Cactus Pear and Nopalito Production in Mexico

Claudio A. Flores V.
Professor, Department of Agricultural Economics
Coordinator of the Prickly Pear Program of CIESTAAM
University of Chapingo, Mexico

1. INTRODUCTION

Prickly pear is an important crop in Mexico. There are three million hectares of wild prickly pear populations that are the source of forage, fruit, mainly "*cardon*" (*Opuntia streptacantha* Lemaire) and nopalito, mainly "*tapón*" (*Opuntia robusta* Wendl). Moreover, in the home gardens of the Central Mesa and the North, prickly pear is an important component, used to produce cactus pears, nópalito, and forage. In commercial plantations, prickly pear is grown in the following proportions: 150,000 ha for forage, 50,000 ha for fruit, and 10,000 ha for nopalito production.

2. NOPALITO PRODUCTION IN MEXICO

2.1. Supply

In Mexico, under the plantation system, 10,000 ha of prickly pear are cultivated for nopalito production (Table 1).

Table 1. State, area, average yield, and production of nopalito.

STATE	AREA CULTIVATED (HA)	YIELD (t/ha)	PRODUCTION (tons)
D.F.	7,750	60.0	465,000
Morelos	450	70.0	31,500
Puebla	400	40.0	16,000
Michoacán	320	35.0	11,200
Guanajuato	280	35.0	9,800
B. California	150	60.0	9,000
Jalisco	120	60.0	7,200
Oaxaca	100	60.0	6,000
México	90	25.0	2,250
Hidalgo	85	40.0	3,400
Zacatecas	65	30.0	1,950
Aguascalientes	55	30.0	1,650
Tlaxcala	45	25.0	1,125
Querétaro	35	20.0	700
San Luis Potosí	20	20.0	400
Durango	15	20.0	300
Sonora	10	80.0	800
Others	10	10.0	100
TOTAL	10,000	---	568,375

Sourse: Flores V. and Olvera M., 1995.

The concentration of the area in a single state (Federal District with more than 77% of the total) and in a single area of the Federal District (the Milpa Alta delegation) is the reason that what happens in this area has repercussions in the behavior of the market in the rest of the country. Here, nopalitos are produced at more than 2400 m above sea level, in volcanic soils with protuberances of lava. Production is rainfed (756 mm mean annual precipitation), with six months of sufficient moisture from May to October and six months of dry season, November to April. The mean annual temperature is 15.9 °C with eight months of mild temperatures from March to October, and four months of cold temperatures, from November to February. The lack of irrigation and low rainfall and the cold temperatures in the months of November, December, January, and February result in a decrease in production and a rise in the prices of nopalito in all of the markets of the country (Table 2).

However, the high winter prices have not been as high as they were several years ago. In the last 10 years, nopalito production has expanded to other states where it is produced under more sophisticated systems of production.

The first to enter production was the State of Morelos, in the areas free of frosts. In other states, such as Puebla, Michoacán, Guanajuato, Jalisco, Oaxaca, Zacatecas, and Aguascalientes, besides producing in frost-free areas, they use irrigation, while in others states such as the state of Mexico, Hidalgo, San Luis Potosí, Sonora, and Baja California, nopalito is produced with irrigation and in plastic tunnels to prevent frost damage.

Table 2. Average monthly prices of nopalitos in several wholesale markets, 1993. (US dollar/kg)

