

## Evaluation of MMSU Fresh Market Tomato F1 Hybrids for Off-season Production

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### ABSTRACT

The performance of 21 fresh market tomato F1 hybrids was evaluated and compared with eight open-pollinated varieties in Ilocos Norte during the off-season, *i.e.*, wet season (WS), for five years. Using the best performing hybrids and two of the open-pollinated varieties, the economics of producing tomato during off-season as well as the economics of producing seeds were evaluated in the succeeding two years.

All the hybrids showed promising performance. These out yielded the open-pollinated varieties. The highest yielders were Line 5 X N, Line 7 X N, and Line 1 X N, with an average yield of 25.86, 24.23, and 23.19 t ha<sup>-1</sup>, respectively. These hybrids, dubbed as MMSU F<sub>1</sub> Hybrid 1, MMSU F<sub>1</sub> Hybrid 2, and MMSU F<sub>1</sub> Hybrid 3, performed well even during high intensity rainfall and strong typhoons. The fruits of the hybrids possess the qualities preferred by local consumers.

Off-season tomato production using the MMSU F<sub>1</sub> Hybrid 1, MMSU F<sub>1</sub> Hybrid 2, and MMSU F<sub>1</sub> Hybrid 3 could provide an average net income of P312,145 ha<sup>-1</sup> and a benefit-cost ratio (BCR) of 6.75 at a farm gate price of P15 kg<sup>-1</sup>. With the open-pollinated varieties, net income was P34,845 and a BCR of 1.65. Producing the seeds of the hybrids was also profitable. For 1000m<sup>2</sup> area, 26410 g of seeds could be produced giving a net cash income of P65,435 and a net farm income of P53,115.

*Keywords: fresh market tomato, tomato hybrids, off-season tomato production*

### INTRODUCTION

In the Ilocos Region, tomato is one of the major cash crops normally cultivated by the farmers during dry season (DS) after rice is harvested. Planting time is from November to December; and the bulk of the produce is harvested between February and March. Thus, during this period, the local market is generally flooded with locally produced fresh market tomato. Naturally, the price becomes very low

averaging less than P5 kg<sup>-1</sup>. Worst, the supply is much higher than the demand for the product resulting in a host of marketing problems.

On the other hand, tomato during off-season, *i.e.* WS, commands a very high price. However, farmers in the Ilocos seldom grow tomato during this period due to lack of suitable varieties. The recommended open-pollinated varieties including the native

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cultivar, generally do not perform well during the WS. Starting in mid 1980s, MMSU and the Department of Agriculture have been actively involved in the National Cooperative Testing (NCT) of tomato, but none of the tomato varieties released by the Philippine Seedboard, including those claimed to be all-season, showed good performance and stable yields during the WS trials. These cultivars could not tolerate the hot/humid conditions of the area, resulting in excessive flower drop and abortion. Further, these cultivars could not withstand the damage caused by strong typhoons, a common phenomenon in the Ilocos provinces during WS.

In contrast, the native tomato cultivar was observed tolerant to leaf diseases and excessive moisture. It could recover from typhoon damage provided the planting site is not waterlogged. Moreover, the native tomato is very much preferred by local consumers

because of its sour and succulent fruits. Thus, it commands a price higher than the other varieties. However, there are negative attributes of this cultivar which need improvement like undesirable shape, susceptibility to cracking and poor shelf life. These negative characteristics can only be improved by hybridizing this cultivar with other genotypes.

Thus, MMSU launched a program to improve the negative attributes of the native cultivar and its performance during the WS. Through this program, the native cultivar was hybridized with 21 tomato lines, which were selected from the entries of the NCT based on their performance during the WS trials. The research evaluated the performance of these hybrids in comparison with recommended open-pollinated varieties including the native cultivar with the ultimate goal of identifying tomato hybrid(s) that could be recommended for off-season tomato production.

## **MATERIALS AND METHODS**

### **Locale of the Study**

The trials were conducted at the experimental farm of the Mariano Marcos State University (MMSU), Batac, Ilocos Norte. Based on the Corona classification, the climate of Ilocos Norte belongs to Type I, *i.e.* two distinct seasons, wet and dry. WS is from May to October. About 90% of the total annual rainfall, averaging 2000mm, occurs within this period. An average of six tropical cyclones visit the area each year, most of which are considered tropical storms (63-118 kph) and typhoons (>118 kph). These tropical cyclones bring heavy rains that usually keep the low-lying areas submerged or waterlogged. Such conditions do not favor the cultivation of tomato using the recommended cultivars such as Maigaya, Improved Harbot, Marikit, Ilocandia 4, and Native.

### **Seed Production**

Seeds of the hybrids were produced using the native cultivar (N) as the female parent and tomato lines coded as lines 1 to 21 as the male parents. The hybridization activity was done during the early part of the DS, *i.e.* November to February from 1992 to 1999. The performance of the hybrids was evaluated in field trials conducted during the succeeding WS.

### **Field Trials**

The field trials for evaluating the performance of the F<sub>1</sub> hybrids in comparison with the recommended open-pollinated cultivars were conducted from 1992 to 1997. The economics of producing seeds of the most promising hybrids and off-season tomato

production using these hybrids were evaluated during the 1998 and 1999 DS.

In the performance evaluation trials, each entry was planted in a single-row plot 1.25 m wide x 5 m long and raised to about 20 to 30 cm. The plants were spaced 0.40 m within the row with one plant hill<sup>-1</sup>. The entries were assigned in the experimental plots following a Randomized Complete Block Design in four replicates.

