

FLORENCE FENNEL — PRELIMINARY RESEARCH ON A POSSIBLE NEW CROP FOR THE WAIKATO

J.A. Douglas and J.M. Follett
Ruakura Soil and Plant Research Station
Hamilton

ABSTRACT

Five cultivars and two unnamed lines of Florence fennel (*Foeniculum vulgare* var. *dulce*) were compared in a trial sown in the Waikato with sowings in October, November and December 1983. Bolting was the major influence on bulb development in the first two sowings but it was considerably less in the December sowing. Fresh bulb yields of over 20 t/ha were achieved by the cultivars Zefa tardo and Domino and an unnamed Italian line. No uncontrollable pest or diseases were apparent and there seems few reasons why yields comparable to European crops should not be obtained with more experience. Florence fennel is a possible new export crop although further research is required to define individual market requirements.

Additional Key Words: finnochio, bulb fennel

INTRODUCTION

Fennel (*Foeniculum vulgare*) is regarded by most except herb lovers as a weed but there are several distinct varieties which are grown extensively overseas as vegetables. The two most important of these are carosella (*F. vulgare* var. *piperitum*) which is grown for its young stems and Florence fennel or finnochio (*F. vulgare* var. *dulce*) which is grown for the pseudo-bulb formed by the swollen base of the stalks. Florence fennel is a major vegetable crop in Mediterranean countries with Italy producing 301 000 t in 1980 and more recently it has become a sought after vegetable in Northern Europe. Dutch production has increased from 1 ha in 1978 to about 40 ha in 1980 (Anon, 1982; Bransden, 1984).

While we have used the name Florence fennel in this work there are a variety of names used around the world to describe the same product. Florence fennel is the accepted name in the United Kingdom and Finnochio in Italy but terms such as bulb fennel, sweet fennel, fennel, aniseed and anise are used more loosely.

Florence fennel is a biennial plant and prolonged exposure of immature plants to temperatures below 7°C is used in seed production (Lorenz and Maynard, 1980). However, the magnitude of cold temperature spells and their timing in relation to plant development and bolting of spring-sown crops appears to be poorly defined. To avoid bolting, Florence fennel is grown as a warm season crop

with the optimum temperatures for good growth being between 16°C and 18°C. Poor seed germination may also occur under cold wet conditions (Bransden, 1984) and for early crops, seedlings may be raised under glass and transplanted into the field (Buishand and Snoek, 1980). Growing Florence fennel in a period of decreasing day length rather than increasing day length is also known to reduce bolting (Mol, 1981). Consequently Florence fennel is best suited to summer and autumn conditions with many plants likely to bolt if it is sown too early in the spring (Buishand and Snoek, 1980).

The increased interest in Florence fennel in Europe and the possibilities of an export trade for New Zealand growers prompted us to test it in the Waikato. In November 1982 we successfully grew a small area of Florence fennel and in 1983 this work was expanded to evaluate a range of cultivars sown at three separate times to provide initial production information for growers.

METHOD

The trial was carried out at Rukuhia Horticultural Research Area on Horotui sandy loam. Meteorological data for the trial period are presented in Table 1.

Three months before sowing 1 t/ha Diammonium phosphate, 3 t/ha 15% potassic serpentine superphosphate and 12 t/ha lime was rotary hoed into the trial site and this

TABLE 1: Meteorological data for the trial period, Rukuhia Research Station (daily mean).

	Temperature (°C)		Grass min. (°C)	10 cm soil (°C)	Rain (mm)	Evapotranspiration (mm)
	max.	min.				
October 1983	18.3	10.2	8.1	14.8	498	2.7
November	20.2	9.8	6.9	16.7	22	3.9
December	21.2	11.1	8.1	18.1	20	4.7
January 1984	22.7	10.7	8.8	18.8	34	5.0
February	24.1	12.8	10.4	19.3	29	4.3

TABLE 2: Average bulb characteristics from all harvests.