MONTH	D.F.*	ECATEPEC, EDO. DE MEX.	GUADALAJARA, JALISCO	MONTERREY, N.L.	LEON, GUANAJUATO**	PUEBLA, PUEBLA *	TOLUCA, EDO. DE MEX.*	VILLAHERMOSA, TAB.	XALAPA, VERACRUZ*	AGUASCALIENTES, AGS-	TORREON, COAHUILA	CAMPECHE, CAMPECHE*	CUAUTLA, MORELOS*
JAN	0.36	0.32	0.41	0.68	0.95	0.86	0.50	0.57	0.74	0.47	0.90	0.88	0.48
FEB	0.22	0.23	0.29	0.52	1.14	0.41	0.27	0.55	0.37	0.30	0.40	0.75	0.74
MAR	0.25	0.27	0.29	0.40	0.79	0.36	0.34	0.52	0.38	0.34	0.60	0.90	0.31
APR	0.21	0.19	0.20	0.35	0.68	0.24	0.26	0.47	0.28	0.23	0.67	0.80	0.29
MAY	0.23	0.25	0.17	0.36	0.66	0.22	0.29	0.42	0.31	0.23	0.90	0.81	0.50
JUN	0.28	0.32	0.17	0.36	0.83	0.22	0.35	0.44	0.31	0.27	0.83	0.83	0.33
JUL	0.43	0.43	0.17	0.39	0.83	0.33	0.46	0.48	0.41	0.33	1.00	0.73	0.17
AUG	0.24	0.20	0.21	0.38	0.63	0.36	0.40	0.46	0.35	0.33	1.00	0.83	0.20
SEP	0.19	0.20	0.20	0.34	0.64	0.27	0.33	0.40	0.33	0.33	0.97	0.83	0.40
OCT	0.53	0.52	0.32	0.35	0.87	0.50	0.56	0.46	0.56	0.32	0.73	0.83	0.67
NOV	0.71	0.72	0.41	0.72	1.05	0.73	0.95	0.61	0.61	0.63	0.44	0.83	0.83
DIC	0.41	0.40	0.43	0.41	1.24	0.65	0.59	0.62	0.61	0.46	0.85	0.83	0.58
ANNUAL AVERAGE	0.34	0.34	0.27	0.44	0.86	0.43	0.44	0.50	0.44	0.35	0.78	0.83	0.46

* Sales per hundred (calculated as 100 pieces = 10 kg)

** Nopalitos cleaned of thorns.

Source: S.N.I.M. 1994

Several varieties are used to produce nopalito; however, there are 14 varieties (Table 3) that are of certain importance, by area and sales on the market. Of these, one is wild, two are from the genus *Nopalea*, and the rest are from the genus *Opuntia*, among which is the variety Milpa Alta (*O. ficus-indica* L.) which covers 85% of the total area cultivated in nopalito and makes up 88% of all the nopalito marketed in Mexico.

Table 3. Principal varieties cultivated of nopalito.

VARIETY	PRODUCTION ZONE
Milpa Alta	Distrito Federal, Morelos
Atlixco	Puebla, Edo. de México
Copena V1	Edo. de México, Baja California, San Luis Potosí, Sonora, Hidalgo
Copena F1	Edo. de México, Sonora, Baja California
Moradilla	Edo. de México
Blanco	Michoacán
Negro	Michoacán, Guanajuato
Blanco con espinas	Guanajuato
Polotitlán	Edo. de México
Villanueva	Zacatecas
Jalpa	Zacatecas
Oaxaca	Oaxaca
Tamazunchale	San Luis Potosí
Tapón*	San Luis Potosí, Zacatecas

*Wild prickly pear, planted as live fence in home gardens and agricultural plots and collected in wild populations.
Sourse: Flores V. and Olvera M. 1995.

Regarding the supply of nopalito outside of Mexico, it is only in the United States that nopalito is produced. We estimate the area cultivated at less than 100 ha, located in the states of Texas and California. In both states, the varieties we have identified belong to the genus

Nopalea, and the production is destined to the markets where consumers of Mexican origin buy.

The authors are also interested in promoting the consumption of nopalitos in other countries, such as South Africa, Chile, Argentina, Bolivia, Algeria, etc.

2.2. Demand

Nopalito is a vegetable widely used in Mexican cooking; thus, its use is somewhat restricted to Mexicans and groups of Mexican origin residing abroad. It is also consumed by people of other origins who have been in Mexico and have tasted and liked nopalitos, although we believe that these cases are not very numerous.

In Mexico, nopalito is the fifth most important vegetable in volume of production, following tomatoes, potatoes, chillis, and onions. However, in area cultivated, nopalitos are in twelfth place among vegetables produced.

Geographically, the demand in Mexico is not homogeneous. Most of the demand is concentrated in the central part of the country. There is less demand in the northern states, although it is increasing, while there is almost no demand in the states on the coasts.

The demand is constant throughout the year, with short seasons in which it rises during Lent and Christmas. It has been observed that the demand grows year by year. This is due to two factors. Because of the recession, the people have reduced their consumption of meat products and other expensive foods and eat more vegetables; among these are nopalitos which are cheap. The second motive is health. Consumers have found out that nopalitos are beneficial for weight reduction and reducing sugar and cholesterol levels in the blood.

