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Impact of foliar nitrogen supplementation on Chardonnay and Sauvignon Blanc wines

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The effectiveness of an application of foliar nitrogen at veraison depends on the initial level of vine nitrogen deficiency, an Agroscope study has shown. The threshold levels of assimilable nitrogen deficiency in the grape must are validated for Chardonnay but still need to be confirmed for Sauvignon Blanc.

PHOTO LEAD. Agroscope's experimental vineyard at Nyon in Switzerland.

Introduction

Cultivation practices in our vineyards are gradually evolving towards reduced fertilisation and the increasing use of cover crops, intensifying competition for nitrogen. In this context, managing nitrogen nutrition in order to achieve a sustainable balance between vine vigour and grape composition is a genuine challenge. The amount of yeast-assimilable nitrogen (YAN) present in the grape must at harvest determines the vinification conditions and ultimately, the quality of the wine[1] [2]. Threshold levels of nitrogen deficiency have been defined for Chasselas musts: a YAN level of below 140 mg N/L is considered very low, between 140 and 200 mg N/L low, and above 200 mg N/L satisfactory [3]. A six-year trial was conducted at the Agroscope vineyard in Nyon (Switzerland) to test the effectiveness of a late foliar application (veraison) and thus validate the threshold levels of assimilable nitrogen for Chardonnay and Sauvignon Blanc wines.

Material and methods

The study was conducted at Agroscope's experimental vineyard in Nyon. Details of the material and methods are published in the reference article[4]. In 1994, two blocks of vines, one Chardonnay and the other Sauvignon Blanc (120 vines in each block) were uniformly planted in the same plot and cultivated using a simple guyot. From 2006 to 2011, each block was divided into two treatments: a control without supplementary nitrogen and a treatment fertilised with 20 kg N/ha of foliar urea, applied four times at weekly intervals around veraison. Each year from 2006 to 2011, various physiological parameters of the two varieties were measured and the grape must and wine were analysed. Vine vigour was estimated by weighing 50 shoots per treatment removed during winter from the penultimate position of the fruiting branch (no measurement in 2006). Bud fertility (i.e., the number of bunches per shoot) was estimated on 20 vines of each variety. The main mineral elements (N, P, K, Ca and Mg) were quantified on samples of 25 washed mature leaves collected from the bunch zone (leaf blade + petiole) after the fourth application of foliar urea (Sol-Conseil Laboratory, Gland, Switzerland). Berry weight was estimated by weighing a sample of 200 berries immediately before harvesting (no measurement in 2006). The yields were measured after harvesting. Bunch weight was estimated based on number of bunches per vine and yield. The grapes from each variety were pressed then vinified at Agroscope's experimental cellar in Nyon following a standard protocol. A must sample from each variety was analysed by infrared spectroscopy (WineScan, FOSS) for soluble sugars, total acidity (in eq. tartaric acid), tartaric and malic acid, pH and YAN. The Sauvignon Blanc wines were characterised by a high proportion of thiolated aromas (wood, grapefruit, passion fruit); the amount of 3-mercaptohexanol precursors (P-3MH) present in the Sauvignon Blanc must was measured in 2010 and 2011. The organoleptic profile of the wines was evaluated by a panel of Agroscope experts based on a predefined description. The study treatments were compared using a three-factor ANOVA test with interactions (year × variety × fertilisation × year*variety × year*fertilisation) followed by a post-hoc analysis (Tuckey, $p < 0.05$). The data were also analysed per variety using two-factor ANOVAs (year*fertilisation).

The application of nitrogen at veraison is effective except for severe deficiencies

The Chardonnay vine was moderately deficient in nitrogen initially (1.84% DM in the leaves at veraison), whereas the Sauvignon Blanc vines were more severely deficient (1.63% DM) and showed signs of reduced vigour. Foliar fertilisation increased nitrogen levels in the two varieties by 0.26±0.11% DM on average over a six-year period.Foliar fertilisation increased concentrations of YAN in the must (+69 mg/L for Chardonnay and +67 mg/L for Sauvignon Blanc). The average concentration of YAN in the must of the Chardonnay increased from a severely deficient level (125±32 mg N/L, control) to a satisfactory level after foliar fertilisation, (194±52 mg N/L, treatment fertilised); whereas that of the Sauvignon Blanc was so low (65±26 mg N/L, control) that it remained at a severely deficient level despite fertilisation (132±39 mg N/L, treatment fertilised).