The recommended cultural management practices for off-season tomato production were employed. Seedlings were grown in 1 m x 10 m raised bed with garden soil, sand and compost at 1:1:1 ratio. The seedlings were transplanted 20 to 30 days after sowing. Complete fertilizer was applied basally at 20 g hill<sup>-1</sup> by dibbling holes near the base of the plant. A mixture of 10 g urea and 5 g muriate of potash was applied per hill at 3, 7, and 11 weeks after transplanting (WAT). Recommended insecticides (Lannate/Decis) and fungicides (Dithane M-45) were sprayed at seedling and vegetative stages whenever necessary to control insect pests and diseases. Weeds were controlled manually.

The plots were mulched with rice straw. The plants were provided with bamboo

trellises to prevent them from being exposed to excessive moisture as well as to protect the fruits from rotting and rats. After heavy rains or typhoons, the plants were fertilized with ammonium sulfate at the rate of 5 g hill<sup>-1</sup>. This enhanced production of new buds and lateral shoots/branches from which flowers and fruits were subsequently produced. When rain was continuous, green mature fruits were harvested to prevent them from cracking. During periods of interspersed dry spells, fruits were harvested at breaker stage (half-ripe).

### Data Gathered

The performance of the hybrids and open-pollinated cultivars were evaluated in terms of maturity, fruit size, fruit yield plant<sup>-1</sup> and fruit yield ha<sup>-1</sup>. The best performing hybrids were later characterized morphologically with respect to fruit size and shape, fruit yield per plant, and growth habit. The economics of producing seeds of the best-performing hybrids and off-season tomato production using the hybrids was estimated taking into account all the material and labor inputs and their corresponding unit cost during the trials.

## RESULTS AND DISCUSSIONS

### Performance Evaluation

**Vine length.** In 1992, the entries with the longest vines were Line 6 x N, Line 7 X N, and Line 1 X N with 218.24 cm, 154.19 cm, and 146.77 cm, respectively (Table 1). The entries with the shortest vines were Marikit, Line 3 X N, and Line 10 X N. However, in 1993, Line 2 X N, Line 13 X N, Line 17 X N, Line 15 X N, and Line 6 X N produced the longest vines. Entries with determinate growth habit like the Improved Harbot, Maigaya, Line 12 X N and Line 11 X N had the shortest. In 1994, entries

that produced the longest vines were Line 13 X N, Line 17 X N, Line 2 X N and Line 15 X N. The three check varieties, Ilocandia 4, NFC Hybrid 1, and Native (Magnuang), had the shortest vines. Among the eight entries evaluated in 1995, the entries that produced the longest vines were Line 3 X N, and the Native variety, while NFC Hybrid 1, Line 5 X N, and Line 7 X N produced the shortest. In general, the vines produced by all entries in 1995 were longer than in the previous years. Heavier rainfall and more typhoons occurred in 1995.

**Maturity.** Maturity ranged from 53 to 90 days. In 1992, all the hybrids matured in less than 55 days, while the open-pollinated varieties matured in 60 to 64 days. In 1993, the earliest maturing hybrids were Line 1 X N, Line 8 X N, and Line 12 X N which took 62 days. Some hybrids showed a comparable maturity with the open-pollinated varieties like Line 2 X N, Line 6 X N, Line 7 X N, Line 19 X N, and Line 13 X N, which matured in 70 to 81 days. The same trend was observed in the succeeding years of trials wherein the hybrids matured earlier than the open-pollinated varieties. For the five-year period, Line 8 X N, Line 5 X N, and Line 10

Table 1. Vine length of the different fresh market tomato F1 hybrids and open-pollinated tomato varieties (1992-1997 WS).

ENTRY	VINE LENGTH (cm)					AVE.
	1992	1993	1994	1995	1997	
Line 1 x N	146.77	150.33 <sup>cd</sup>	143.22	117.17 <sup>b</sup>	180.88 <sup>cdc</sup>	147.67
Line 2 x N	-	264.67 <sup>a</sup>	191.56	-	226.31 <sup>f</sup>	227.51
Line 3 x N	122.50	120.00 <sup>d-h</sup>	125.00	164.55 <sup>a</sup>	151.81 <sup>a-d</sup>	136.77
Line 4 x N	135.05	126.33 <sup>c-g</sup>	143.78	-	179.00 <sup>b-c</sup>	137.29
Line 5 x N	139.55	157.00 <sup>c</sup>	122.11	107.39 <sup>b</sup>	160.38 <sup>a-d</sup>	137.29
Line 6 x N	218.24	199.67 <sup>b</sup>	-	-	236.81 <sup>fg</sup>	218.24
Line 7 x N	154.19	136.00 <sup>c-f</sup>	136.67	110.11 <sup>b</sup>	172.38 <sup>a-c</sup>	141.87
Line 8 x N	130.00	128.00 <sup>c-g</sup>	-	-	-	129.00
Line 9 x N	130.33	121.33 <sup>d-h</sup>	139.33	-	183.88 <sup>dc</sup>	143.72
Line 10 x N	125.00	127.67 <sup>c-g</sup>	-	-	-	126.33
Line 11 x N	136.83	113.33 <sup>e-h</sup>	160.34	-	138.25 <sup>ab</sup>	137.19
Line 12 x N	-	108.33 <sup>e-h</sup>	132.67	-	138.19 <sup>ab</sup>	126.40
Line 13 x N	-	258.67 <sup>a</sup>	241.33	-	269.50 <sup>gh</sup>	256.50
Line 14 x N	-	148.67 <sup>cd</sup>	148.89	119.94 <sup>b</sup>	140.06 <sup>abc</sup>	139.39
Line 15 x N	-	205.00 <sup>b</sup>	187.78	-	221.75 <sup>f</sup>	204.84
Line 16 x N	-	128.00 <sup>c-g</sup>	137.11	-	288.75 <sup>h</sup>	184.62
Line 17 x N	-	213.33 <sup>b</sup>	222.56	-	296.38 <sup>h</sup>	244.09
Line 18 x N	-	128.33 <sup>c-g</sup>	121.67	-	205.06 <sup>ef</sup>	151.69
Line 19 x N	-	136.67 <sup>cdc</sup>	124.22	-	163.81 <sup>a-d</sup>	141.57
Line 20 x N	-	-	173.33	-	-	173.33
Line 21 x N	-	-	146.78	-	-	146.78
Native (B)	132.05	123.67 <sup>d-h</sup>	14.44	143.17 <sup>a</sup>	155.31 <sup>a-d</sup>	138.93
Maigaya	126.77	104.33 <sup>fgh</sup>	149.22	-	131.81 <sup>a</sup>	128.03
Marikit	120.00	121.67 <sup>d-h</sup>	-	-	-	120.83
Improved Harbot	-	94.00 <sup>h</sup>	-	-	-	94.00
Native (Magnuang)	-	132.67 <sup>c-f</sup>	123.22	-	-	127.94
Ilocandia 4	-	-	94.33	-	-	94.33
NFC Hybrid 1	-	-	100	98.78 <sup>b</sup>	-	99.39
NFC Hybrid 2	-	-	124	118.50 <sup>b</sup>	-	121.25