Cultivar	Bulb length (cm)	Bulb breadth (cm)	Bulb width (cm)	Bulb weight (gm)
Zefa tardo	16.5	5.7	10.9	703.4
Zefa fino	14.8	5.7	11.1	593.0
Perfection	14.1	3.9	7.9	269.6
Mantivano solar	15.7	4.9	11.3	188.9
Domino	14.3	6.4	9.8	378.2
Italian line	15.9	4.8	8.7	449.1
New Zealand line	10.8	3.1	6.5	181.7
SED	1.7	0.5	1.2	98.7

TABLE 3: The percentage of plants bolted and those in the 0-6 cm, 6-12 cm and over 12 cm width for individual cultivars at each time of sowing.

Sowing date/cultivar	Bolted	0-6 cm	6-12 cm	>12 cm
13-10-83				
Zefa tardo	5	—	68	27
Zefa fino	18	—	56	27
Perfection	87	—	9	5
Mantivano solar	88	—	6	6
Domino	83	—	17	0
Italian line	65	—	27	8
New Zealand line	49	—	49	2
23-11-83				
Zefa tardo	67	—	23	10
Zefa fino	60	—	21	21
Perfection	91	—	8	1
Mantivano solar	94	—	5	1
Domino	94	—	5	1
Italian line	93	—	7	0
New Zealand line	81	—	17	2
28/12/83				
Zefa tardo	0	8	45	47
Zefa fino	7	10	42	41
Perfection	4	16	53	27
Mantivano solar	16	7	38	39
Domino	11	11	48	30
Italian line	12	12	46	30
New Zealand line	42	13	32	13

gave soil test values at planting of pH 6.9, P45, K4, Mg9. A stale seed bed was used to give initial weed control and this was followed by hand weeding. Three seeds per station were hand sown 20 cm apart in rows 40 cm apart on 13/10/83, 23/11/83 and 28/12/83 and later thinned to 1 seedling. Individual plots consisted of 4 rows, 5 m long with 3 replicates.

Seven cultivars were sown from the following sources.

- Dutch: Zefa tardo; Zefa fino; Perfection.
- United Kingdom: Mantivano-solar; Domino.
- Italian: Unnamed line.
- New Zealand: Unnamed line.

Lannate insecticide (1.5-2.0 μ /ha) was applied when the seedlings were 3-5 cm high as a protection against aphids and greasy cutworm. No disease control programme

was carried out.

Harvesting and grading was carried out to Dutch and Swiss recommendations (Buishand and Snoek, 1980) with the bulb cut at ground level and the stalks cut at an angle 5-7 cm above the bulb. Harvest measurements and weighings were carried out on bulbs with a width over 6 cm on 2/2/84, 19/3/84 and 27/4/84 with a second harvest of all remaining bulbs on 19/2/84, 9/4/84 and 7/5/84 for each sowing respectively.

RESULTS AND DISCUSSION

The bulbs were first harvested after growth periods of 112 days, 117 days and 121 days for each sowing respectively. The bulb characteristics of each cultivar are shown in Table 2. Bulbs of the two Swiss cultivars

(obtained from the Netherlands), Zefa tardo and Zefa fino were considerably heavier than those of the other cultivars and they had wide, fat bulbs. Domino and the Italian line had rounder finer bulbs and Mantivano-solar had wide thin bulbs. Perfection and the New Zealand line had small flat bulbs. The shape of the bulbs may be important for individual markets depending on consumer requirements.

The percentage of bulbs which bolted and those in various size ranges for each sowing date are shown in Table 3. In the first sowing Zefa tardo and Zefa fino gave low bolting compared to the other cultivars and, although bolting was high in all cultivars in the second sowing, Zefa tardo and Zefa fino gave the lowest percentages. At the final sowing bolting was low except for the unselected New Zealand line. Where bolting was not a problem appreciable numbers of bulbs grew to over 12 cm in width.

