

Crosses of tetraploid species with each other or with tetraploid standard daffodils

Most species are diploid. When they are crossed with each other, the seedlings are diploid too with two different chromosome sets and therefore usually infertile. The situation concerning the fertility is much better for crossing tetraploids: You obtain fertile tetraploid plants.

The following species are tetraploid:

- *N. viridiflorus*
- *N. cavanillesii*
- *N. cantabricus foliosus*
- *N. romieuxii*
- *N. bulbocodium graellsii*
- *N. bulbocodium obesus*
- *N. bulbocodium* (Orihuela del Tremedal, Spain)
- *N. bulbocodium* (Odeceixe, Portugal)
- *N. bulbocodium* (Santiago, Spain)
- *N. bulbocodium* (Mazagón, Spain)
- *N. bulbocodium citrinus* (Saucats, France)
- *N. bulbocodium* (Grazalema, Spain)
- *N. bulbocodium* (Puebla de Don Rodrigo, Spain)

Some diploid species have been transformed to tetraploid by a special chemical treatment. As far as I know, are these:

- *N. tazetta papyraceus* (transformed by William R.P. Welch)
- *N. jonquilla* (transformed by Lawrence Trevanion)
- *N. jonquilla henriquesii* (transformed by the author)

The combination of species from the same section yields seedlings, which in most cases react as autotetraploids during meiosis. That means the chromosomes behave as if they are all from one species. This can be expected from crosses between different *bulbocodium* and *cantabricus* types. The situation may be the same for combinations of *N. viridiflorus* and the tetraploid *jonquillas*.

For crosses with species which are not so densely related, for example combinations of *N. viridiflorus* and *N. cavanillesii* the descendants are allotetraploid: They have all over four chromosome sets. Two sets are very similar to each other but different from the other two very similar sets. Each similar set react during meiosis separately like in a diploid plants.

The real situation may often reside between these two extreme cases. The 28 more or less similar chromosomes can decide if they react in groups of four or of two with each other.

N. viridiflorus frequently has been crossed with tetraploid standard daffodils. An example is the well-known Emerald Sea from John Hunter. In my climate, it is rather easy to get seeds if the temperatures during pollinating are higher than normally, perhaps about 18 centigrade. There are already many second-generation plants, often backcrosses with standard daffodils - some of them are also fertile- and crosses with jonquilla hybrids, which are in most cases fertile. Combinations with diploid species like *N. cyclamineus*, *N. hedraeanthus*, *N. triandrus*, diploid yellow bulbocodiums, and *N. cantabricus* are successful.

I have used *N. viridiflorus* pollen on *N. cavanillesii*. The seedlings are called *N. x xanthochlorus*. The parents flower together during autumn in Spain, but nobody found the cross until now. *N. xanthochlorus* was successfully used as seed parent with pollen of Maria Pia, Solar System and *N. assoanus* in 2016.

Seedlings of *N. romieuxii* x *N. cavanillesii* are one year old. Utilizing *N. cavanillesii* as a seed parent is a little complicated for me, because I get from about hundred bulbs two or three flowers only. Therefore, I pollinated in 2016 many plants in Spain. I harvested seeds with the pollen of Solar System and *N. serotinus* and the little seedlings are already growing. In autumn 2017, I shall do the same with the pollen of a Y-R split corona and some other standard daffodils. The resulting progeny should have some very special characteristics. With these allotetraploid seedlings, similar crosses can be made as with the *viridiflorus* hybrids like Emerald Sea, for example back crosses with standard daffodils. Some interesting traits as early flowering time, blossoms looking up to the observer, long styles and anthers, rapid bulb increase can perhaps be integrated into the standard daffodils.

In DaffSeek there are listed in Division 10 'Bulbocodium Hybrids' 173 varieties. Most of them are crosses of different bulbocodiums and *cantabricus* and many of them should be autotetraploid and fertile. Crosses of standard daffodils with tetraploid bulbocodiums are very rare. This combination was tried at first, as

far as I know, from Jan De Graff, Karel van der Veek, Jack Romine, and Lawrence Trevanion. Little Soldier from Jack Romine is *N. bulbocodium* obesus x Chemawa. It should be fertile but I found no pollen on it. Lawrence Trevanion developed Gold Step (Alfriston x *N. bulbocodium*) and assumes that it is triploid (NNB), which means two chromosome sets NN from standard daffodils and one set B from *N. bulbocodium*. His Gold Step x Gold Step is fertile (perhaps NNBB?). His backcrosses with standard daffodils and *N. bulbocodium* are often fertile. Furthermore he got fertile seedlings from *N. bulbocodium* x Parton and from Flash Affair x *N. bulbocodium*. It seems to be laborious to obtain seeds from these crosses but it is possible. I shall try for this purpose the bulbocodiums listed on page 1. Perhaps these species are better suitable because of their high fertility than varieties.

The combination of some of these bulbocodiums with *N. viridiflorus* is projected for this month.

The existing fertile jonquilla hybrids like Quick Step, Hillstar, and Limequilla come from pollination of Wild Rose (2W-P), Daydream (2Y-W), and Lime Chiffon (1Y-GWW) with unreduced (JJ) Pollen. Allotetraploid plants NNJJ with two chromosome sets NN of the standard daffodils and two chromosome sets JJ of *N. jonquilla* developed. This happened by chance and can perhaps be reproduced by a cross with thousands of seeds, because the diploid species normally generates less than 1 % unreduced pollen. The same JJ-Pollen develop by artificially made tetraploid jonquillas. Lawrence Trevanion was not successful in getting seed from many crosses of standard daffodils x tetraploid jonquilla. His reverse cross was slightly more successful. I have nearly no experience with my tetraploid jonquilla *henriquesii*, because it flowered for the first time in 2016. But I think the existence of the fertile jonquilla hybrids which were produced with very few JJ-pollen proofs that these crosses are possible. It may be that for the generation of the existing fertile jonquilla hybrids the great number of J-pollen stimulated the movement of the pollen tubes of JJ-pollen within the style. This situation could be simulated by mixing JJ-pollen with a smaller number of J-pollen. Furthermore, the pollen tubes of the first kind should grow faster. More fertile jonquilla hybrids are of great interest, because all tetraploid standard daffodils can be used as parents and therefore intense colours of red and pink can be introduced.

The tetraploid jonquillas can perhaps also be combined with tetraploid bulbocodiums. I tried it this month with *N. romieuxii*.

About crosses of the artificially made *N. papyraceus* I am not informed.