The greatest demand for nopalitos outside of Mexico is in the United States in the areas where large populations of Mexican origin are concentrated: the Los Angeles-San Diego area of California, the triangle formed by Houston, Dallas, and San Antonio, and, finally, the city

of Chicago, in the state of Illinois.

2.3. Prices

Besides the variations in prices during the year, nopalito prices have also had major fluctuations from year to year, as can be seen in Tables 4 and 5, which show nominal and real prices for the Central Wholesale Market in the Federal District.

Table 4. Average nominal monthly prices of nopalito at the Central Wholesale Market of the Federal District. (US dollars/kg).

MONTH	1988	1989	1990	1991	1992	1993	1994
JANUARY	0.24	0.24	0.71	0.56	0.45	0.6	0.55
FEBRUARY	0.38	0.25	0.31	0.26	0.50	0.22	0.53
MARCH	0.30	0.28	0.12	0.17	0.27	0.25	0.20
APRIL	0.06	0.19	0.16	0.16	0.21	0.21	0.25
MAY	0.16	0.13	0.12	0.26	0.42	0.23	
JUNE	0.11	0.14	0.12	0.23	0.31	0.28	
JULY	0.11	0.18	0.22	0.25	0.16	0.43	
AUGUST	0.16	0.32	0.49	0.27	0.20	0.24	
SEPTEMBER	0.28	0.13	0.35	0.20	0.55	0.19	
OCTOBER	0.45	0.37	0.35	0.49	0.82	0.53	
NOVEMBER	0.29	0.55	0.62	0.80	1.00	0.71	
DECEMBER	0.39	0.41	0.71	0.65	0.84	0.41	
YEARLY AVERAGE	0.24	0.25	0.36	0.36	0.48	0.34	

Source: Constructed with data from S.N.I.M. (several years).

Table 5. Real average monthly prices of nopalito at the Central Wholesale Market of the Federal District. (US dollars/kg).

MONTH	1988	1989	1990	1991	1992	1993	1994
JANUARY	4.07	1.98	0.23	1.25	0.82	0.51	0.66
FEBRUARY	6.18	1.94	0.86	0.57	0.89	0.31	0.63
MARCH	4.73	2.06	0.33	0.38	0.47	0.34	0.24
APRIL	0.87	1.25	0.42	0.36	0.36	0.28	0.29
MAY	2.20	0.79	0.30	0.55	0.71	0.31	
JUNE	1.41	0.81	0.29	0.48	0.52	0.38	
JULY	1.40	0.97	0.53	0.52	0.27	0.58	
AUGUST	1.91	0.82	1.17	0.56	0.32	0.31	
SEPTEMBER	3.07	0.60	0.84	0.40	0.87	0.24	
OCTOBER	4.62	1.60	0.83	0.98	1.27	0.69	
NOVEMBER	2.86	2.19	1.45	1.57	1.52	0.90	
DECEMBER	3.49	1.43	1.63	1.24	1.23	0.51	
YEARLY AVERAGE	3.07	1.37	0.90	0.74	0.77	0.45	

Source: Constructed with data from S.N.I.M. (several years).

An analysis of Tables 4 and 5 reveals that real prices have fallen drastically: growers in 1994 were receiving only 15% of what they obtained five years before for their nopalitos.

2.4. Alternatives

In this situation of harder competition and falling prices, the nopalito grower has some alternatives:

Production: The grower can increase productivity, producing more and lowering costs.

Marketing: The grower can look for places in the market, and very important, he can organize and carry out publicity campaigns to raise the demand.

Industrialization: We find that this is a very competitive area. In the CIESTAAM Prickly Pear Program collection, we have nopalitos processed at 32 food plants, 20 plants that produce medicine, and 8 cosmetic companies. We believe that in this area the problem is not the processing, but the selling of the products.

2.5. Exportation

Exporting is an alternative that is always in the mind of the Mexican grower. However, compared with the total production (568,375 t), the volumes of exports are minimal. The most recent reliable data from Green and Plummer (1992) report that during the fiscal year September 30, 1991 to October 1, 1992, Mexico exported 1,527 t to the US. We estimate that around 3,500 t of processed nopalitos, in brine or pickled, in jars or cans, are exported every year.

