seedling in Ho Chi Minh City from 2016 through 2020" (PCHCM, 2016).

The objective of this study was to create new F1 cucumber varieties that would meet the demands of the regional market in term of higher yield and reasonable cost with the following characteristics: High productivity reaches over 35 tons/ha/crop; Fruit length is 18 - 20 cm, straight, balanced; Color: blue is darker than the left colour of Hunter 1.0; Fruit diameter < 3.5 cm. The rate of marketable fruits > 90%; Crunchy, sweet equivalent to Hunter 1.0, not bitter (sensory evaluation).

## 2. Materials and Methods

### 2.1. Material

Eight cucumber hybrids bred by the dialling method were selected and developed from 12 va-

rieties of S<sub>7</sub> generation with the agronomic characteristic was shown in Table 1, which was saved at the Research Center of Tan Loc Phat Seeds Company Limited. The Hunter 1.0 variety distributed by East-West Seed Company was used as the control variety in the study.

### 2.2. Methodology

#### 2.2.1. Experimental design

Breeding F<sub>1</sub> hybrid from 12 S<sub>7</sub> cucumber lines by dialling method obtained 66 F<sub>1</sub> cucumber hybrid combinations. By comparing and evaluating the agronomic characteristics of the hybrid combination, the eight most promising hybrid combinations have been selected which were suitable for the market requirements.

This single factor experiment was arranged in a randomized complete block design, including nine treatments (8 hybrid combinations and one control variety - Hunter 1.0); 3 repetitions. The area of each experimental plot is 2.4 m x 1.2 m = 2.88 m<sup>2</sup>. The planting distance is 1.2 x 0.6 cm. Applied technical procedures and evaluation criteria and monitoring methods are based on National Technical Regulations (MARD, 2012-QCVN 01-87:2012/BNNPTNT) on the value of cultivation and use of cucumber varieties by the Ministry Issued by Agriculture and Rural Development.

#### 2.2.2. Monitoring criteria

Criteria of fruit morphology, yield and quality included yield, fruit length, fruit breadth, the average weight per fruit, rate of marketable fruits, fruit shape, fruit peel colour, fruit peel features and fruit hardness.

#### 2.2.3. Statistical analysis

Data of experiments were collected and calculated on computers according to ANOVA statistical analysis method and LSD ranking test by using SAS software 9.1.

#### 2.2.4. Time and location

The experiment was conducted in 9 months (from November, 2018 to August, 2019) at the Seeds Research Center of Tan Loc Phat Seeds Company Limited that is located in Ham Tan district, Binh Thuan province.

**Table 1.** Morphological characteristics of parental lines

Parental lines	Fruit shape	Fruit colour	Fruit peel features	Fruit length (cm)	Fruit diameter (cm)
C2	Cylinder, conical top, tapering bottom	Green, short stripes	Soft, white, thin spines, many pollens	17.8	3.4
C4	Cylinder, conical top, circular bottom	Green, short stripes	Soft, white, thin spines, fewer pollens	18.2	3.6
C12	Cylinder, conical top, spherical bottom	Light green, short stripes	Soft, white, thin spines, fewer pollens	19.2	3.5
C20	Cylinder, conical top, spherical bottom	Green, short stripes	Hard, white, thin spines, fewer pollens	17.8	3.5
C21	Cylinder, tapering top, circular bottom	Dark green, no stripes	Soft, white, thin spines, fewer pollens	18.7	3.6
C31	Cylinder, conical top, circular bottom	Green, fewer stripes	Hard, white, thin spines, fewer pollens 17.5	3.5	
C35	Cylinder, conical top, spherical bottom	Light green, short stripes	Soft, white, thin spines, many pollens	18.3	3.7
C37	Cylinder, conical top, tapering bottom	Light green, long stripes	Soft, white, thin spines, fewer pollens	17.6	3.5
C40	Cylinder, conical top, spherical bottom	Green, fewer stripes	Soft, white, thin spines, fewer pollens	19.4	3.4
C41	Cylinder, conical top, spherical bottom	Green, short stripes	Soft, white, thin spines, fewer pollens	20.1	3.6
C44	Cylinder, conical top, circular bottom	Green, short stripes	Soft, white, thin spines, fewer pollens	19.6	3.6
C52	Cylinder, conical top, spherical bottom	Green, fewer stripes	Soft, white, thin spines, fewer pollens	17.8	3.6

**Table 2.** Flowering periods and growth time of the hybrid combinations

Parental lines	Days to female flower initiation	Days to male flower initiation	Growth time (Days)
C2 x C44	26.5	25.4	64.7
C4 x C37	30.9	29.8	64.3
C12 x C44	31.5	27.3	65.3
C20 x C40	31.6	27.8	66.0
C31 x C44	28.3	27.1	66.3
C35 x C44	28.0	26.0	65.7
C41 x C52	28.7	25.9	65.0
C44 x C52	26.8	24.1	66.3
Hunter 1.0	31.7	27.8	71.3

