

How Russian Breeders Discovered *Citrullus mucosospermus* and *Citrullus lanatus* var. *cordophanus*, the Likely Closest Relatives of Domesticated Watermelon

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Watermelon is among the commercially most important fruit crops and has therefore received a lot of attention from breeders, especially in the US and China. Probably the most successful modern work on wild watermelons, however, was carried out by Russian breeders connected to the Vavilov institute in St. Petersburg and breeding stations near Astrakhan and Tashkent. Thus, it was Russians who discovered both current contenders for the position as closest relatives or progenitors of domesticated watermelon, *Citrullus mucosospermus* and *Citrullus lanatus* var. *cordophanus*, although it is only with molecular-genomic methods that the importance of these discoveries is becoming clear.

Between 1959 and 1964, the Armenian botanist David Ter-Avanesyan (1909-1979), whose life and travels are described on a website linked to the Vavilov institute (http://www.ras.ru/science/14_Exhibitions/ter.php), travelled to the Kordofan region of Sudan to collect seeds of economically important plants. The seeds he brought back were grown out and are still being maintained at the Vavilov Institute (personal communication, Larisa Bagmet, Curator of the herbarium of the Vavilov Institute, 30 March 2017). His Sudanese watermelons, which he described as '*C. lanatus* subspecies *cordophanus*', have striped fruits with white non-bitter pulp and beige seeds, all illustrated by B/W photos (Ter-Avanesyan, 1966). He considered these plants to represent the progenitors of cultivated watermelon.

The next discovery came from Ter-Avanesyan's colleague, Tatjana Borisovna Fursa (b. 12 May 1928; d. 4 August 2020), now retired from the Vavilov Institute. It was she who first clarified the close relationships among sweet watermelon, subsp. or var. *vulgaris* (Schrad.) Fursa, egusi melon, *C. mucosospermus* (Fursa) Fursa, and Ter-Avanesyan's Kordofan melon, in an immunochemical analysis of seed proteins from all then-known species of *Citrullus* (Fursa and Gavrilyuk, 1990). This revealed that *cordophanus* is closer to the dessert watermelon than are *mucosospermus* and the South African watermelons *C. amarus* and *C. ecirrhosus*, a finding since borne

out by molecular data (Chomicki and Renner, 2015; Guo et al., 2019; Wu et al., 2019). The egusi melons, which Fursa (1983) described as new to science, had been discovered by a Russian collector, N.P. Oltarshevskiy (Oltarshevskiy) in Ghana in 1957 (type material is in the herbarium of the Vavilov institute). Egusi melons are of great interest for their seeds, which lack a hard seed coat and can be eaten raw; the fruit pulp, on the other hand, is too bitter for human consumption (Achigan-Dako et al., 2015). Fursa (1972: 38) also validated Ter-Avanesyan's name '*cordophanus*' by preparing and then citing a type specimen (Fursa, 1972: 38). She grew the specimen near Tashkent from some of his Sudanese seeds and formally named the material *Citrullus lanatus* subsp. *vulgaris* var. *cordophanus* (Ter-Avan.) Fursa.

Unfortunately, Fursa's insights and her protein-based phylogeny (Fursa and Gavrilyuk, 1990), from which she inferred that "*Citrullus cordophanus* seems to be the nearest ancestor of the cultivated water-melon," were not widely read by Western or Chinese breeders. To remedy this, a recent paper on the taxonomy of *Citrullus* was dedicated to her and includes a color photo provided by her daughter that shows Tatjana in Astrakhan in 1977, holding one of watermelons (Renner et al. 2017).

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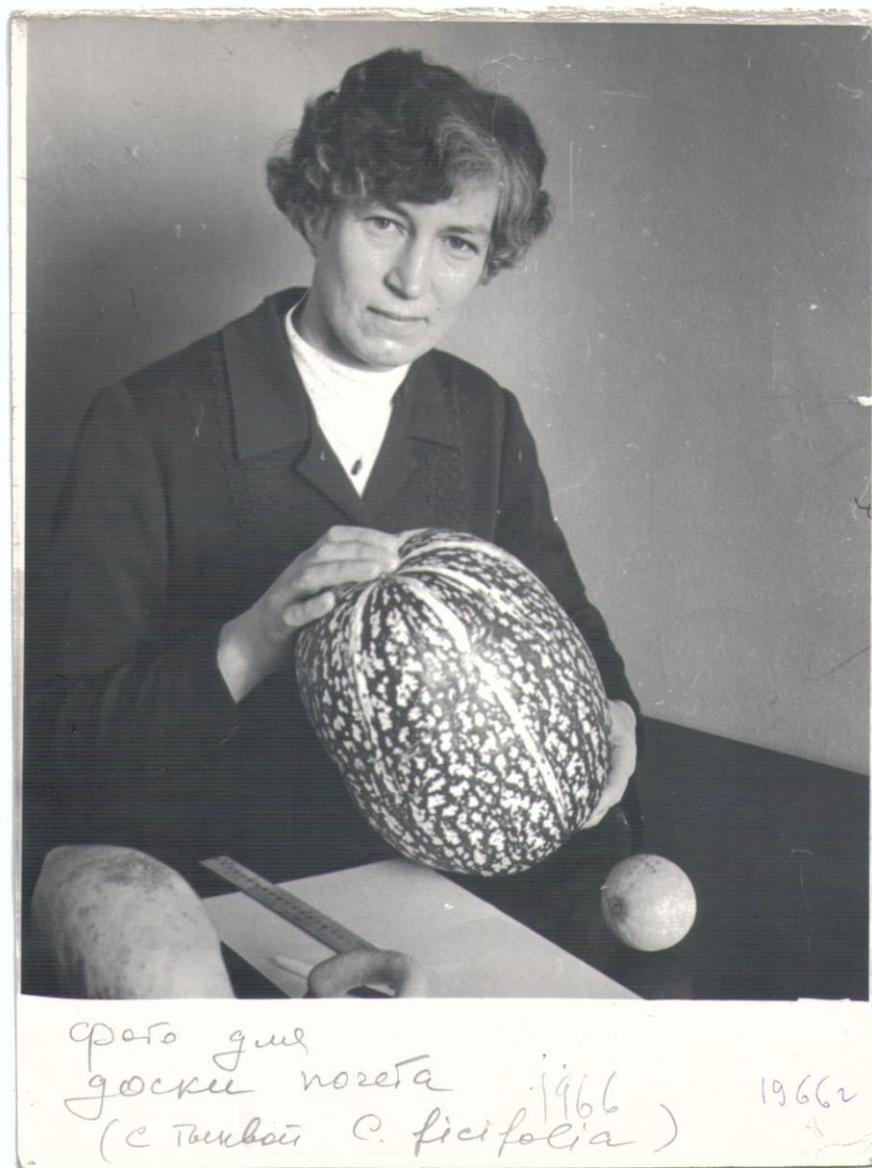


Figure 1. Photograph taken in 1966 of Tatjana Borisovna Fursa holding a fruit of *Cucurbita ficifolia*.



Figure 2. Photograph taken in 1977 in Astrakhan, Russia, of Tatjana Borisovna Fursa holding a fruit of *Citrullus* sp.