Means in a column marked with a common letter do not differ significantly at 0.01 level using DMRT.  
 - not included in the trial

X N were the earliest maturing entries (58 to 59 days), while the Native variety was the latest to mature (Table 2).

**Fruit size.** Fruit size of the entries ranged from 7 to 43 g (Table 3). In 1992, the heaviest fruits were produced by Line 6 X N and Line 3 X N with an average of 30 g. Entries with comparable fruit sizes were Line 7 X N, Line 5 X N, Line 9 X N, Line 1 X N, Line 4 X N, Line 8 X N and the Native variety. The smallest fruits were produced by Maigaya. For three years (1993, 1994, and 1997), Line 17 X N consistently produced the heaviest fruits with an average of 42.27 g. Line 13 X N also produced fruits averaging 34.72 g which were comparable to the Native variety (34.38 g). The entries that produced fruits with an average weight of 25 g were Line 7 X N, Line 6 X N, Line 8 X N, Line 19 X N, Line 16 X N, Line 1 X N and Line 9 X N. In 1994, Line 17 X N produced the heaviest fruits (41.89 g), followed by Line 13 X N (33.52 g). In 1995, when only eight entries were involved in the trial, the Native variety produced the heaviest fruits (49 g). The other entries produced medium to large fruits. In 1997, Line 17 X N again produced the heaviest fruits (39.30 g) followed by Line 16 X N, Line 13 X N, and Native with average fruit weight of 30 g, while Line 20 X N and the Native (Magnuang) variety produced the smallest fruits (<10 g).

**Fruit yield per plant.** In 1992, Line 5 X N, Line 7 X N, and Line 1 X N produced the highest fruit yield per plant at 0.48, 0.42 and 0.40 kg, respectively (Table 4). The lowest fruit yield was produced by the check varieties Native (0.20 kg), Maigaya (0.14 kg), and Marikit (0.04 kg). The same trend was observed in 1994. For five years line 5 X N, Line 7 X N, Line 1 X N, and Line 2 X N produced the highest yield per plant with an average of more than 0.70 kg. Marikit (0.09 kg) and Native (Magnuang) produced the least.

**Average fruit yield.** The hybrids consistently yielded higher than the open-pollinated varieties in the five-year trial (Table 5). This could be attributed to high fruit setting of the hybrids. In 1992, Line 7 X N, Line 5 X N, and Line 1 X N produced the highest yield of 22.87, 21.74, and 20.72 t ha<sup>-1</sup>, respectively. The hybrids yielded 13.13 to 32.82 t ha<sup>-1</sup> in 1993, while the open-pollinated varieties yielded less than 10 t ha<sup>-1</sup>. This was due to the occurrence of less rainfall and tropical cyclones than the other years of trial. In the third year (1994), there was high rainfall due to the occurrence of nine tropical cyclones, four of which were typhoons. These adversely affected the performance of the test plants. Nevertheless, Line 7 X N still produced a yield of 21.92 t ha<sup>-1</sup>, Line 5 X N, 17.64 t ha<sup>-1</sup>, and Line 1 X N, 14.77 t ha<sup>-1</sup>. For the last two years, *i.e.*, 1995 and 1997, the highest yields were produced by Line 5 X N (26.20 and 21.55 t ha<sup>-1</sup>, respectively). Other hybrids that produced more than 20 t ha<sup>-1</sup> were Line 7 X N and Line 5 X N (24.31 t ha<sup>-1</sup>), Line 7 X N (21.41 t ha<sup>-1</sup>) and Line 1 X N (20.52 t ha<sup>-1</sup>).

**Morphological and yield characteristics of the best performing hybrids.** The best performing hybrids, *i.e.* Line 5 X N, Line 7 X N, and Line 1 X N, were already reported in research reviews and symposia and have been dubbed as MMSU Hybrid 1, MMSU Hybrid 2, and MMSU Hybrid 3, respectively. These hybrids mature in 60 to 65 days which suggest early maturity. The three hybrids have indeterminate growth habit, are moderately tolerant to insect pests and diseases, and are tolerant to typhoon. However, two of the hybrids (MMSU Hybrids 1 and 2) are moderately susceptible to fruit cracking. Hence, to maintain fruit quality and marketability, fruits should be harvested at green mature stage when rains are continuous in order to avoid fruit cracking (Table 6).

