New breeding techniques for sustainable apple production

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Introduction and Goals:

- Annually, 226'500 tons of apples are produced in Switzerland, 90 mio. tons worldwide. This makes apple the second most important fruit crop worldwide (FAO, 2018).
- However, apple is one of the most intensively sprayed crops due to pests and diseases (**Figure 1**).
- Breeding resistant varieties to reduce pesticide inputs is a complex and time consuming process. The long juvenility and the heterozygosity of apple trees make it difficult to develop novel cultivars.
- Genetic editing considerably shortens the breeding cycle and makes it possible to improve market establised cultivars.
- **We aim to reliably apply novel genetic editing technologies to improve existing cultivars and to contribute to a more sustainable apple production (Figure 2).**

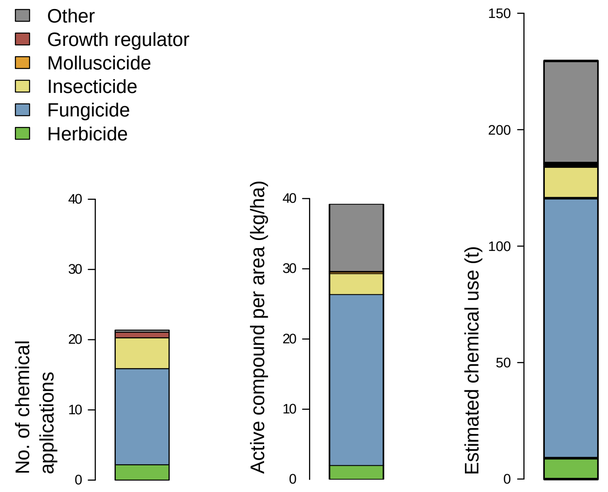

Figure 1: Pesticide use in pome fruits in CH for the year 2014, de Baan (2016, modified)

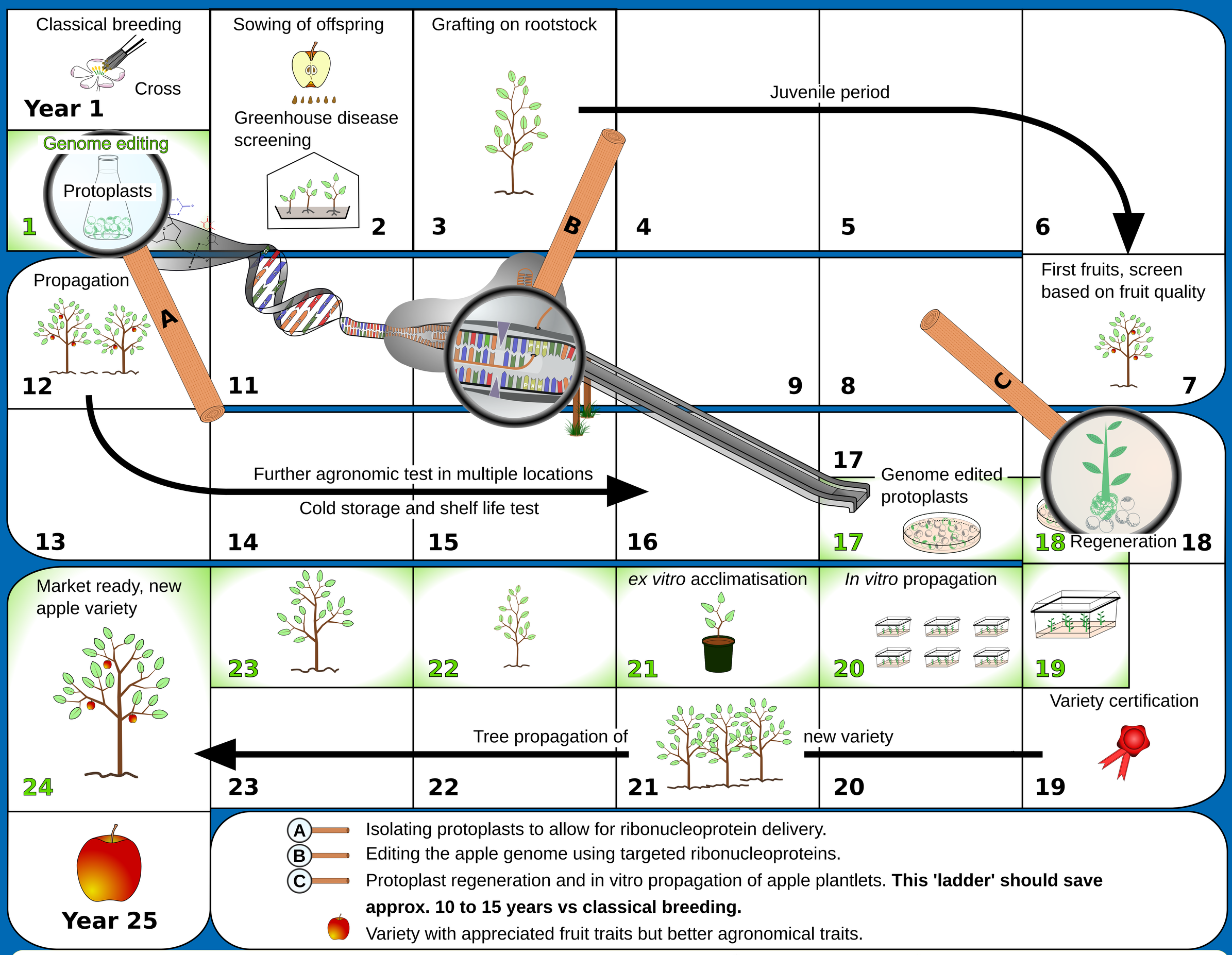

Figure 2: Snakes and Ladder scheme (dt. Leiterlispiel) comparing the classical breeding process ( ) and genome editing ( )

Summary and Outlook: Existing protocols for protoplast isolation (Malnoy et al., 2016) have been tested and optimized (magnifying glass A). In the next step, protoplast DNA will be altered by transiently transfecting the protoplasts with preassembled Cas9 ribonucleoproteins (magnifying glass B). Subsequently, protoplasts will be regenerated (magnifying glass C) which leads to a new apple variety with favorable traits and better disease resistance

de Baan, L. (2016). Agrarbericht 2016.
FAO (2018). www.fao.org/faostat/en
Malnoy, M. et al. (2016). Frontiers in plant science, 7:1904.

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