

## Behaviour of 'Nova' Mandarin in Spanish Conditions

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### Abstract

The behaviour of 'Nova' mandarin in comparison to 'De Nules' clementine was studied. The high productivity, outstanding fruit characteristics, and the maturity season that allows picking 'Nova' right after the 'De Nules' clementine, makes its growing interesting, mainly in the late maturing areas.

### Introduction

'Nova' mandarin [*Citrus clementina* Hort. ex Tan, x (*C. paradisi* Macf. x *C. tangerina* Hort. ex Tan.)] is a hybrid from clementine mandarin (*C. clementina*) and 'Orlando' tangelo (*C. paradisi* x *C. tangerina*), obtained by Gardner and Bellows at Orlando, Florida, in 1942 (10). Characteristics of this variety were described in 1964 (13).

Commercial interest in 'Nova' mandarin started in 1964 (13). Although some studies have been carried out in order to know its behaviour in several citrus producing countries (1,5,14), only an almost negligible hectareage of this variety is grown in the world. A certain interest for 'Nova' exists in Florida, where a total of 166,000 trees were recorded in 1982, although this number represents a marked decrease with respect to the total trees grown in the former years (2,7,8).

'Nova' mandarin was introduced into Spain in 1971 through the importation of bud material from Florida, that was grafted and included in a citrus experimental collection located at Vinaroz (Castellón).

Preliminary results with reference to yields and fruit characteristics of 'Nova' encouraged the potential interest in growing this variety in Spain. In the present work, the behaviour of this variety and its commercial value have been determined in comparison to the 'De Nules' clementine (3,6) being the main clementine cultivar in Spain.

## Materials and Methods

The study was carried out in a plot located at Villalonga (Valencia). There is a Mediterranean climate, with dry hot summers and mild winters, with maximum rainfall in autumn and winter. The soil was clay loamy, had a pH (H<sub>2</sub>O) of 8.1, 12.25% carbonates, and 4.19% active lime.

The plot selected consisted of adult 'Washington Navel' (*C. sinensis* (L.) Osbeck) trees grafted on sour orange (*C. aurantium* L.) rootstock. All trees, except 8 of them that were randomly selected, were top worked in March, 1979, with 'De Nules' clementine, while these 8 trees were top worked with 'Nova' mandarin. In this way both cultivars could be compared under the same environmental conditions and cultural practices.

The study has been carried out for three consecutive seasons, starting in 1983-84. Random samples of 25 fruits were periodically taken for morpho-qualitative analysis that was performed following the usual methods. Colour index (CCI) of fruit rind was calculated by measuring the 'L', 'a' and 'b' parameters with a Hunterlab D25 P-2 colorimeter (12). Sampling started when the fruits were large enough to allow analysis, and ended when fruits overpassed commercial maturity. Samples were taken every season on the same dates.

In order to determine the incidence of crossed pollination on the number of seeds of the two cultivars, hand pollination was done in the flowering season of 1985. One hundred flowers of each cultivar were selected among those with a high fruit set probability, according to their size, appearance and location on the tree; once marked, they were cross pollinated with pollen from 'Nova' mandarin or 'De Nules' clementine respectively. One hundred of random unmarked fruits plus the marked fruits of both varieties were picked and the number of seeds counted.

Comparison of fruit characteristics between 'Nova' mandarin and 'De Nules' clementine was made when both cultivars reached the best quality from the commercial viewpoint.

## Results

Table 1 shows the main fruit characteristics of both cultivars.

A higher weight and size of 'Nova' as well as a higher colour index, that is the expression of its deep orange-red rind colour, were the main differences when comparing both varieties. The external colour of 'Nova' makes it very valuable commercially.

The variation of the fruit density with time was plotted in Fig. 1. The high values in the case of 'Nova' indicated low tendency to puffing, the fruits being able to hold on the tree with good quality. However, towards the middle of January, with slight variations according to the climatic conditions for each season, some of the 'Nova' mandarin fruits started to show small circular furrows around the calix; later on, this disorder became more and more visible, affecting almost all the fruits on the tree and, under adequate temperature and humidity conditions, causing water spot. As a result of this, the adherence of the fruit to the peduncle was reduced, causing easy fruit drop and the consequent loss of commercial value. Likewise, some of the 'Nova' mandarin fruits had the tendency to split at the stylar end before maturity, depending on the climatic conditions and on water management, although the percent of affected fruits was rather low in total yield.

