Blackcurrant Breeding in Burgundy (France): aims and challenges

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The cultivar "Noir de Bourgogne" (NB), a very old self-sterile cultivar from the 19's century, is grown mainly in Burgundy (France) to produce "Crème de cassis de Dijon" and "Crème de cassis de Bourgogne". This cultivar produces fruits with intense flavor and gives a liquor with protected geographical indication. Its organoleptic qualities are really different compared to other French and worldwide varieties. The last created varieties in France were Andega, Andorine and Andelene in the early 2000's. Then research and breeding activities on blackcurrant have stopped for almost 20 years in France.

In 2016, Burgundy producers and transformers decided to restart research programs, following several years with yield decreases. This was mainly due to the development of the White Peach Scale (*Pseudaulacaspis pentagona*) in the area. They formed a research team by looking for competences in the different local research structures. They also worked on other factors which could explain poor yield:

- Decrease of the blackcurrant pollinator populations (Andrena fulva; Osmia …)
- Effects of the climate change: earlier blossom destroyed by late freezing in April, time lag of the flowering of NB and its traditional pollen donor, Royal de Naples, drought and increase of temperatures before harvest.

A breeding program was first conducted in order to generate blackcurrant plants more resistant to white peach scale and with high heritability of the quality attributes of Noir de Bourgogne fruits. Since 2018, this breeding program has generated more than 316 hybrids from 10 parental combinations using controlled pollination methods. The agronomical parameters considered evolved :

- Satisfying yield, proving satisfying fertility
- Allowed auto-pollination with flowers with stamens above the pistil, flower quantity an floral induction study
- Late blossoming to avoid frost risk and early ripening to avoid heat risk
- Satisfying strength and growth, drought resistance (root architecture)
- Tolerance to White Peach Scale (WPS)
- Tolerance to diseases such as powdery mildew, anthracnose and rust.

