# Behavior of Alemow as a Citrus Rootstock in Tucuman, Argentina

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ABSTRACT. Since the appearance of citrius tristeza virus (CTV), numerous species have been tested in the Argentine northwest as replacements for sour orange rootstock. In 1968 a test was planted at Famaillá, Tucumán in a randomized block design with six replications and one plant per plot. Eight rootstocks and six scions were used.

The present paper reports the behavior of alemow (*C. macrophylla*) in a situation where CTV is wide spread.

Alemow was the worst rootstock for sweet orange, tangerine and grapefruit scions, but it conferred the highest productivity to lemon scions even though all plants showed strong stem-pitting symptoms.

Tucumán, in the Northwest of Argentina has 22,000 ha of citrus representing 25% of the national production and 70% of the lemon production. Gummosis in 1920 and tristeza in 1950-60 caused critical losses to the citrus industry (13). Because of these two diseases, sweet and sour oranges cannot be recommended as rootstocks and other substitutes are used based on tests done with lemons (4, 11), tangerines (5), grapefruit (12) and oranges (10).

The present paper reports the results of a test conducted by EERA, INTA, Famailla in which alemow was compared with other rootstocks for different citrus cultivars.

## MATERIALS AND METHODS

Alemow was used as a rootstock for Redblush grapefruit, Valencia late, Hamlin and Ruby blood sweet oranges, common tangerine, Frost Eureka lemon and its behavior was compared with sweet orange, rough lemon, Rangpur lime, Cleopatra mandarin, trifoliate orange, Troyer citrange and Orlando tangelo.

Two tests were planted during 1968 at Famaillá (Tucumán) and La Banda (Santiago del Estero). In both cases, a randomized block design with six replications and one plant per plot was used.

Seedlings were grown in the field and budwood for grafting was taken from nucellar plants without protection and we suppose that both seedlings and scion could have been infected with CTV because it is widespread in the area (3) and carried by *Toxoptera citricida* (Kirk) (6).

We recorded growth (diameter of the canopy and trunk circumference) and productivity (number of fruit and weight).

The data were collected and analyzed from both young and adult trees.

During 1982 we evaluated the presence and effects of CTV on the combination Frost Eureka/alemow by indexing on Mexican lime and evaluating the stem pitting reaction.

A conventional scale for evaluating the stem-pitting was used. It takes into account size, depth and intensity and ranges from zero (absence) to three (maximum). Equal aged alemow seedlings were included in the experiment, and alemow shoots from dead scions were also observed.

In Frost Eureka/alemow we removed a bark patch of 3 x 7 cm at the budunion and looked for "macrophylla rootstock necrosis" reported by other authors (1, 7, 8, 9).

## RESULTS AND DISCUSSION

**Oranges, tangerines and grapefruits.** From the outset these

scions grafted on alemow (figure 1) performed poorly as reported previously (4, 10, 11, 12). This is because alemow is susceptible to CTV and suffers stem-pitting and sometimes death (table 1). In the Redblush/alemow combination no plants were killed, but stem-pitting and budunion crease was severe. On the other hand, Ruby blood and Hamlin in oranges reached 84% and 67% respectively in the stem-pitting ratings.

All combinations except Redblush, showed overgrowth of the rootstock portion of the trunk (table 3). Figure 2 shows the poor yields over the years, although in some years, Redblush/alemow showed a high efficiency. We considered using this combination in closely spaced plantations for high productivity per ha, but, it was inconsistent and we gave up the idea.

**Lemon.** Frost Eureka/alemow performed well and the plants were the same size and had the same trunk circumference as those on Rangpur lime and rough lemon rootstocks (table 2 and figure 3).