Table 1: Fruit Characteristics of 'Nova' Mandarin and 'De Nules' Clementine<sup>z</sup>

Characteristics	Nova mandarin	De Nules clementine	Significantly level <sup>y</sup>
Fruit weight (g)	115.1	85.8	*
Diameter (mm), D	62.7	57.5	**
Height (mm), H	53.1	48.4	N.S
D/H ratio	1.18	1.18	N.S
Colour index (CCI)	23.1	12.5	**
Fruit density (g/cm <sup>3</sup> )	0.965	0.875	**
Rind thickness (mm)	2.7	2.5	N.S
Rind (% by weight)	19.5	21.5	N.S
No. of segments	9.8	9.9	N.S
Juice density (at 15°C)	1.051	1.047	N.S
Juice (% by weight)	46.1	44.1	N.S
Total soluble solids (%), TSS	12.9	12.5	N.S
Total acidity (%), TA	0.71	0.66	N.S
Maturity ratio TSS/TA	18.2	18.9	N.S

<sup>z</sup>Three seasons average (1983–84 to 1985–86); fruit samples collected in mid–December for 'Nova' mandarin and late November for 'De Nules' clementine,

<sup>y</sup>N.S. = not significant; \* = significant at 5% level; \*\* = significant at 1% level.

Fig. 2 shows the variation of juice acidity with time. It appears that toward the end of January the acidity of 'Nova' mandarin reached rather low values, this being more marked in the subsequent weeks, producing loss of the good organoleptic characteristics. Consequently, this factor should be taken into account in the harvesting of 'Nova', since the fruit, that is not affected by puffing as mentioned before, could be collected when the acidity values were too low and hence, when the organoleptic conditions and the commercial quality has been reduced.

Table 2 shows the results of hand pollination. The high percentage of highly seedy fruits is remarkable, both in 'Nova' mandarin and in 'De Nules' clementine. This suggests the high compatibility occurring between these two varieties.

The high percentage of seedless randomly picked fruits, Table 2, ratified the autoincompatibility of 'Nova' mandarin (4, 9), the presence of seedy fruit being caused by the crossed pollination with other varieties. On the other hand, the high yields obtained, over 100 kg per tree average in the three seasons studied, indicated that, under the conditions of this experience, 'Nova' mandarin behaved as highly parthenocarpic, in contrast to the results known to have been obtained elsewhere (4, 11).