Table 2. Maturity of the different fresh market tomato F1 hybrids and open-pollinated tomato varieties during the 5-year evaluation trial (1992-1997 WS).

ENTRY	MATURITY (days after transplanting)					MEAN
	1992	1993	1994	1995	1997	
Line 1 X N	54 <sup>b</sup>	62 <sup>d</sup>	66 <sup>bc</sup>	58 <sup>d</sup>	66 <sup>a-d</sup>	61.20
Line 2 X N		76 <sup>abc</sup>	65 <sup>bc</sup>	-	67 <sup>a-c</sup>	69.33
Line 3 X N	53 <sup>b</sup>	68 <sup>bcd</sup>	69 <sup>bc</sup>	64 <sup>bc</sup>	72 <sup>cd</sup>	65.20
Line 4 X N	53 <sup>b</sup>	65 <sup>cd</sup>	64 <sup>bc</sup>	-	62 <sup>ab</sup>	61.00
Line 5 X N	53 <sup>b</sup>	64 <sup>cd</sup>	61 <sup>d</sup>	58 <sup>d</sup>	62 <sup>ab</sup>	59.60
Line 6 X N	53 <sup>b</sup>	71 <sup>a-d</sup>	-	-	76 <sup>cf</sup>	66.66
Line 7 X N	53 <sup>b</sup>	73 <sup>a-d</sup>	70 <sup>b</sup>	61 <sup>cd</sup>	66 <sup>a-d</sup>	64.60
Line 8 X N	54 <sup>b</sup>	62 <sup>d</sup>	-	-	-	58.00
Line 9 X N	54 <sup>b</sup>	64 <sup>cd</sup>	67 <sup>bc</sup>	-	65 <sup>abc</sup>	62.50
Line 10 X N	53 <sup>b</sup>	64 <sup>cd</sup>	-	-	-	59.00
Line 11 X N	-	64 <sup>cd</sup>	63 <sup>bcd</sup>	-	-	60.00
Line 12 X N	-	62 <sup>d</sup>	65 <sup>bc</sup>	-	-	63.50
Line 13 X N	-	80 <sup>a</sup>	68 <sup>bc</sup>	-	74 <sup>cf</sup>	74.00
Line 14 X N	-	64 <sup>cd</sup>	58 <sup>d</sup>	58 <sup>d</sup>	61 <sup>a</sup>	60.25
Line 15 X N	-	65 <sup>cd</sup>	63 <sup>bcd</sup>	-	67 <sup>a-c</sup>	65.00
Line 16 X N	-	67 <sup>bcd</sup>	67 <sup>bc</sup>	-	76 <sup>def</sup>	69.33
Line 17 X N	-	69 <sup>a-d</sup>	78 <sup>ab</sup>	-	74 <sup>e-f</sup>	73.00
Line 18 X N	-	74 <sup>a-d</sup>	72 <sup>b</sup>	-	71 <sup>b-c</sup>	70.66
Line 19 X N	-	-	63 <sup>bcd</sup>	-	69 <sup>a-e</sup>	68.66
Line 20 X N	-	-	73 <sup>b</sup>	-	-	73.00
Line 21 X N	-	81 <sup>a</sup>	72 <sup>b</sup>	-	-	72.00
Native (B)	64 <sup>b</sup>	70 <sup>a-d</sup>	87 <sup>a</sup>	90 <sup>a</sup>	90 <sup>a</sup>	82.40
Maigaya	62 <sup>a</sup>	73 <sup>a-d</sup>	61 <sup>d</sup>	-	-	64.33
Marikit	60 <sup>a</sup>	79 <sup>ab</sup>	-	-	-	66.50
Improved Harbot	-	70 <sup>a-d</sup>	-	-	-	79.00
Native (Magnuang)	-	-	71 <sup>b</sup>	-	-	70.50
Ilocandia 4	-	-	65 <sup>bc</sup>	65 <sup>b</sup>	-	65.00
NFC Hybrid 1	-	-	62 <sup>bcd</sup>	62 <sup>bcd</sup>	-	62.00
NFC Hybrid 2	-	-	59 <sup>d</sup>	59 <sup>d</sup>	-	59.00

Means in a column marked with a common letter do not differ significantly at 0.01 level using DMRT.  
 - not included in the trial

Table 3. Average fruit size based on weight of the different fresh market tomato F1 hybrids and open pollinated tomato varieties (1992-1997 WS).