There were no statistically significant differences in productivity between lemon plants grafted on Rangpur lime (the highest in the

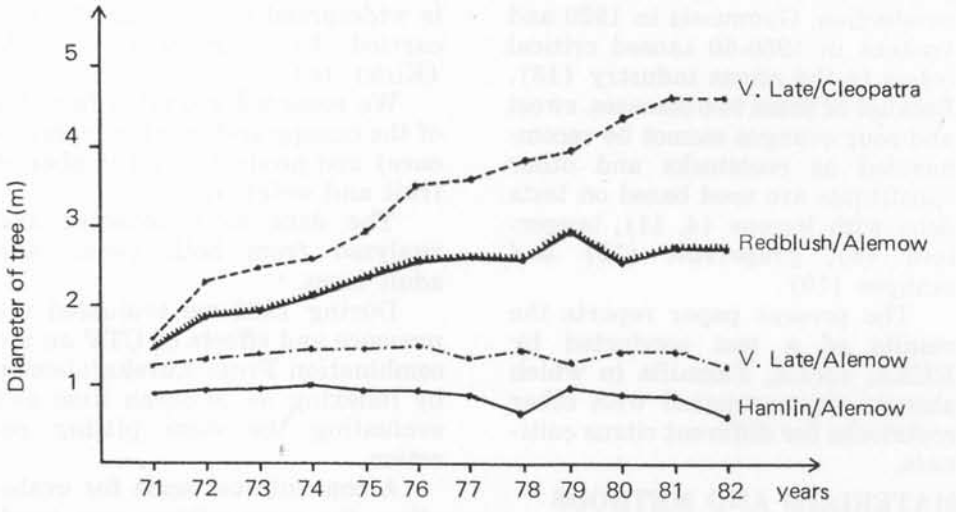


**Fig. 1. Effects of C. macrophylla on diameter of trees of different stionics varieties. Valencia late/Cleopatra mandarin is used for comparing.**

TABLE 1
STEM PITTING VALUES AND DEATH OF PLANTS GRAFTED ON ALEMOW

| Kind of plant | Stem-pitting values* | | Dead trees in 1983 (%) |
|---|---|---|---|
| | Rootstock | Scion | |
| Alemow seedlings | 2.00 | — | 0 |
| Frost Eureka lemon | 2.17 | 0.17 | 0 |
| Redblush grapefruit | 2.83 | 1.75 | 0 |
| Valencia Late orange | 2.20 | 1.10 | 17 |
| Común tangerine | 2.75 | 1.50 | 34 |
| Hamlin orange | 2.75 | 1.00 | 67 |
| Ruby blood orange | 2.50 | 2.00 | 84 |
| Alemow rootsprouts† | 2.50 | — | — |

*Stem pitting was rated on the scale: 0 = no pits; and 3 severe pitting.
†Rootsprouts from trees where scion had declined and died.

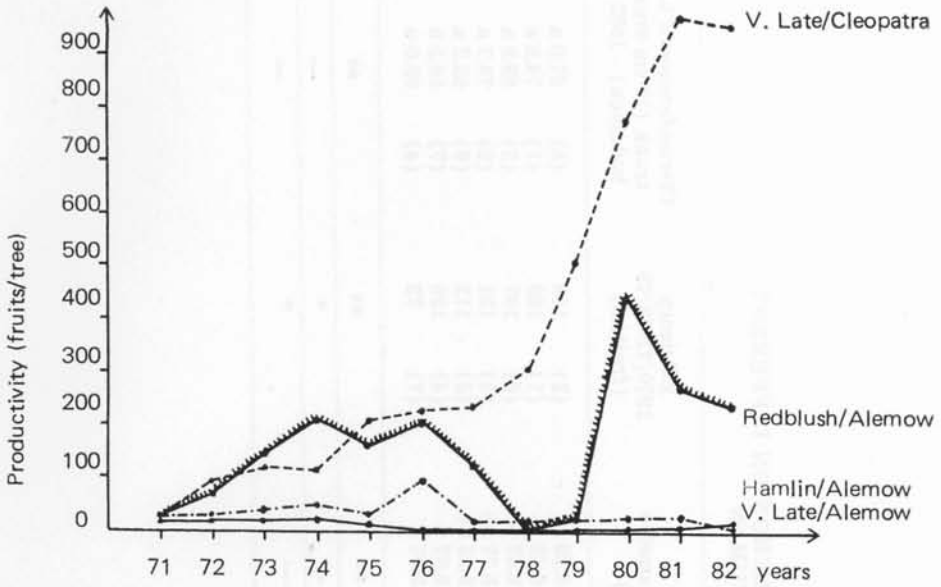


**Fig. 2. Effects of Citrus macrophylla on the productivity of different stionic varieties. Valencia late/Cleopatra is used for comparing.**

test) and alemow (table 2 and figure 4).