Bolting was the major influence on bulb development and yield in this trial. Temperatures below 7 °C (Lorenz and Maynard, 1980) and increasing day length (Mol, 1981) both promote bolting in Florence fennel but the higher bolting in the second sowing compared with the first was unexpected and no precise reason for this effect can be given. Whether low temperature alone caused the high bolting in the second sowing or whether other environmental effects such as drought stress were also involved is unknown. Average grass minimum temperatures for the 10 days after each sowing were 6.1 °C, 4.0 °C and 8.0 °C for each sowing respectively. The grass minimum temperature recorded after the second planting was well below the long term grass minimum temperature readings for November for Waikato meteorological stations (Ruakura, 5.8 °C, Rukuhia, 7.5 °C) and if the temperature pattern was the cause of the high bolting the long term averages suggest late November plantings should not have excessive bolting in most years. Certainly in the preliminary sowing in November of the previous year little bolting occurred.

TABLE 4: Yield of trimmed bulbs greater than 6 cm in width for each cultivar and time of sowing (t/ha).

	Sowing date		
	13-10-83	23-11-83	28-12-83
Zefa tardo	20.6	12.4	19.4
Zefa fino	12.9	15.2	16.2
Perfection	2.8	2.4	14.4
Mantivano solar	1.3	1.3	11.4
Domino	3.0	1.7	23.2
Italian line	6.9	2.1	24.0
New Zealand line	7.0	4.5	1.9
SED	4.9		

The yield of bulbs greater than 6 cm in diameter are shown in Table 4. The yields were markedly influenced by bolting and where this was at a low level, yields in excess of 20 t/ha were recorded in the first sowing by Zefa tardo and over 23 t/ha by Domino and the Italian line in the final sowing. Dutch growers expect 30 t/ha as an average crop

(Anon, 1982) and with more experience similar yields appear achievable here.

Zefa tardo and Zefa fino produced the highest yield of unblemished bulbs over 6 cm diameter from both the October and November sowings and although they continue to produce well from the December sowing, Domino and the Italian line gave higher yields. Overall Zefa tardo and Zefa fino were the most consistent cultivars over the three sowing dates with Zefa tardo giving the higher yield of the two cultivars. Nevertheless Domino and the Italian line showed they were capable of high yields at one sowing and consequently they may be equal to or better than Zefa tardo and Zefa fino in other situations.

The marketable yield of Florence fennel is based on the size of bulbs with the Europeans considering bulbs less than 6 cm diameter as immature and bulbs over 12 cm diameter are considered overmature (Buishand and Snoek, 1980). Zefa tardo and Zefa fino and the unselected New Zealand line had the highest percentage of their bulbs in the 6-12 cm size category when sown in October but all the other cultivars produced their highest percentage in this range from the December sowing. It is not known how necessary it is to keep the bulb size below 12 cm diameter for marketing purposes but to do so would probably require several pickings. In Europe, plant populations of 125 000 plants/ha are recommended to obtain good bulb size and shape and our low plant population of 43 000 to 90 000 plants/ha may have aided large bulb development.

Florence fennel has some local demand but our interest has been the development of an export crop. It is a favoured vegetable of the Italians and although it is low priced and an everyday vegetable in Italy, Italian communities in other parts of the world are prepared to pay high prices for it. For instance, Trade and Industry enquiries suggest Florence fennel is an expensive item in Sydney although no price details were available. One of the requirements of exporting Florence fennel to Australia is that it must be accompanied by a phytosanitary certificate endorsing that the Florence fennel has been grown in an area free of carrot rust fly (*Psila rosae*) or be fumigated with methyl bromide. Carrot rust fly occurs in the Waikato region and consequently tests were carried out by DSIR to determine the effect of methyl bromide on Florence fennel bulbs. Bulbs were undamaged and their shelflife unaffected by 58 g/m³ methyl bromide for 2 hours at 12 °C and, although it was considered this dose would be sufficient to kill carrot rust fly, further work is needed to determine the actual dose rate required (D. Beever, pers. comm.).

CONCLUSION

Florence fennel is a suitable warm season crop for the Waikato but the problem of bolting may limit late spring plantings to warm sites. It suffers from few uncontrollable pests and diseases and the main constraints to growing it at the present time is a lack of information on chemical weed control. A programme to evaluate suitable herbicides is planned.

The development of an export trade in this vegetable requires further definition of the market requirement in regard to the most desirable shape and size of the bulbs and the most desirable selling period. There is also a need to establish what name Florence fennel should be sold under in each specific market.

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