Exporting fresh nopalitos has some problems. If the cactus pads are thorny, the consumer has to clean them, a task even Mexican housewives don't do since they generally buy their nopalitos freshly cleaned in markets and stores. If the nopalitos are shipped cleaned of thorns then they tend to oxidize and have a short shelf life. We have found companies in Tijuana, Baja California, and Reinosa, Tamaulipas, which dethorn and dice nopalitos and seal them in plastic bags, shipping them in refrigerated trucks to markets in the United States.

Nopalitos processed in brine or vinegar and packed in glass jars are exported in larger volumes. However, the 34 companies that process nopalitos in Mexico export only to American markets.

The import duty in the U.S. on fresh nopalito in 1992 and 1993 was 25%, but with the signing of the North American Free Trade Agreement (NAFTA), on January 1, 1994, the tax was reduced to zero. In Canada the import tax was zero and continues to be so. For processed nopalitos, the U.S. duty was set at 17.5% and, with NAFTA, the vegetable passed into a deregulation code C, under which duty will reach 0 in ten years. In Canada, processed nopalitos had an import duty of 6.2% and entered into a code B, under which in five years the duty will

be eliminated completely (SECOFI, 1994).

3. CACTUS PEAR PRODUCTION IN MEXICO

3.1. Supply

In Mexico, under the system of commercial plantation, almost 50,000 ha of prickly pear are cultivated for cactus pear production (Table 6).

Table 6 shows the surface area cultivated, average yields, and production by state and producer zones in Mexico.

Regarding surface area, the seven states with the largest areas, Zacatecas, Mexico, Hidalgo, San Luis Potosí, Guanajuato, Puebla, and Jalisco, total 44,567 ha, representing almost 90% of the country's producing area. In yields, the cactus pear producer states with the best yields are Puebla, Mexico, Hidalgo, Oaxaca, Jalisco, Tlaxcala, Zacatecas, and San Luis Potosí. The states which produce the largest total volumes are the state of Mexico, Puebla, Zacatecas, Hidalgo, San Luis Potosí, and Jalisco. Together, these six states produce 309,047 t, or 94% of the total national production.

For an analysis of the main characteristics of cactus pear production in Mexico, we will divide the Central Zone into two (Puebla and the state of Mexico/Hidalgo), and we will compare them with the North Central region (Table 7).

Table 7 shows the characteristics of the three regions we are considering. It should be pointed out that in this table average production is being characterized, in which all kinds of producers participate, bad, average, and excellent producers. Because variation in types of producers is greater within each region than among the regions, emphasis is made on the main differences among the regions.

Table 6. Surface area cultivated, average yield, and production by state in the cactus pear producer zones of the Mexican Republic in 1993.

ZONE/STATE	SURFACE AREA CULTIVATED (ha)	YIELD (t/ha)	PRODUCTION (tons)
SOUTH-CENTRAL			
Estado de México	8,622	10.00	86,220
Hidalgo	7,000	7.50	52,500
Puebla	3,000	25.00	75,000
Tlaxcala	130	5.00	650
Subtotal	18,750		214,370
NORTH-CENTRAL			
Zacatecas	13,901	5.00	69,505
San Luis Potosí	3,918	3.70	14,497
Guanajuato	3,059	1.25	3m824
Jalisco	2,008	5.64	11,325
Aguascalientes	1,888	1.25	2,360
Subtotal	24,774		101,511
OTHER STATES			
Durango	2,000	1.00	2,000
Querétaro	2,000	2.00	4,000
Coahuila	1,000	1.00	1,000
Oaxaca	620	7.00	4,340
Guerrero	300	1.00	300
Sinaloa	270	1.00	270
Veracruz	80	1.00	80
Baja California	60	1.00	60
Subtotal	6,330		12,050
TOTAL	49,854		327,931

Source: Flores and Gallegos, 1995.
(National average $\frac{327{,}931 \text{ t}}{49{,}854 \text{ ha}} = 6.578$ t/ha)

Climate. While precipitation is greatest in Puebla, followed by the state of Mexico and Hidalgo and lowest in the North-central region, the pattern of temperatures is the reverse: Puebla is frost-free, in the state of Mexico and Hidalgo it may frost between November and January, and in the North-central region the frost period is longer (October to March) and more intense. These climatic conditions, plus more intensive management practices, allow for higher yields in Puebla, followed by the state of Mexico and Hidalgo, and the lowest yields in the North-central region. The conditions also determine the early harvest in Puebla (April to August), a later one in the state of Mexico and Hidalgo (July to September), and the late harvest in the North-central region (August to October). Prices obtained in Puebla are therefore high, those of the state of Mexico and Hidalgo are in the middle range, and the North-central region obtains low prices.