**Table 3.** Morphological and yield characteristics of the hybrid combinations

Parental lines	Fruit length (cm)	Fruit diameter (cm)	Average weight per fruit (g)	Rate of marketable fruits (%)	Yield (ton/ha)
C2 x C44	18.0 <sup>cd</sup>	3.5 <sup>b</sup>	183.3 <sup>ab</sup>	97.1 <sup>a</sup>	37.2 <sup>c</sup>
C4 x C37	17.9 <sup>cd</sup>	3.5 <sup>b</sup>	166.7 <sup>bc</sup>	97.4 <sup>a</sup>	37.6 <sup>c</sup>
C12 x C44	19.3 <sup>ab</sup>	3.6 <sup>a</sup>	193.3 <sup>a</sup>	96.7 <sup>a</sup>	38.0 <sup>bc</sup>
C20 x C40	18.3 <sup>bcd</sup>	3.4 <sup>b</sup>	156.7 <sup>c</sup>	96.8 <sup>a</sup>	39.8 <sup>a</sup>
C31 x C44	18.4 <sup>bcd</sup>	3.5 <sup>b</sup>	186.7 <sup>ab</sup>	97.4 <sup>a</sup>	39.2 <sup>ab</sup>
C35 x C44	18.7 <sup>abc</sup>	3.6 <sup>a</sup>	173.3 <sup>abc</sup>	97.2 <sup>a</sup>	38.0 <sup>bc</sup>
C41 x C52	19.7 <sup>a</sup>	3.6 <sup>a</sup>	173.3 <sup>abc</sup>	97.2 <sup>a</sup>	38.3 <sup>abc</sup>
C44 x C52	18.5 <sup>bcd</sup>	3.6 <sup>a</sup>	173.3 <sup>abc</sup>	96.5 <sup>a</sup>	39.2 <sup>ab</sup>
Hunter 1.0	17.6 <sup>d</sup>	3.5 <sup>b</sup>	180.0 <sup>ab</sup>	95.0 <sup>b</sup>	37.6 <sup>c</sup>
CV%	2.2	0.8	6.1	0.8	2.1
Fvalue	7.74 <sup>**</sup>	16.0 <sup>**</sup>	3.15 <sup>*</sup>	2.83 <sup>*</sup>	3.49 <sup>*</sup>

In the same column, numbers with the same letter do not have a statistically significant difference; \*: significant difference at the level of  $\alpha = 0.05$ ; \*\*: very significant difference at the level of  $\alpha = 0.01$ .

### 3. Results

As shown in Table 2, the deviation between male and female flowering date affects the pollination rate of the hybrid combinations. In terms of growth time, the combination C31 x C44 and C35 x C44 had the longest growing days and hybrid combination C4 x C37 had the shortest number of growing days with 65.7 to 66.6 days and 64.3 days, respectively. In general, the days to flower initiation in the hybrid combinations were earlier than the existing varieties in Vietnam's Southeastern market, with the flowering time ranging from 32 to 34 days after sowing.

In the Table 3, the C41 x C52 hybrid combination had the longest fruit length (19.7 cm) and was significantly different from the other hybrid combinations and the control variety. Furthermore, all hybrid combinations gave a longer length of fruit than varieties in the Vietnam's

Southeastern market (Table 5) except for the C4 x C37 hybrid. Fruit breadth of the hybrid combinations C12 x C44, C35 x C44, C41 x C52, and C44 x C52 had the largest value (3.6 cm) and the difference is statistically significant compared to other treatments as well as four available varieties in the Southeastern market.

Cucumber's fruits in the C12 x C44 hybrid combination yielded the heaviest weight at 193.3 g per fruit, which was a higher and statistically significant difference compared to the C4 x C37 and C20 x C40 hybrid combinations. Moreover, this weight was also higher than the varieties as Hunter 2.0, SL 1.2 and Vino 67 on Vietnam's Southeastern market with an average weight per fruit similar to Hunter 1.0. The marketable rate of cucumber in the hybrid combinations showed high results and the difference was not statistically significant. All the hybrid combinations in the experiment had higher marketable fruit rate

