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Botrytis bunch rot in vineyards: still a challenge for commercial biological control products and novel microbial antagonists

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Abstract: The grey mould or botrytis bunch rot (BBR), caused by *Botrytis cinerea*, is the most important fungal disease in ripening grapevine bunches late in the growing season. The effects involve losses in yield as well as remarkable faults in wine quality. Biological control using antagonistic microorganisms is considered as a suitable alternative to control BBR in the field. After more than 20 years of research in biological control of BBR, grapevine growers have a little choices, i.e., in Europe only three products, based on biological control agents (BCAs), are commercially available. However, some other microorganisms are following the registration procedure and should be available in the near future. In addition, several research units in Europe are also investigating new biological control agents. The case study of *Candida sake* CPA-1 represents a long development process from laboratory to field application, including improved formulations, beforehand physiological adaptation of the strain, and high control levels in the field. Another interesting case study is the selection process of bacterial BCAs based on efficacy, mode of action, survival and persistence on berry surface, followed by a further field screening step involving four candidate strains, in which *Bacillus ginsengihumi* S38 resulted to be effective. Both are good examples of the methodologies and strategies needed to achieve effective biological control in the field, while they bring up the discussion on the appropriateness of selection process steps to follow. When applied in vineyards, commercial BCA products present efficacy rates that are sometimes variable and may depend on climatic conditions. Therefore, three different research programs at INRA Bordeaux-Aquitaine have focused in field efficacy of biological control products, in partnership with the French Institute of Grapevine & Wine (IFV), and the Gironde Agriculture Chamber. From 2012 to 2017, we tested commercial products based on *Aureobasidium pullulans*, *Bacillus subtilis* and *Bacillus amyloliquefaciens*, as well as other BCAs in a developmental stage. The goals were: 1) to

compare efficacy levels in commercial vineyards of registered products (or close to registration) in order to give advice to local growers in South-West of France, and 2) to test new microbial antagonists in experimental vineyards to improve its efficacy and confirm its potential as future BCAs against BBR. The results of these experiments have showed the comparative success of some of the BCAs compared to others. The commercial products have shown partial efficacy, not always significant, and highly variable according to the site*season conditions. As for the novel BCAs of prime importance, the efficacy results of both *C. sake* CPA-1 and *B. ginsengihumi* S38 showed similar control rates than registered, or close to registration, BCA products. The amount of field tests along 5 years of experiments, allows us to extract some conclusions about the reliability of BCA products in SO France region, as well as to confirm the potential of other microbial antagonists. This experience motivates the discussion on how to improve BCA performance in vineyards, based in some axes, such as: application timing regarding mode of action, application following Disease Support System, survival and persistence on vine organs, formulation, and combinational strategies. Key words: *Vitis vinifera*, natural products, biocontrol, wine grapes, disease risk model