Our results did not coincide with those of Broadbent (2) who observed poor growth from the early stages. On the other hand, Schneider (8, 9) pointed that problems appeared erratically when trees were 16-21 years old and according to him; we could expect decline later.

No symptoms of budunion crease or sieve-tube necrosis (8, 9) causing girdling effects (1) were observed, but it might be suspected because productivity has increased

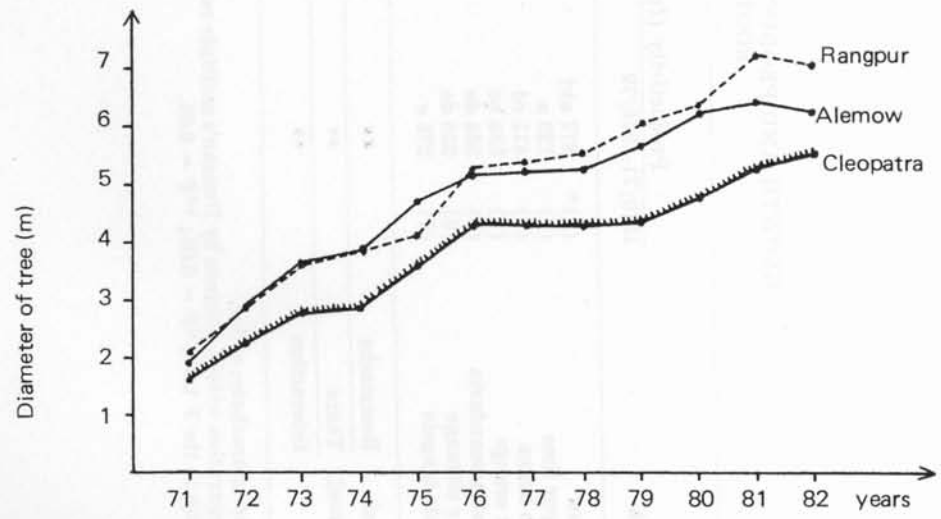


**Fig. 3. Growing evolution (expressed in diameter of tree) of Frost Eureka lemon on three rootstocks in Famaillá-Tucumán.**

TABLE 2
GROWTH AND PRODUCTIVITY OF FROST EUREKA LEMON ON DIFFERENT ROOTSTOCKS AT FAMAILLÁ, TUCUMÁN

| Rootstock | | Productivity (fruits/tree) 1970/71-1978/79 | | Productivity (fruits/tree) 1979/80-1981/82 | | Canopy diameter (m) | | Efficiency 1970/71-78/79 (fruit/m) | | Circumference of the trunk (10 cm over budunion) - 1982 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| — Alemow | | (2)* | 677 ab† | (1) | 7342 a | (3) | 6.29 a | (2) | 160 | (5) | 67.0 a |
| — Rangpur lime | | (1) | 729 a | (2) | 6026 a | (2) | 6.42 a | (1) | 169 | (1) | 74.8 a |
| — Rough lemon | | (4) | 411 cd | (3) | 5920 a | (1) | 6.67 a | (6) | 107 | (3) | 69.8 a |
| — Sweet orange | | (3) | 534 bc | (4) | 4795 b | (4) | 5.77 ab | (3) | 131 | (2) | 73.7 a |
| — Cleopatra mandarin | | (5) | 364 de | (6) | 4516 bc | (5) | 5.55 ab | (5) | 112 | (6) | 65.2 a |
| — Troyer citrange | | (6) | 336 de | (5) | 4524 bc | (6) | 5.07 b | (4) | 125 | (7) | 56.5 b |
| — Orlando tangelo | | (7) | 275 e | (7) | 2277 c | (6) | 5.07 b | (7) | 72 | (4) | 69.0 a |
| Statistical significance‡ | Rootstocks | | ** | | ** | | ** | | ** | | ** |
| | Years | | ** | | ** | | — | | * | | — |
| | Interaction | | ** | | ** | | — | | * | | — |

*Numbers in brackets: order.
†Mean separation within columns by Duncan's multiple range test; P = 0.05.
‡According to the F test; *P = 0.05; **P = 0.01.