ENTRY	FRUIT SIZE (g)					MEAN
	1992	1993	1994	1995	1997	
Line 1 X N	25 <sup>a-d</sup>	25.00 <sup>def</sup>	21.27 <sup>bc</sup>	31 <sup>bc</sup>	23.53 <sup>c-f</sup>	25.5
Line 2 X N	-	23.33 <sup>efg</sup>	23.45 <sup>bc</sup>	-	22.55 <sup>b-f</sup>	23.11
Line 3 X N	30 <sup>a</sup>	22.33 <sup>efg</sup>	26.26 <sup>b</sup>	25 <sup>c</sup>	28.54 <sup>gh</sup>	26.43
Line 4 X N	25 <sup>a-d</sup>	23.00 <sup>efg</sup>	22.84 <sup>bc</sup>	-	20.07 <sup>bcd</sup>	22.73
Line 5 X N	27 <sup>a-d</sup>	22.67 <sup>efg</sup>	22.43 <sup>bc</sup>	28 <sup>bc</sup>	19.65 <sup>bc</sup>	23.95
Line 6 X N	30 <sup>a</sup>	30.33 <sup>c</sup>	-	-	24.43 <sup>d-g</sup>	27.81
Line 7 X N	28 <sup>abc</sup>	29.00 <sup>cd</sup>	25.03 <sup>b</sup>	33 <sup>b</sup>	23.55 <sup>b-e</sup>	27.98
Line 8 X N	25 <sup>a-d</sup>	25.00 <sup>def</sup>	-	-	-	27.00
Line 9 X N	26 <sup>a-d</sup>	21.33 <sup>fg</sup>	20.63 <sup>bc</sup>	-	20.88 <sup>b-e</sup>	23.13
Line 10 X N	21 <sup>de</sup>	23.00 <sup>efg</sup>	-	-	-	21.33
Line 11 X N	23 <sup>cd</sup>	22.67 <sup>efg</sup>	22.00 <sup>bc</sup>	-	20.54 <sup>b-e</sup>	22.13
Line 12 X N	-	38.00 <sup>b</sup>	21.28 <sup>ab</sup>	-	21.56 <sup>b-e</sup>	21.84
Line 13 X N	-	19.67 <sup>gh</sup>	33.52 <sup>ab</sup>	-	32.63 <sup>hi</sup>	34.72
Line 14 X N	-	21.00 <sup>fg</sup>	19.25 <sup>c</sup>	26 <sup>bc</sup>	19.33 <sup>bc</sup>	21.06
Line 15 X N	-	25.67 <sup>def</sup>	19.71 <sup>c</sup>	-	18.88 <sup>b</sup>	19.86
Line 16 X N	-	43.33 <sup>a</sup>	23.05 <sup>b</sup>	-	32.64 <sup>ih</sup>	27.12
Line 17 X N	-	23.00 <sup>efg</sup>	41.48 <sup>a</sup>	-	39.30 <sup>j</sup>	42.27
Line 18 X N	-	26.67 <sup>cde</sup>	24.13 <sup>b</sup>	-	24.84 <sup>efg</sup>	23.99
Line 19 X N	-	-	22.22 <sup>bc</sup>	-	26.23 <sup>fg</sup>	25.04
Line 20 X N	-	-	7.16 <sup>b</sup>	-	-	7.16
Line 21 X N	-	-	13.91 <sup>cd</sup>	-	-	13.19
Native (B)	25 <sup>a-d</sup>	37.67 <sup>b</sup>	27.41 <sup>b</sup>	49 <sup>d</sup>	32.82 <sup>l</sup>	34.38
Maigaya	17 <sup>e</sup>	16.00 <sup>hi</sup>	14.00 <sup>cd</sup>	-	13.42 <sup>a</sup>	15.10
Marikit	24 <sup>bcd</sup>	24.67 <sup>def</sup>	-	-	-	12.12
Improved Harbot	-	13.00 <sup>l</sup>	-	-	-	13.00
Native (Magnuang)	-	8.33 <sup>j</sup>	9.83 <sup>d</sup>	-	-	9.08
Ilocandia 4	-	-	16.00 <sup>cd</sup>	-	-	16.00
NFC Hybrid 1	-	-	22.03 <sup>bc</sup>	28 <sup>bc</sup>	-	24.01
NFC Hybrid 2	-	-	17.08 <sup>c</sup>	25 <sup>bc</sup>	-	21.04

Means in a column marked with a common letter do not differ significantly at 0.01 level using DMRT.  
 - not included in the trial

Table 4. Average fruit yield per plant of the different fresh market F1 tomato hybrids and open-pollinated tomato varieties (1992-1997 WS).

