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► To cite this version:

Lucas Mazal, Boris Fumanal, Dov Jean-François Corenblit, Irène Till-Bottraud. Colonisation of alluvial banks by black poplar seedlings: how intra-specific interactions shape the spatial genetic structure. Young Researchers in Biology of Auvergne-Rhône-Alpes Region Congress, Jun 2021, Videoconference NextTech AR, France. . hal-03482819

HAL Id: hal-03482819

<https://hal.science/hal-03482819v1>

Submitted on 16 Dec 2021

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Colonisation of alluvial banks by black poplar seedlings: how intra-specific interactions shape the spatial genetic structure.

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Context and problematic

Populus nigra L. (Salicaceae) seedlings grow in high densities in stressful environment. Individual plants interact mostly with their direct neighbors. Spatial genetic structure (SGS) indicates the presence of related individuals close to each other. Thus, SGS pattern can influence what type of biotic interaction (positive or negative, see Fig1) will take place among immediate neighbors (i.e. within the zone of interaction). Moreover, intra-specific interactions can change with stress intensity. Studying SGS at a scale including the zone of interaction (ZOI) between plants allows to allows us to explore the type of interaction occurring between individuals.

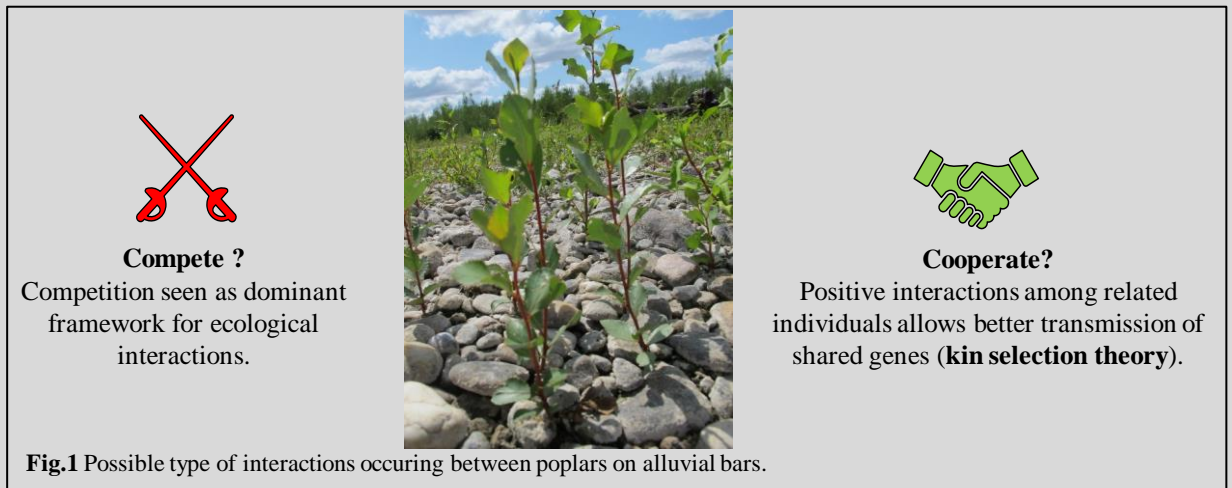


Fig.1 Possible type of interactions occurring between poplars on alluvial bars.

Material & Methods

We sampled individuals corresponding to three colonization stages: dispersion (seedlings), establishment (5 and 10 years old) and mature (more than 20 years old) along the Allier River. Each individual was georeferenced. We genotyped individuals using 6 microstallite markers and assessed the SGS for each colonization stage.

Key results and discussion

- ✓ We found highly related individuals at very close distances.
- ✓ The colonization process is coupled with a reduction of the stress level (Fig.2) as well as a decrease in density (Table 1).
- ✓ The ZOI increases (Table 1) as individuals grow, therefore they interact with individuals further away (Fig.2).
- ✓ SGS was detected at the establishment stage (Fig.2, 5 years old individuals) but not at the seedling or mature stage.
- ✓ We interpret this as a shift of intra-specific interactions from negative at the dispersion stage (i.e. competition) to positive at the establishment stage (i.e. facilitation, cooperation) and back to negative in mature stands. Positive interactions towards related individuals lead to the emergence of SGS at the establishment stage. Kin selection theory is a useful framework to understand these positive interactions towards related individuals.

Table 1. Description of the colonization stages. Zone of interaction values are mean \pm SE.

Cohort	Mean number of individuals	Mean area (m ²)	Mean density (inds/m ²)	Zone of interaction (m)
Seedlings	92	1,09	134	0.053 \pm 0.002
5 years old	16	21,5	0.94	1.50 \pm 0.36
10 years old	20	76,79	0,46	1.20 \pm 0.046
>20 years old	15	241,67	0,10	2.10 \pm 0.20

References

Mazal et al. (2021). Fine-scale spatial genetic structure and intra-specific interactions of *Populus nigra* within a natural river corridor along the lower Allier River (France). *Flora*, Elsevier, 2021, 275, pp.151763. [10.1016/j.flora.2021.151763](https://doi.org/10.1016/j.flora.2021.151763)

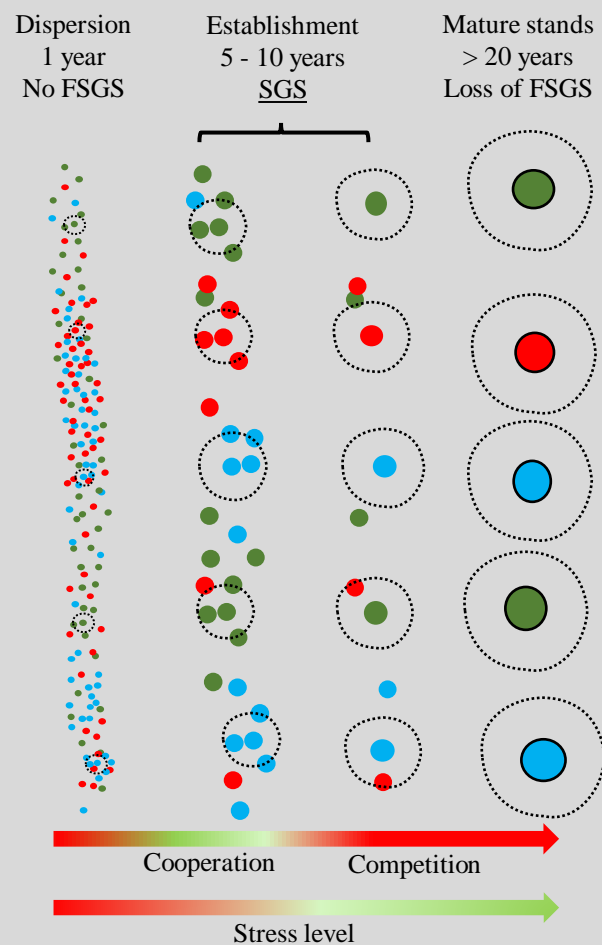


Fig.2 Evolution of the ZOI (dashed circle) along with the stress gradient, type of interactions and SGS.

Conclusion and perspectives

The evolution of SGS is closely linked with intraspecific interactions, which also dependent on the stress level. A change in the type of interaction can lead to the emergence or loss of SGS. The study of FSGS through time from dispersion to mature stands can be a valuable tool to understand and monitor intra-specific interactions. Cohort monitoring approach from establishment to the mature stage appears to be promising for understanding how riparian successions unfold and guide managements actions.