Organoleptic properties of berries

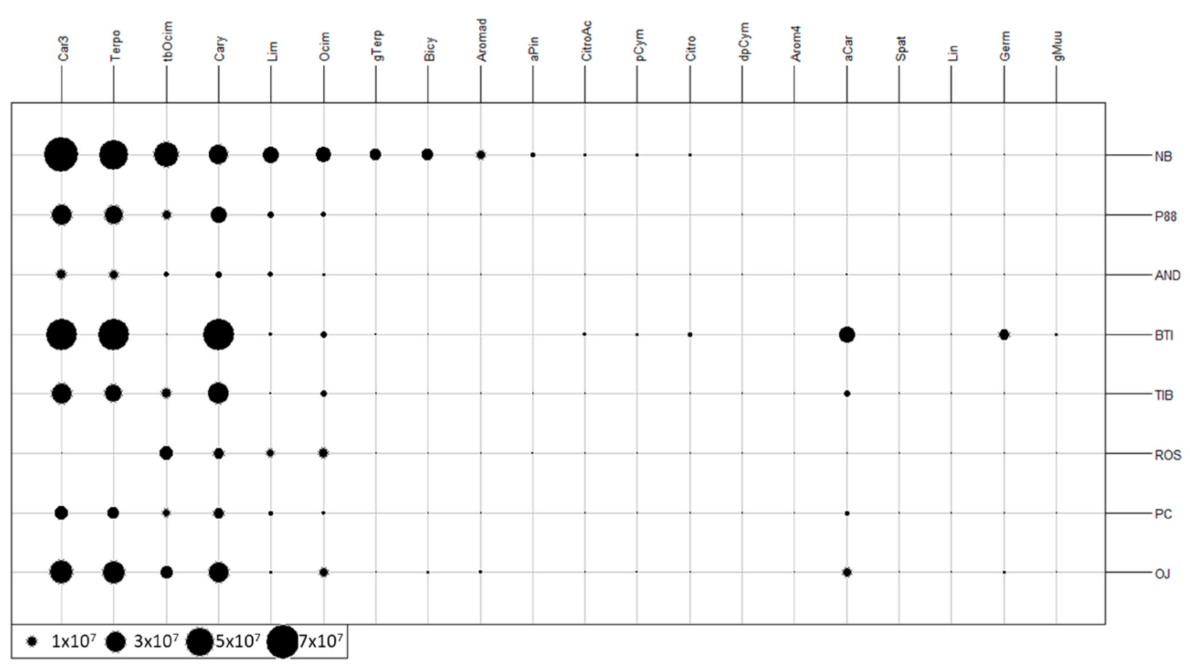


Figure 6. Two-dimensional table plot with proportional circles for peak areas of each volatile compound for the eight varieties harvested in 2020 used in the seven crosses (**NB: Noir de Bourgogne**, P88: 88-04-181, AND: Andega, BTI: Ben Tirran, TIB: Tiben, ROS: Rosenthal, PC: PC110, OJ:OJ-5-3).(Car3: 3-Carene, Terpo: Terpinolene, tbOcim: trans-beta-Ocimen, Cary: Caryophyllene, Lim:Limonene, Ocim: Ocimene, gTerp: gamma-Terpinene, Bicy: Bicyclogermacrene, Aromad: Aromadendrene,aPin: alpha-Pinene, CitroAc: Citronellyl Acetate, pCym: para-Cymene, Citro: Citronellol,dpCym: dehydro-para-Cymene, Arom4: 4-aromadendrene, aCar: alpha-Caryophyllene, Spat:Spatulenol, Lin: Linalol, Germ: Germacrene D, gMuu: gamma-Muurolene).