ENTRY	FRUIT YIELD (kg plant <sup>-1</sup> )					MEAN	
	1992	1993	1994	1995	1997		
Line 1 X N	0.30 <sup>bcd</sup>	0.80 <sup>ab</sup>	0.72 <sup>ab</sup>		0.85 <sup>b</sup>	0.85 <sup>g</sup>	0.70
Line 2 X N	-	0.56 <sup>bc</sup>	0.70 <sup>ab</sup>		-	0.84 <sup>fg</sup>	0.70
Line 3 X N	0.41 <sup>ab</sup>	0.54 <sup>bc</sup>	0.47 <sup>cd</sup>		0.43 <sup>cd</sup>	0.58 <sup>cde</sup>	0.49
Line 4 X N	0.26 <sup>dc</sup>	0.52 <sup>bc</sup>	0.39 <sup>cd</sup>		-	0.66 <sup>d-g</sup>	0.46
Line 5 X N	0.48 <sup>a</sup>	0.95 <sup>a</sup>	0.95 <sup>a</sup>		1.08 <sup>a</sup>	0.86 <sup>g</sup>	0.86
Line 6 X N	0.18 <sup>de</sup>	0.42 <sup>bc</sup>	-		-	0.47 <sup>b-c</sup>	0.36
Line 7 X N	0.42 <sup>a</sup>	0.90 <sup>a</sup>	0.79 <sup>ab</sup>		0.84 <sup>b</sup>	0.85 <sup>g</sup>	0.76
Line 8 X N	0.14 <sup>ef</sup>	0.40 <sup>cd</sup>	-		-	-	0.27
Line 9 X N	0.26 <sup>dc</sup>	0.54 <sup>bc</sup>	0.40 <sup>cd</sup>		-	0.70 <sup>d-g</sup>	0.48
Line 10 X N	0.20 <sup>dc</sup>	0.35 <sup>cd</sup>	-		-	-	0.28
Line 11 X N	0.39 <sup>abc</sup>	0.46 <sup>bc</sup>	0.42 <sup>cd</sup>		-	0.72 <sup>efg</sup>	0.50
Line 12 X N	-	0.56 <sup>bc</sup>	0.62 <sup>ab</sup>		-	0.85 <sup>g</sup>	0.67
Line 13 X N	-	0.52 <sup>bc</sup>	0.50 <sup>bc</sup>		-	0.57 <sup>cde</sup>	0.53
Line 14 X N	-	0.60 <sup>bc</sup>	0.61 <sup>ab</sup>		0.86 <sup>b</sup>	0.66 <sup>d-g</sup>	0.68
Line 15 X N	-	0.50 <sup>bc</sup>	0.52 <sup>bc</sup>		-	0.58 <sup>cde</sup>	0.53
Line 16 X N	-	0.35 <sup>cd</sup>	0.30 <sup>de</sup>		-	0.34 <sup>abc</sup>	0.45
Line 17 X N	-	0.37 <sup>cd</sup>	0.34 <sup>de</sup>		-	0.32 <sup>ab</sup>	0.34
Line 18 X N	-	0.48 <sup>bc</sup>	0.46 <sup>cd</sup>		-	0.44 <sup>bcd</sup>	0.61
Line 19 X N	-	0.62 <sup>bc</sup>	0.61 <sup>ab</sup>		-	0.60 <sup>def</sup>	0.12
Line 20 X N	-	-	0.12 <sup>g</sup>		-	-	0.15
Line 21 X N	-	-	0.15 <sup>g</sup>		-	-	0.47
Native (B)	0.02 <sup>g</sup>	0.10 <sup>f</sup>	0.13 <sup>g</sup>		0.05 <sup>e</sup>	0.17 <sup>a</sup>	0.09
Maigaya	0.14 <sup>ef</sup>	0.22 <sup>dc</sup>	0.18 <sup>ef</sup>		-	0.29 <sup>ab</sup>	0.26
Marikit	0.04 <sup>fg</sup>	0.14 <sup>f</sup>	-		-	-	0.14
Improved Harbot	-	0.26 <sup>dc</sup>	-		-	-	0.26
Native (Magnuang)	-	0.13 <sup>f</sup>	0.15 <sup>g</sup>		-	-	0.14
Ilocandia 4	-	0.20 <sup>dc</sup>	0.23 <sup>ef</sup>		-	-	0.21
NFC Hybrid 1	-	0.35 <sup>cd</sup>	0.32 <sup>b</sup>		0.30 <sup>d</sup>	-	0.32
NFC Hybrid 2	-	0.30 <sup>cd</sup>	0.30 <sup>b</sup>		0.32 <sup>d</sup>	-	0.31

Means in a column marked with a common letter do not differ significantly at 0.01 level using DMRT.  
 - not included in the trial

Table 5. Yield performance of the different fresh market tomato F1 hybrids and open-pollinated tomato varieties (1992-1997 WS).

ENTRY	YIELD (t ha <sup>-1</sup> )					MEAN
	1992	1993	1994	1995	1997	
Line 1 X N	20.72 <sup>ab</sup>	29.56 <sup>ab</sup>	14.77 <sup>ab</sup>	22.22 <sup>b</sup>	21.20 <sup>fg</sup>	23.19
Line 2 X N	-	15.47 <sup>def</sup>	14.25 <sup>cde</sup>	-	20.85 <sup>fg</sup>	16.86
Line 3 X N	27.29 <sup>bc</sup>	19.8 <sup>bcd</sup>	14.52 <sup>cde</sup>	14.1 <sup>c</sup>	14.53 <sup>cde</sup>	18.05
Line 4 X N	14.81 <sup>bc</sup>	32.59 <sup>a</sup>	17.03 <sup>abc</sup>	-	16.56 <sup>d-g</sup>	21.31
Line 5 X N	21.74 <sup>ab</sup>	32.82 <sup>a</sup>	17.64 <sup>abc</sup>	26.20 <sup>a</sup>	21.55 <sup>g</sup>	25.86
Line 6 X N	18.53 <sup>bc</sup>	13.13 <sup>def</sup>	-	-	11.75 <sup>b-c</sup>	15.27
Line 7 X N	22.87 <sup>ab</sup>	24.87 <sup>bc</sup>	21.92 <sup>ab</sup>	20.24 <sup>b</sup>	21.32 <sup>g</sup>	24.23
Line 8 X N	15.97 <sup>bc</sup>	20.86 <sup>bc</sup>	-	-	-	19.74
Line 9 X N	15.08 <sup>bc</sup>	16.19 <sup>def</sup>	12.34 <sup>cde</sup>	-	17.46 <sup>efg</sup>	14.90
Line 10 X N	14.02 <sup>bc</sup>	22.76 <sup>bc</sup>	-	-	-	19.60
Line 11 X N	14.06 <sup>bc</sup>	23.69 <sup>bc</sup>	24.78 <sup>a</sup>	-	8.01 <sup>efg</sup>	20.14
Line 12 X N	-	23.48 <sup>bc</sup>	20.67 <sup>ab</sup>	-	21.22 <sup>fg</sup>	21.79
Line 13 X N	-	28.27 <sup>ab</sup>	20.22 <sup>ab</sup>	-	14.26 <sup>cde</sup>	20.92
Line 14 X N	-	27.67 <sup>ab</sup>	23.72 <sup>a</sup>	21.49 <sup>b</sup>	16.32 <sup>d-g</sup>	22.30
Line 15 X N	-	24.89 <sup>bc</sup>	19.29 <sup>abc</sup>	-	14.38 <sup>cde</sup>	19.52
Line 16 X N	-	23.46 <sup>bc</sup>	11.59 <sup>de</sup>	-	8.38 <sup>abc</sup>	14.48
Line 17 X N	-	16.88 <sup>def</sup>	16.98 <sup>abc</sup>	-	8.09 <sup>ab</sup>	13.98
Line 18 X N	-	20.70 <sup>bc</sup>	12.04 <sup>de</sup>	-	11.04 <sup>bcd</sup>	14.59
Line 19 X N	-	18.08 <sup>bcd</sup>	17.06 <sup>abc</sup>	-	14.91 <sup>def</sup>	16.68
Line 20 X N	-	-	8.65 <sup>ef</sup>	-	-	8.65
Line 21 X N	-	-	16.82 <sup>abc</sup>	-	-	16.82
Native (B)	3.70 <sup>d</sup>	3.53 <sup>g</sup>	8.17 <sup>ef</sup>	0.98 <sup>d</sup>	4.11 <sup>a</sup>	4.10
Maigaya	2.80 <sup>d</sup>	8.36 <sup>fg</sup>	12.11 <sup>de</sup>	8.00 <sup>c</sup>	7.24 <sup>ab</sup>	7.70
Marikit	0.98 <sup>c</sup>	6.80 <sup>fg</sup>	-	-	-	3.89
Improved Harbot	-	5.64 <sup>g</sup>	-	-	-	5.64
Native (Maguang)	-	10.23 <sup>fg</sup>	10.65 <sup>de</sup>	-	-	10.44
Ilocandia 4	-	-	5.73 <sup>g</sup>	-	-	5.73
NFC Hybrid 1	-	-	9.00 <sup>ef</sup>	7.42 <sup>d</sup>	-	8.21
NFC Hybrid 2	-	-	10.65 <sup>de</sup>	7.99 <sup>d</sup>	-	9.32