In management and use of inputs, in general, it is high for the state of Mexico and Hidalgo, medium for Puebla, and low for the North-central region.

One important aspect is that in Puebla growers depend on a single white variety ("Villanueva"), although recently they have planted other varieties in order to prolong the harvest season. In the state of Mexico and Hidalgo, also, only one variety is harvested ("Alfajayucan"). In contrast, the North-central region has a large selection of white, red, yellow, and orange varieties (Table 8).

3.2. Demand

When compared with other fruits produced in Mexico, cactus pear is seventh (in 1992) in area cultivated (50,000 ha in plantations) and tenth in volume of production. In 1992, the per capita consumption of cactus pear was 3.72 kg, tenth place among Mexican fruits (Table 9). The per capita consumption was calculated by adding up imports and subtracting exports from the national production, then dividing the remainder by the population of 1992 (88,153,000 inhabitants).

Table 7. Characteristics of the three major producer regions of cactus pear in Mexico.

	REGION		
	Puebla	México-Hidalgo	North-central
System	Semi-Intensive	Intensive	Extensive
Soils Type	Cambisols	Feozem	Xerosol, Feozem, Planosol
Texture	Sandy to loam	Medium with hardpan	Medium to light clay
Depth pH	>50 cm Acid	20-100 cm Acid to slightly alkaline	20-80 cm Acid to slightly alkaline
Mean annual rainfall (mm	600-750	400-700	350-500
Temperature (°C)	13 - 15	14 - 18	16 -18
Period of frosts	None	Nov-Jan	Oct-Mar
Physiography	Hillsides flats	Flats hillsides	Flats hillsides
Variety	Villanueva	Alfajayucan	Burrona, Montesa, Cristalina, Pico Chulo, Roja pelona, Pepina
Harvest dates	Apr-Aug	Jul-Sep	Oct-Mar
Yield (t/ha)	15-25	10-15	3-15
Level of Management			
a) Soil b) Plant c) Plant density	High Medium High	Medium High High	Low Low Low
Use of; a) Inputs b) Org. matter c) Machinery	 Medium Medium Low	 High High Low	 Low Low High Others:
Others: Plantation size Land ownership	 >2 ha ejido, small holdings	 <5 ha small holdings, ejido	 3 - 200 ha small holdings, ejido

*Manure, fertilizers and pesticides
Source: Mondragón, 1992, with modifications by the author.

Table 8. Characteristics of the fruit of the cactus pear varieties found in the North-central region.

VARIETY	FRUIT SIZE (cm)		FRUIT WEIGHT (g)			DEGREES BRIX
	LENGTH	WIDTH	TOTAL	PEEL	%	
Burrona	10.1	6.4	213.0	90.6	42.5	12.5
Cristalina	11.5	6.3	207.0	92.0	44.4	14.8
Reina	8.1	5.7	138.1	59.8	43.3	15.0
Esmeralda	7.8	5.5	122.0	51.1	49.7	14.0
Papanton		1.39*	154.7	70.7	45.7	12.8
Pelón rojo	9.5	6.1	184.0	69.0	37.5	15.0
Ruby reyna	8.0	4.2	89.2	43.0	48.2	10.4
Mexicana R1		1.36*	186.6	73.6	39.4	12.7
Pico chulo	6.9	5.8	87.50	29.5	33.7	13.7
Amarilla montesa	7.8	4.6	143.0	59.8	44.6	13.0

*Quotient length/width.
Source: Flores and Gallegos, 1993.

In Mexico, the consumption of cactus pear is highest in the center, less in the northern states (although this tends to increase) and is insignificant on the coasts.

3.3. Prices

As a consequence of the areas and the harvest dates in each zone, prices tend to be high at the beginning of the season, April and May, drop in August and September, and later rise slightly (Table 10).

Table 9. Area, production, and per capita consumption of the most important fruits of Mexico.