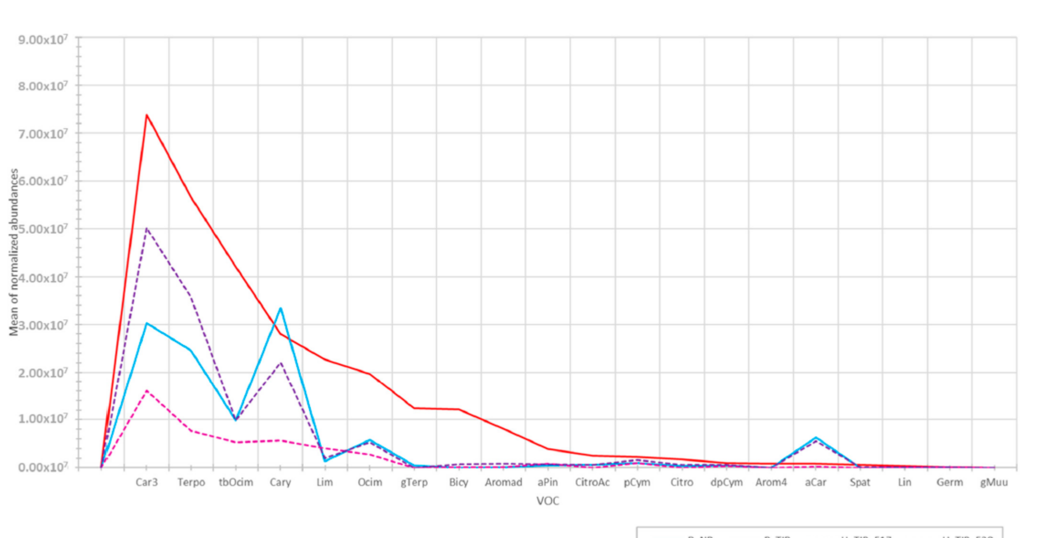
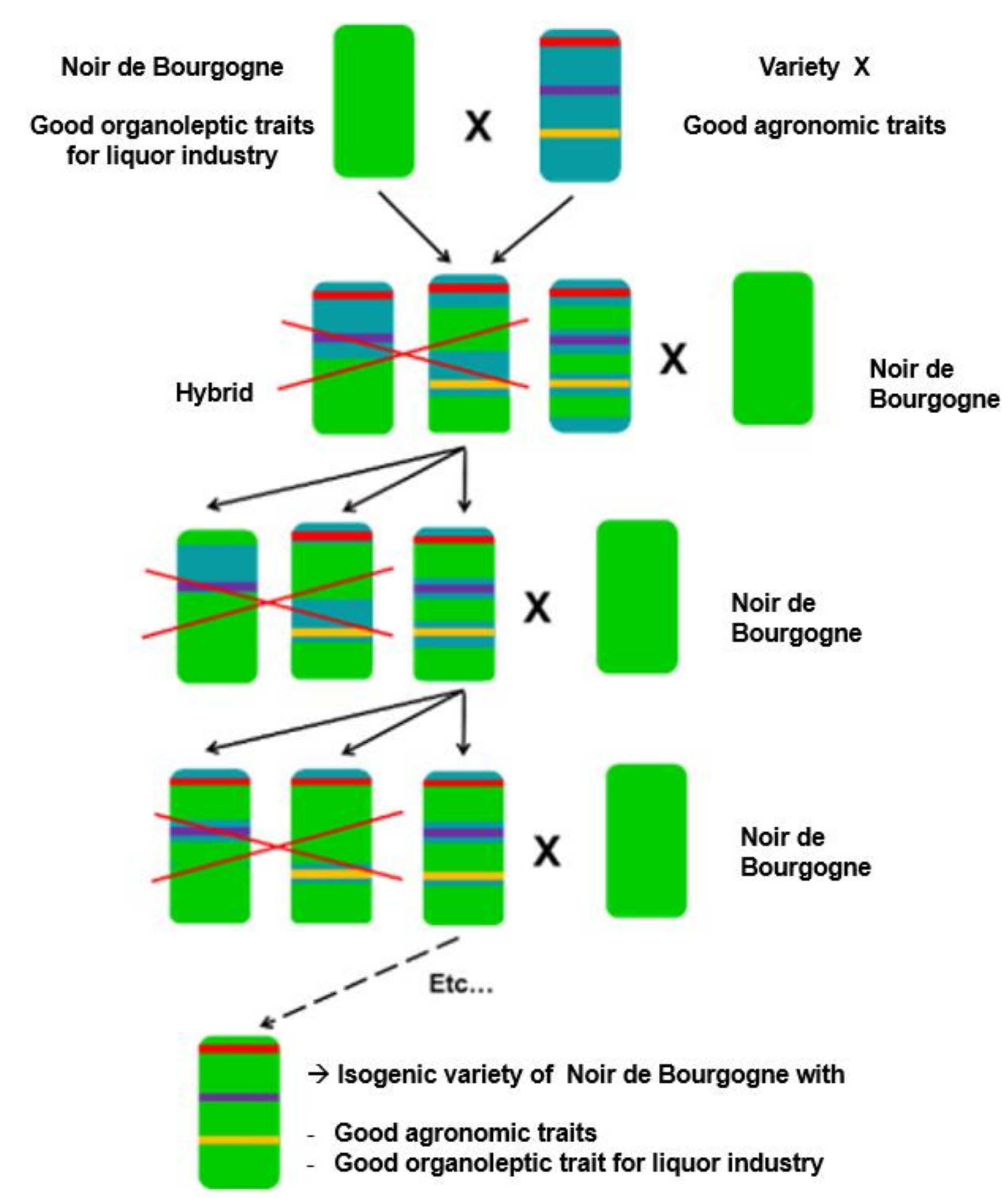


Figure 7. Profile in volatile compounds for Noir de Bourgogne (P_NB), Tiben (P_TIB), and two hybrids (H_TIB_F17 and H_TIB_F28) plants from their crosses (mean values of three replicates). Harvest 2020.



Flower induction (Figures 1 and 2) and root architecture (Figures 3 and 4) are being studied in different varieties of our collection as well as in hybrids and in the **context of drought stress**. Large variations can be observed between genotypes and these traits could be interesting for breeding programs.