Means in a column marked with a common letter do not differ significantly at the 0.01 level using DMRT.

- not included in the trial

The fruits weighed 23 to 28 g each. Fruit weight per plant ranged from 700 to 860 g which resulted in high mean yield of 25.86, 24.23, and 23.19 t ha<sup>-1</sup>, respectively. Consumers prefer these hybrids because of their juicy sour taste and round, deep oblate shape.

### Seed Production Economics

The estimated economics of producing F<sub>1</sub> seeds of MMSU Hybrid 1, MMSU Hybrid 2, and MMSU Hybrid 3 in 1000 m<sup>2</sup> area is shown in Table 7. The variable costs (labor and material) amounted to P66,615 ha<sup>-1</sup> while the fixed and depreciation costs totaled to P11,200 ha<sup>-1</sup> and P1,120 ha<sup>-1</sup>, respectively. Thus, the total production costs was P78,935.

The average seed yield for the two trials was 26,410 g, at a selling price of P5 g<sup>-1</sup> seeds, a net income of P65,435 and a net farm income of P53,115 ha<sup>-1</sup>. This is equivalent to a BCR of P1.98.

### Fruit Production Economics

Table 8 and Table 8a show the economics of producing fresh market tomato during the off-season using hybrids and open-pollinated varieties. The total cost of production was P 54,225 and P 53,655 ha<sup>-1</sup> for the hybrids and open-pollinated varieties, respectively. The cost incurred in producing the former was higher because the hybrid seeds cost higher than the seeds of the latter.

At a price of P15 kg<sup>-1</sup> of fruits, the gross income derived from MMSU Hybrid 1, MMSU Hybrid 2, and MMSU Hybrid 3 were P387,900, P363,450, and P347,850 ha<sup>-1</sup>, respectively (Table 8a). The gross income from the two open-pollinated varieties (Native and Maigaya) were P61,500 and P114,450 ha<sup>-1</sup>, respectively. If the price is P20 kg<sup>-1</sup>, the gross income obtained from the three hybrids were P517,200, P484,600, and P463,800 ha<sup>-1</sup> which were much higher than those from the open-pollinated varieties at P82,000 and P152,600 ha<sup>-1</sup>, respectively.

Table 6. Characteristics of the three best performing fresh market tomato F1 hybrids.

ATTRIBUTE	MMSU Hybrid 1	MMSU Hybrid 2	MMSU Hybrid 3
a. Fruits			
Fruit size (wt. per fruit, g)	23	28	25 g
Fruit yield			
Per plant, g	880	740 g	750 g
Per hectare, t	25.86	24.23	23.19
Fruit shape	Round	Deep oblate	Round
Fruit taste/flavor	Juicy/Sour	Juicy/Sour	Juicy/Sour
Acceptability	Highly Acceptable	Highly Acceptable	Highly Acceptable
b. Growth			
Maturity, day	62	67 days	63 days
Growth habit	Viny/indeterminate	Viny/indeterminate	Viny/indeterminate
Insect/disease reaction	Moderate	Moderate	Moderate
Fruit cracking	Moderately Susceptible	Moderately Susceptible	Moderately resistant
Typhoon impact	Tolerant	Tolerant	Tolerant

Table 7. Production economics of a 1000 m<sup>2</sup> seed production area of the three MMSU fresh market tomato F1 hybrids, DS 1998-1999.