FRUIT	Area		Production		Yearly Per capita consumption
	1,000 HA	%	1,000 T	%	
Oranges	218	23.72	2,541	24.77	26.50
Mango	121	13.17	1,076	10.49	12.31
Avocado	88	9.58	725	7.07	8.92
Lime	79	8.60	777	7.57	8.70
aBananas	74	8.05	2,095	20.42	23.14
Apples	60	6.53	598	5.83	8.27
Cactus pear	50	5.44	328	3.15	3.72
Grapes	43	4.68	522	5.09	6.46
Cantaloupe	43	4.68	496	4.83	4.32
watermelon	42	4.57	499	4.86	4.29
Peach	40	4.35	133	1.30	1.75
Pecans	37	4.03	44	.43	1.80
Tangerines	11	1.20	90	.88	1.11
Pineaple	7	.76	264	2.57	3.18
Strawberries	6	.65	77	.75	0.86
TOTALS	919	100.00	10,259	100.00	

Source: Gómez, Rindermann, and Barrera. 1994. Modifications by the author.

Table 10. Nominal average monthly prices of cactus pear in ten Mexican wholesale markets. 1993. US dollars/kg.

MONTH	CEDA D.F.	GUADA LAJARA	MONTE RREY	LEON	PUEBLA	ECATE PEC	VILLA HER MOSA	CUAU TLA	TOLUCA	MORE LIA
APR							0.89			
MAY				0.53			0.78			
JUN	0.78			0.65	0.41		0.75	0.49	0.60	
JUL	0.63	0.51	0.70	0.47	0.38	0.48	0.67	0.54	0.48	0.45
AUG	0.31	0.36	0.49	0.52	0.26	0.28	0.52	0.34	0.30	0.33
SEP	0.49	0.34	0.47	0.38	0.37	0.39	0.45	0.47	0.47	0.39
OCT	0.66	0.26	0.42	0.50	0.30		0.58	0.65	0.63	0.36
NOV			0.41				0.68			
DEC			0.56				0.71			

Source: S.N.I.M. 1994.

Prices have seemingly tended to rise over time (Table 11), but analyzing the deflated prices, prices have actually remained stagnant (Table 12).

Table 11. Average nominal monthly prices of cactus pear in the Central Wholesale Market of the Federal District in five years. US dollars/kg.

YEAR	JUN	JUL	AUG	SEPT	OCT	MEAN
1989			0.37	0.3	0.48	0.38
1990		0.36	0.25	0.32	0.46	0.35
1991		0.48	0.33	0.58		0.46
1992		0.6	0.33	0.4	0.77	0.52
1993	0.78	0.63	0.31	0.49	0.67	0.57

Source: S.N.I.M. Several years.

Table 12. Average real monthly prices of cactus pear in the Central Wholesale Market of the Federal District in five years (base April, 1994 = 100.00). US dollars/kg.

YEAR	JUN	JUL	AUG	SEP	OCT	MEAN
1989			0.75	0.61	0.95	0.77
1990		0.59	0.40	0.51	0.72	0.55
1991		0.64	0.44	0.76		0.61
1992		0.69	0.38	0.45	0.87	0.60
1993	0.83	0.66	0.33	0.51	0.69	0.60

Source: S.N.I.M. Several years.

3.4. Alternatives

Besides improving the quality of cactus pear in terms of size, fewer seeds, etc., an important area of research is forcing out of season production so as to be able to have a year round supply and reduce the concentration of production in a few months of the year, a factor that is pushing prices down.

Besides improving production, it is necessary to find efficient methods of dethorning and packing, and, above all, it is necessary for growers to organize in order to carry out publicity campaigns in Mexico and abroad to increase the demand for cactus pear.

4. CONCLUSIONS

Prickly pear is an important crop in Mexico.

The plantations of prickly pear for fruit production occupy an area of 50,00 ha and the plantations of nopalitos occupy 10,000 ha.

The production of nopalitos is the fifth most important among vegetables and that of cactus pear is tenth among fruits in Mexico.

The main problem that the growers of nopalitos face is the marketing of a supply that exceeds demand almost all year round, while the main problem facing the cactus pear producers is the marketing of a production that is concentrated in a three month period (July, August, and September). Thus, publicity campaigns which would broaden the demand is the principal task at hand.

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