Floral induction study

Figure 1. Flowers in a bud of Royal de Naples (February 2024) and observed under a binocular microscope.

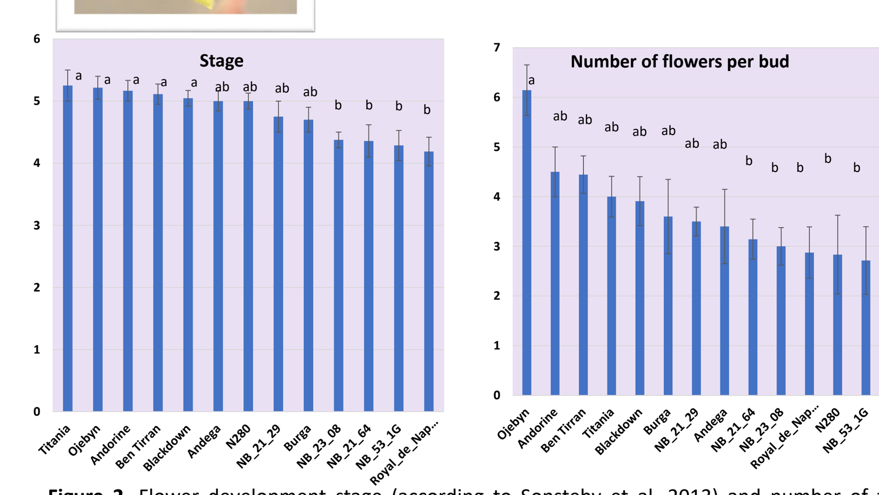


Figure 2. Flower development stage (according to Sonsteby et al. 2013) and number of flowers per bud in different genotypes of the Bretenieres collection (21/07/2022). NB: Noir de Bourgogne ; Mean ± SE.

Reference

Sonsteby A, Heide OM (2013) Variation in seasonal timing of flower bud initiation in black currant (*Ribes nigrum* L.) cultivars of contrasting geographic origin.

Roots architecture for drought resistance

Figure 3. Root development of Ben Tirran in a minirhizotron.

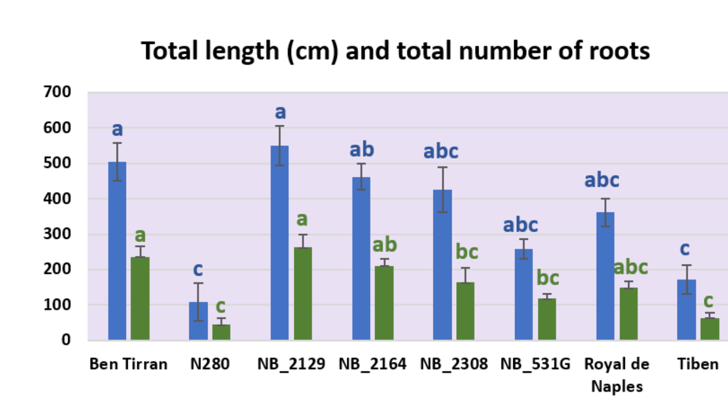


Figure 4. Total length and total number of roots of different blackcurrant genotypes grown in minirhizotrons. NB: Noir de Bourgogne ; Mean ± SE.