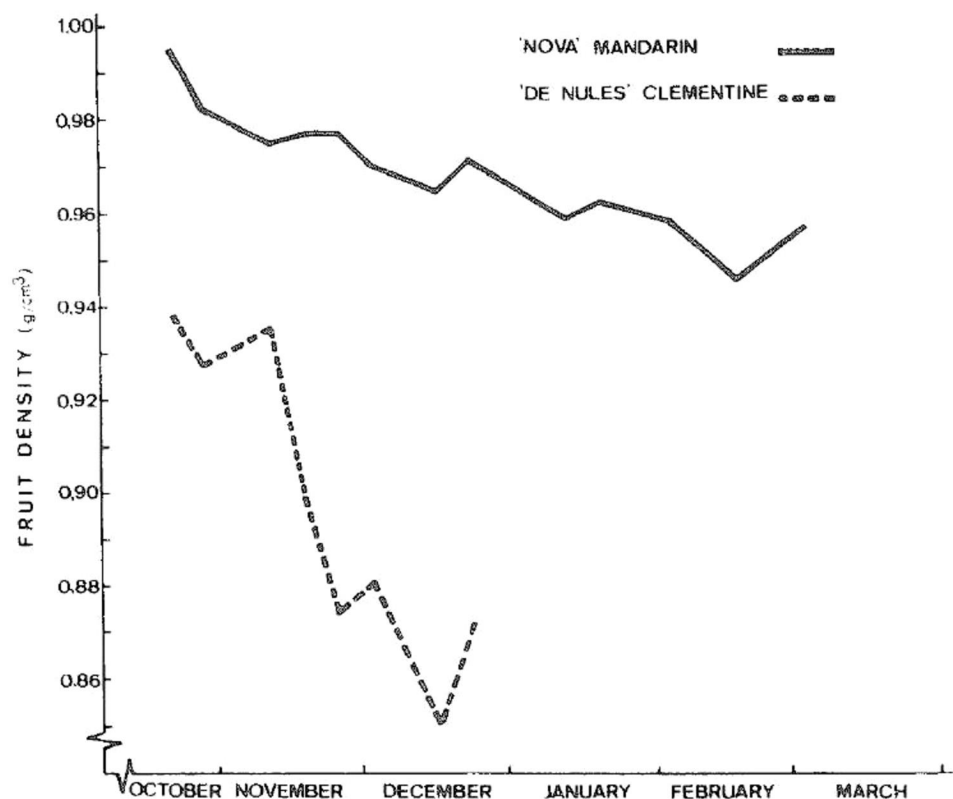


Figure 1: Evolution in fruit density

Table 2: Seed Content in Fruits from Pollinated and Unpollinated Flowers

No. of seeds	No. of fruits <sup>z</sup> (from pollinated flowers)		No. of fruits <sup>y</sup> (from unpollinated flowers)	
	Nova	De Nules	Nova	De Nules
0	0	3 (3.7%)	84	81
1-4	12 (14.2%)	11 (13.7%)	13	17
5-9	30 (35.7%)	10 (12.5%)	2	2
10-30	42 (50.0%)	56 (70.0%)	1	0

<sup>z</sup> Fruit set from 100 hand pollinated flowers. Each variety was cross pollinated with the other one. <sup>y</sup> Sample of 100 randomly picked fruits for each cultivar.

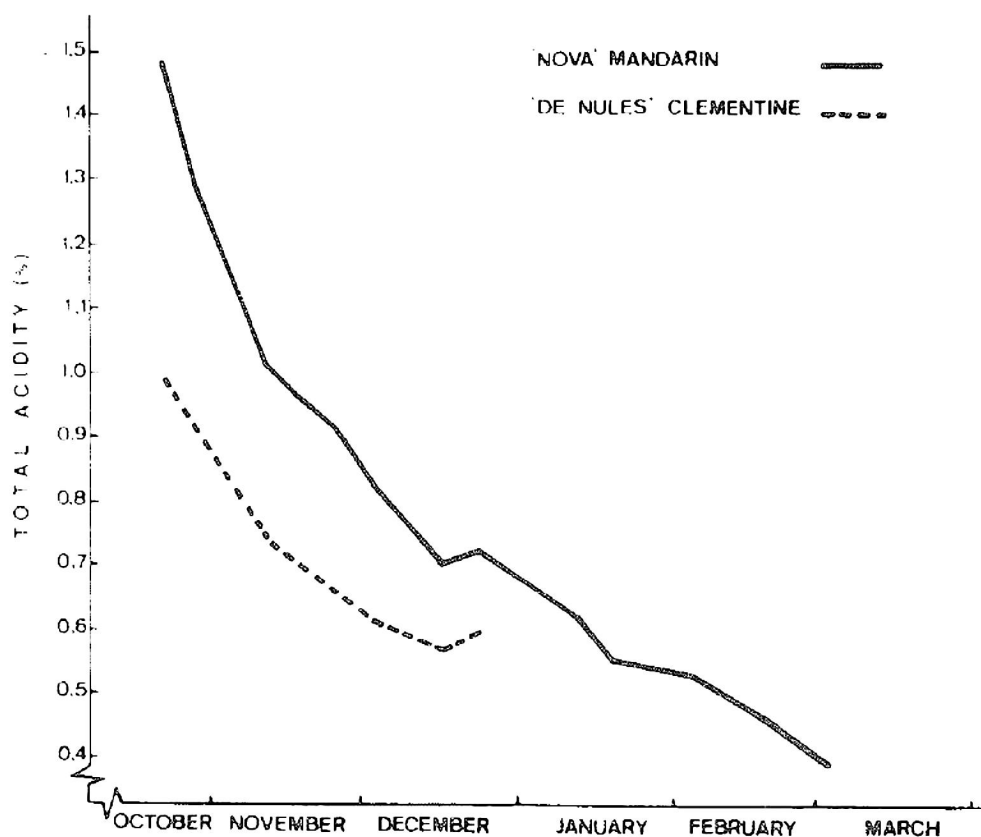


Figure 2: Evolution in juice acidity.

The good fruit size and organoleptic conditions, the attractive rind colour and the high productivity make the growth of 'Nova' mandarin of interest in our citrus areas. In the same plot, the harvest of 'Nova' can be started towards the completion of that of 'De Nules' clementine or right afterwards, although the mentioned drawbacks (appearance of furrows around the calix and loss of acidity) that significantly reduce the harvesting period, should be taken into account.

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