**Table 4.** Fruit characteristics of hybrid combination

Fruit hardness (lbf)	Fruit peel features	Fruit peel color	Fruit shape	Parental lines
C2 x C44	Cylinder, conical top, circular bottom	Green, short stripes	Soft white spines, thin spines, fewer pollens	31.1 <sup>cd</sup>
C4 x C37	Cylinder, conical top, spherical bottom	Green, fewer stripes	Soft white spines, thin spines, fewer pollens	32.0 <sup>a</sup>
C12 x C44	Cylinder, conical top, circular bottom	Green, fewer stripes	Soft white spines, thin spines, medium pollens	32.0 <sup>a</sup>
C20 x C40	Cylinder, conical top, spherical bottom	Green, short stripes	Soft white spines, thin spines, medium pollens	31.3 <sup>bcd</sup>
C31 x C44	Cylinder, conical top, circular bottom	Green, fewer stripes	Soft white spines, thin spines, fewer pollens	30.9 <sup>d</sup>
C35 x C44	Cylinder, conical top, circular bottom	Green, short stripes	Soft white spines, thin spines, fewer pollens	31.5 <sup>bc</sup>
C41 x C52	Cylinder, conical top, spherical bottom	Green, fewer stripes	Soft white spines, thin spines, fewer pollens	31.4 <sup>bc</sup>
C44 x C52	Cylinder, conical top, circular bottom	Green, fewer stripes	Soft white spines, thin spines, medium pollens	31.6 <sup>ab</sup>
Hunter 1.0	Cylinder, conical top, circular bottom	Green, fewer stripes	Soft white spines, thin spines, fewer pollens	31.5 <sup>bc</sup>
CV%				0.6
F value				11.96 <sup>**</sup>

In the same column, numbers with the same letter do not had a statistically significant difference; ns: no significant; \*: significant difference at the level of  $\alpha = 0.05$ ; \*\*: very significant difference at the level of  $\alpha = 0.01$ .

**Table 5.** Characteristics of 3 popular cucumber varieties in Vietnam's Southeastern market (survey results in May, 2019)

Variety	Company	Days to flower initiation	Fruit shape	Fruit peel colour	Average weight per fruit (g)	Fruit diameter (cm)	Fruit length (cm)	Average yield (tons/ha)	Cultivation season	Advantages	Disadvantages
Hunter 2.0	Eastwest seed	32	Cylinder, long, short	Light green	140	3.5	14 - 16	30	Annual	Strong plant, long term harvest	Short fruit
SL 1.2	An Phu Nong	32	Cylinder, long	Light green	160	3.5	16 - 17	33	Annual	Strong plant, concentrated fruit setting	Light green fruit, weak
Vino 67	Viet Nong	34	Cylinder, long	Green	180	3.5	16 - 18	28	Annual	Strong plant, sweet fruit	Late fruit setting, fewer fruit

than the control variety.

In the market for cucumbers, fruit sizes that are too big or too small are unpopular. Fruit sizes of some popular varieties in Vietnam's Southeastern are 16-18 cm long, with an average weight of 160-180 g per fruit. The C2 x C44; C31 x C44; C35 x C44 and C44 x C52 hybrid combinations had suitable fruit shape.

In terms of yield, the C20 x C40 hybrid combination produced the highest yield of 39.8 ton/ha and the difference was statistically significant compared to the C2 x C44, C4 x C37, C12 x C44. C35 x C44 hybrid combinations and the control variety Hunter 1.0. According to the results in Table 5, the varieties currently available in the Southeast had the average yields from 28 to 33 ton/ha and significantly lower than the C20 x C40 hybrid combination.

Regarding to fruit shape, all hybrid combinations have a cylindrical shape and conical top similar to Hunter 1.0. However, the C4 x C37, C20 x C40 and C41 x C52 hybrid combinations produced spherical bottom, which was different from the rest of the hybrid combinations and the control that had the circular bottom (Table 4). In addition, fruits from the hybrid combinations have similar shape and colour to the varieties available in the Southeast, according to the survey results in Table 5.

Next, the peel of cucumber in all treatments was green, thin, and soft white spines. In which, cucumbers of 3 hybrid combinations C2 x C44, C20 x C40 and C35 x C44 had short stripes differing from the remaining hybrids and including the control variety. In addition, the C12 x C44, C20 x C40 and C44 x C52 hybrid combinations had a medium pollen layer, and the rest of the hybrid combinations, including the control variety, had fewer pollen on the pods.

Finally, cucumbers in the C4 x C37, C12 x C44 and C44 x C52 hybrid combinations had the highest fruit hardness with values of 32.0, 32.0, 31.6 lbf, respectively, and the difference was very statistically compared to other hybrid combinations and the control variety Hunter 1.0.

#### 4. Conclusions

The hybrid combinations all grew and developed well under the same experimental conditions. The three C20 x C40, C31 x C44; C44 x C52 hybrid combinations had a higher yield

than Hunter 1.0 control. However, the C31 x C44; C44 x C52 hybrid combinations had the average fruit weight equivalent to the control variety, and equivalent to some popular cucumber varieties in the Southeastern market, while the hybrid C20 x C40 had a smaller fruit size compared with popular varieties (as survey results mentioned in Table 5). About the morphological characteristics, the C31 x C44, C44 x C52 hybrid combinations had fruit shape and fruit colour similar to Hunter 1.0. However, the C31 x C44 hybrid combination had low hardness, leading to damage during transport and storage easily. On the other hand, the C44 x C52 hybrid combination had high hardness and similar to the control variety.

In conclusion, it is reasonable to choose the C44 x C52 hybrid combination as a promising hybrid cucumber variety for Vietnam's Southeastern market.

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