Allowed auto-pollination with flowers with stamens above the pistil

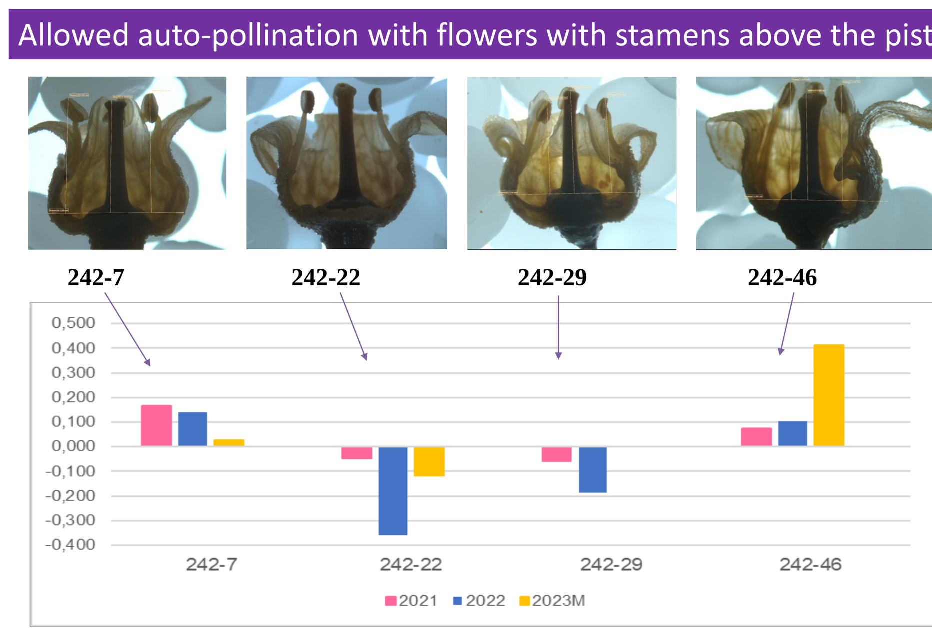


Figure 8. Anther–stigma distance (ASD) of 4 F1 Hybrids NB x Andega for 3 years in Merceuil (France). 5-6 flowers per F1 variety per year were studied.

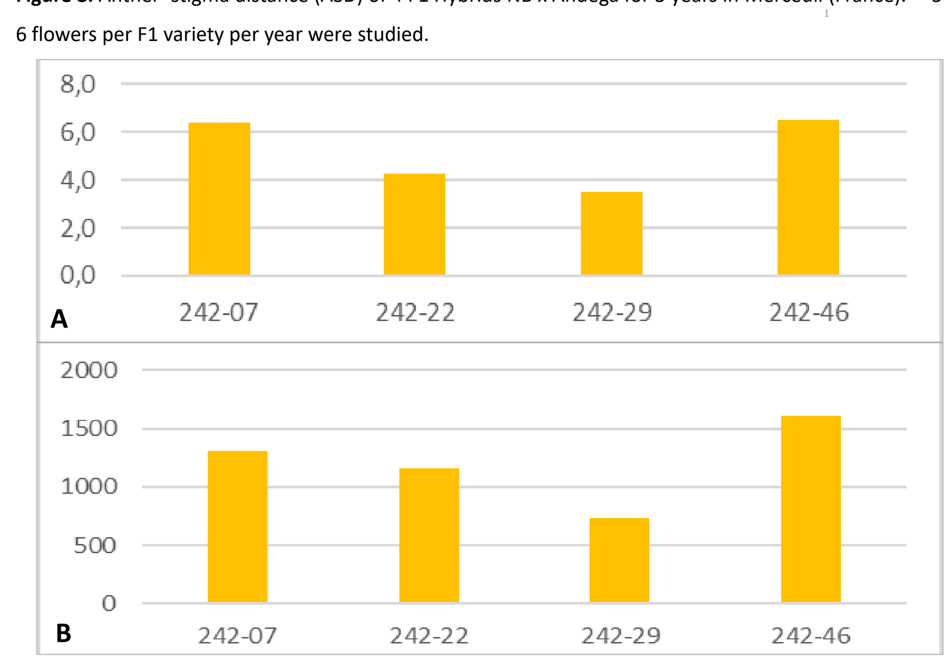


Figure 9. 2023 Harvest at Merceuil (France): F1 NB x Andega. **A**: Yield estimationn (T/ha). **B** : number of berries/ bush. A and b are calculated by harvesting 3 bushes/variety.
Yield an number of berriies are more importants whith positive ASD.