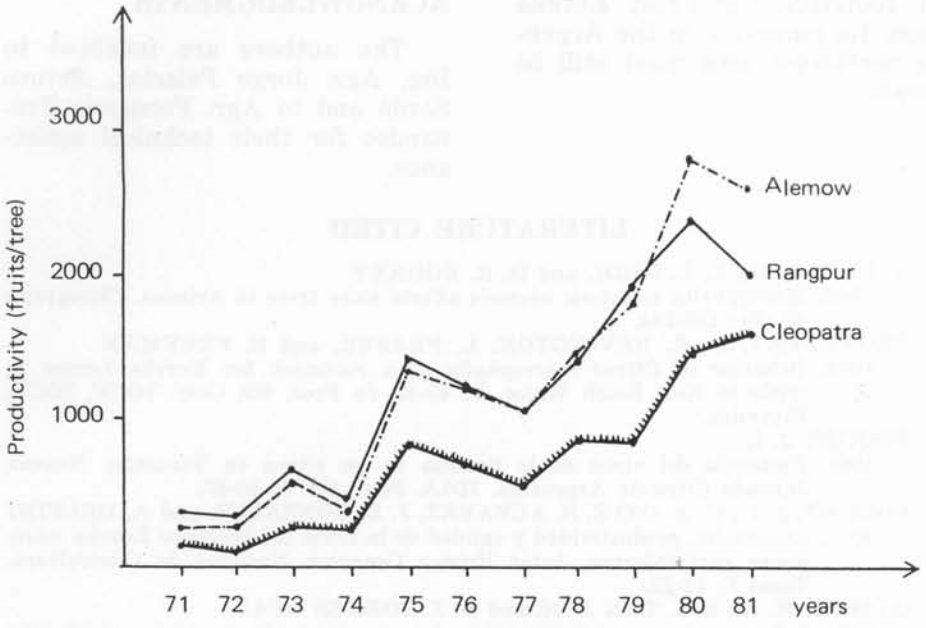


**Fig. 4. Productiveness evolution (expressed in fruits/tree) of Frost Eureka lemon on three rootstocks in Famaillá-Tucumán.**

recently. High soluble solid contents are mentioned as a symptom of the decline of lemon/alemow trees (7); although in a previous report (11), we found the lowest values in fruits from this combination. Overgrowth was not observed in the stionic portion of the trunk (table 3). All trees of Frost Eureka/alemow were infected with CTV according to indexing results on Mexican lime, but the stem-pitting observed was less than from the other varieties on this rootstock.

Apparently, grafting increases or affects stem-pitting synergistically in alemow (table 1). This could be caused by the lack of protection of the mother plants since the new trees had the virus from the beginning whereas the non-grafted ones were infected later.

In the shoots and leaves of dead scions, stem-pitting and vein clearing were observed and their values were higher than in trees which had never been grafted.

## CONCLUSIONS

At least until 15 years of age, alemow has proved to be an excel-

TABLE 3
TRUNK CIRCUMFERENCE OF DIFFERENT SCION CULTIVARS GRAFTED ON ALEMOW ROOTSTOCKS

| Scions | Average circumference (cm)* | | Ratio (1)/(2) |
|---|---|---|---|
| | Rootstocks (1) | Scion (2) | |
| Frost Eureka | 79.7 | 66.8 | 1.19 |
| Valencia Late | 19.0 | 17.0 | 1.12 |
| Hamlin | 14.0 | 11.5 | 1.22 |
| Ruby blood | 15.0 | 12.0 | 1.25 |
| Redblush | 27.5 | 33.5 | 0.82 |
| Common mandarin | 18.3 | 13.7 | 1.34 |

*Measurements were taken 10 cm above and below the budunion.

lent rootstock for Frost Eureka lemon. Its longevity in the Argentine northwest area must still be proved.

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