PARTICULAR	COST (₱)
<b>I. VARIABLE COST</b>	
A. Labor Cost	
1. Land preparation	
a. First plowing @ P0.20 m <sup>2</sup>	200
b. Second plowing @ P0.20 m <sup>2</sup>	200
2. Seedbed preparation, 1 MD <sup>1</sup>	200
3. Care and maintenance of the seedlings, 2 MD	400
4. Transplanting 1MD	200
5. Irrigation, 6MD	1200
6. Fertilizer application, 2MD	400
7. Hilling-up, 2MD	400
8. Trellising, 4MD	800
9. Emasculation, 120MD	24000
10. Pollination, 120MD	24000
11. Weeding, 6MD	1200
12. Spraying, 4 MD	800
13. Harvesting, 8M	1600
14. Seed extraction, 8MD	1600
15. Seed cleaning and drying, 4 MD	800
16. Seed packing and storage, 6MD	1200
17. Establishment and maintenance of male parents	1300
<i>Subtotal</i>	<i>60500</i>
B. Material Cost	
1. Seeds	60
2. Pesticides	1000
3. fertilizer	1000
4. Trellis	1000
5. Net bags	1000
6. Plastic bags	270
7. Ethanol/alcohol	30
8. Gasoline/oil	1000
9. Farm inputs for the maintenance of the male parents	755
<i>Subtotal</i>	<i>6115</i>
Total Variable Costs	66615
<b>II. FIXED COST</b>	
1. Pointed forcep/receptable	600
2. Pollen collector	500
3. Plastic sealer	1000
4. Water pump	8000
5. Sprayer	111000
Total Fixed Cost	11200
III. DEPRECIATION COST (%)	1120
IV. TOTAL PRODUCTION COST (TPC)	78935
V. GROSS INCOME	132050
VI. NET CASH INCOME (GI-TVC)	65435
VII. NET FARM INCOME (GI-TPC)	53115

MD-Mandays

<sup>1</sup>P200/day

Table 8. Production cost (₱ ha<sup>-1</sup>) of MMSU F1 hybrids and open-pollinated varieties.

ITEM	MANDAYS <sup>1</sup>	TOTAL COST(₱)
<b>A. LABOR COST</b>		
1. Land preparation <sup>2</sup>		4000
2. Raised-bed preparation	15	3000
3. Seedling establishment	10	2000
4. Transplanting/Mulching	15	3000
5. Irrigation	10	2000
6. Trellising	20	4000
7. Fertilizer application	10	2000
8. Spraying	5	1000
9. Weeding	10	2000
10. Harvesting and storage	20	4000
<b>B. MATERIAL COST</b>		
1. Fertilizer		
a. Complete, 12 bags <sup>3</sup>		47540
b. Urea, 12 bags <sup>4</sup>		4500
c. Muriate of potash, 6 bags <sup>5</sup>		2280
d. Ammonium sulfate, 6 bags <sup>6</sup>		1440
2. Pesticide		
a. Lannate, 3L <sup>7</sup>		1125
b. Decis, 2 L <sup>8</sup>		2300
c. Dithane, 3 kg <sup>9</sup>		870
3. Trellis, 10,000pcs <sup>10</sup>		4000
4. Rice straw, 400 bundle <sup>11</sup>		2000
5. Oil and gasoline		1000
6. Harvesting and storagecontainers, 20pcs <sup>12</sup>		2000
7. Seed cost		
a. Hybrid, 200 g <sup>13</sup>		1000
b. Open-pollinated, 200g <sup>14</sup>		400
<b>C. TOTAL COST OF PRODUCTION</b>		
a. Hybrid		54255
b. Open-pollinated		53655

<sup>1</sup>P200.00 MD<sup>-1</sup>

<sup>8</sup>P1150.00 L<sup>-1</sup>

<sup>2</sup>P 0.20 M<sup>2</sup>

<sup>9</sup>P290.00 kg<sup>-1</sup>

<sup>3</sup>P 395.00 bag<sup>-1</sup>

<sup>10</sup>P0.40 pc<sup>-1</sup>

<sup>4</sup>P375.00 bag<sup>-1</sup>

<sup>11</sup>P5.00 bundle<sup>-1</sup>

<sup>5</sup>P380.00 bag<sup>-1</sup>

<sup>12</sup>P100.00 pc<sup>-1</sup>

<sup>6</sup>P240.00 bag<sup>-1</sup>

<sup>13</sup>P5.00 g<sup>-1</sup>

<sup>7</sup>P375.00 L<sup>-1</sup>

<sup>14</sup>P2.00 g<sup>-1</sup>

Table 8a. Comparative income of tomato production using different varieties.

PARAMETER	VARIETIES				
	MMSU Hybrid 1	MMSU Hybrid 2	MMSU Hybrid 3	Native	Maigaya
Yield, t ha <sup>-1</sup>	25.86	24.23	23.19	4.10	7.70
Gross Income (P)					
P15 kg <sup>-1</sup>	387,900	363,450	347,850	61,500	114,450
P20 kg <sup>-1</sup>	517,200	484,600	463,800	82,000	152,600
Total Cost (P)	54,255	54,255	54,255	53,655	53,655
Net Income (P)					
P15 kg <sup>-1</sup>	333,645	309,195	293,595	7,845	60,795
P20 kg <sup>-1</sup>	462,945	430,345	409,545	28,345	98,945
BCR					
P15 kg <sup>-1</sup>	7.15	6.70	6.41	1.15	2.13

## CONCLUSION

The three MMSU F<sub>1</sub> hybrids (Hybrid 1, 2, and 3) offer excellent opportunities for Ilocos farmers to venture into profitable tomato production during the off-season. In the five-year trials, these hybrids showed better performance than the native cultivar as well as the recommended open-pollinated varieties. This is particularly so during periods of high rainfall intensity and strong typhoons, which are typical in Ilocos Region.

The hybrids possess the qualities preferred by local consumers. The fruits are juicy and sour. These also possess the external features of the native cultivar and thus, marketing of the product is not a problem. Seeds of these hybrids could be produced easily. With the training, the farmers can already produce their own planting materials for the off-season production. The farmers may even venture into commercial seed production of the hybrid.

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