Late blossoming to avoid frost risk and early ripening to avoid heat risk

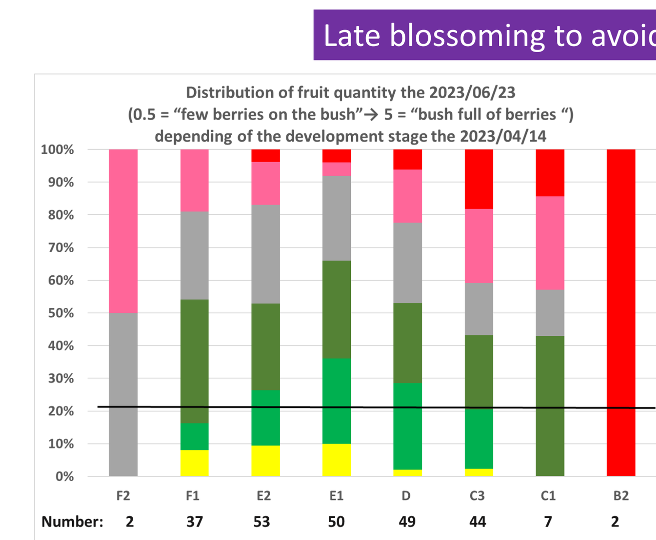


Figure 10. Distribution of fruit quantity the 2023/06/23 (0.5 = "only few berries on the bush"→ 5 = "bush full of berries ") depending of the development stage the 2023/04/14 (B2=green tips, C1: first leaves, C2: third leaves, D : flower buds in domes, E1: detached first flower buds, E2: all flower buds deployed, F1: first flowers, F2: 50% flowering); on 244 F1 hybrids,

Noir de Bourgogne was at stage E2 in April with a berries quantity score of 2 , We observed that we have mores berries when we had flowers buds (D/E1/E2 stage) during freezing in April. Those hybrids were in stage D the 2023/04/7.

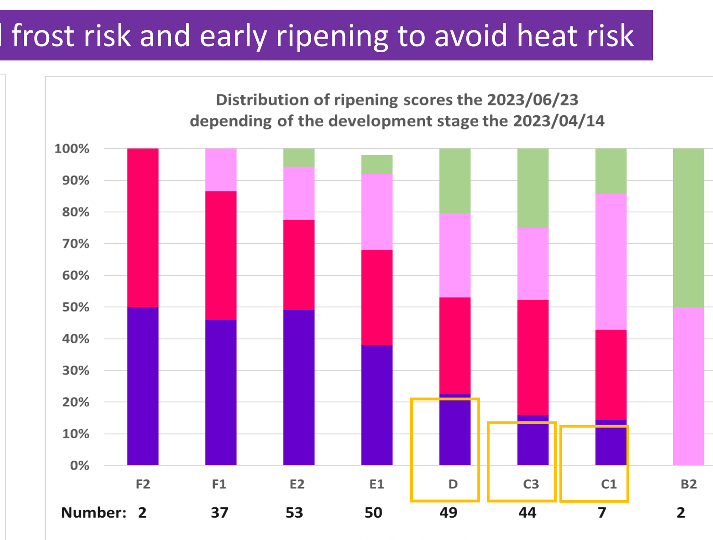


Figure 11. Distribution of ripening scores the 2023/06/23 (0.5 = "start of ripening" → 3 = "complete maturity ") depending of the development stage the 2023/04/14 (B2=green tips, C1: first leaves, C2: third leaves, D : flower buds in domes, E1: detached first flower buds, E2: all flower buds deployed, F1: first flowers, F2: 50% flowering); on 244 F1 hybrids,

Noir de Bourgogne was at stage E2 in April with a ripening score of 3 , We look for the framed phenotypes.

Scientific partners

Growers and industry partners

International Blackcurrant Conference, 11th to 14th June 2024, Leibnitz, Austria.