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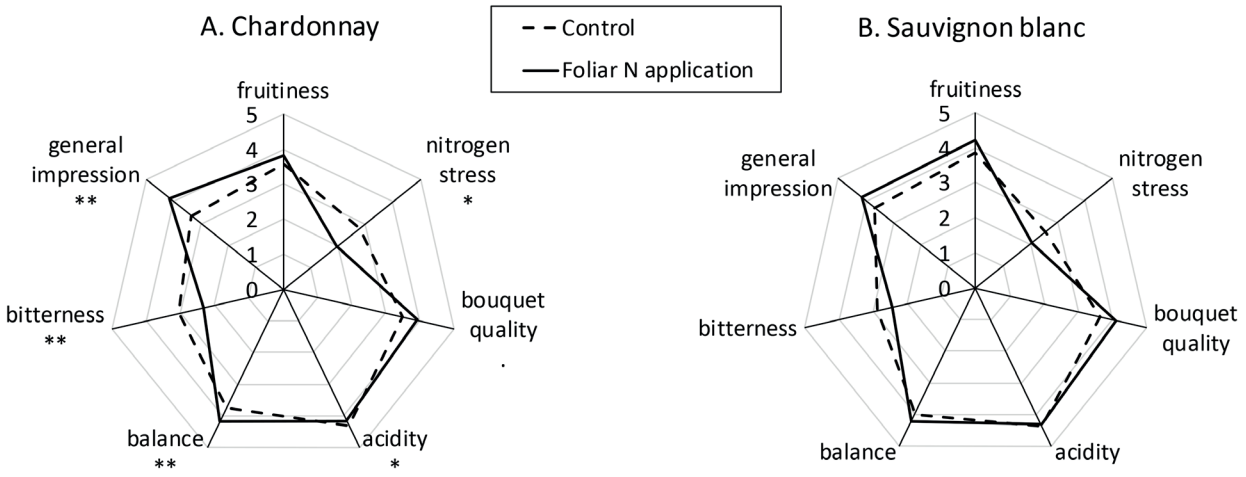

FIGURE 1. Comparison of the organoleptic profiles of wines produced from the control (0 kg N/ha) and the foliar nitrogen application treatment (20 kg N/ha) for Chardonnay (A) and Sauvignon Blanc (B). 2006–2011 averages. Analysis of variances: "." = $p < 0.10$; "*" = $p < 0.05$; "**" = $p < 0.01$.

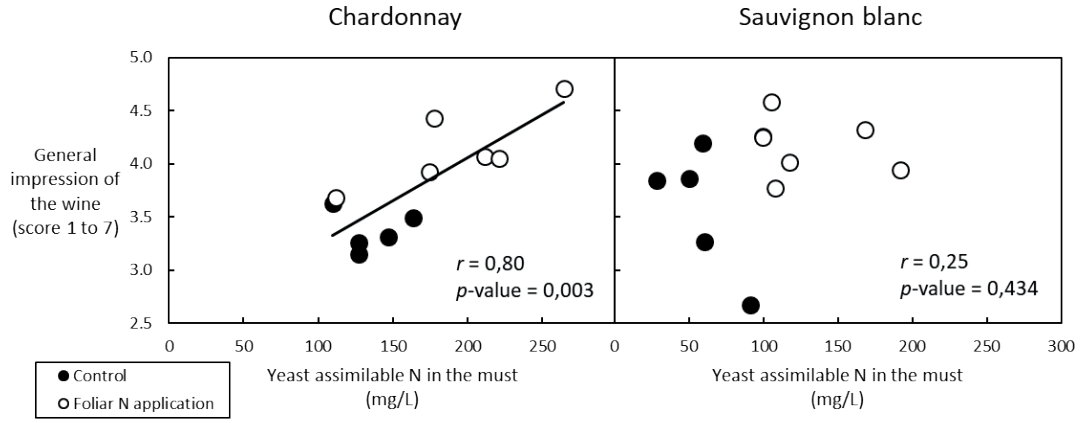

FIGURE 2. Correlations between the concentration of yeast-assimilable nitrogen in the must at harvest and the general impression of the wines during tasting; highly significant for Chardonnay (A) and insignificant for Sauvignon Blanc (B). Nyon, Switzerland, 2006-2011. Each year includes a non-fertilised control (0 kg N/ha, black dots) and a treatment with foliar nitrogen application (20 kg N/ha, white dots).

Threshold levels of YAN deficiency valid for Chardonnay but to be confirmed for Sauvignon Blanc

During tasting, the Chardonnay wines from the fertilised treatments gave a better general impression compared with the control wines from the same year. The delicacy of their bouquet came to the fore, with notably fewer negative aromas linked to nitrogen stress in the must (hay, wax and wet floorcloth). In the mouth, these same wines had a better balance associated with a noticeably reduced level of bitterness and astringency (Figure 1). The Sauvignon Blanc wines showed the same tendencies as the Chardonnay, but differences [between the treated and control versions] were not significant due to the low level of assimilable nitrogen, which remained below the critical 140 mg N/L. The correlation between the level of YAN in the grape must and the general impression given by the wine was highly significant for the Chardonnay ($p = 0.003$), but negligible for the Sauvignon Blanc (Figure 2). Thus, it seems that the threshold levels of YAN deficiency in the must established for Chasselas are also valid for Chardonnay but still need to be confirmed for Sauvignon Blanc.

Conclusion

- The application of foliar nitrogen at veraison is an effective means of increasing the concentration of assimilable nitrogen in grape must, with minimal impact on vine vigour.
- The application of foliar nitrogen improved the quality of wines produced from moderately nitrogen-deficient vines. However, it was insufficient in the case of severe nitrogen deficiency, which would require the nutritional balance of the vine first to be restored.
- The threshold levels of YAN deficiency in the must established for Chasselas are also valid for Chardonnay but still need to be confirmed for Sauvignon Blanc.
- The Sauvignon Blanc vines showed more pronounced signs of nitrogen deficiency than the Chardonnay vines under equivalent growing conditions, highlighting the influence of genetics on grapevine nitrogen nutrition. ■

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Sources: *Sourced from the research article: " Impact d'une supplémentation en azote foliaire sur les vins de Chardonnay et Sauvignon blanc" (Recherche Agronomique Suisse, 2024).*

This translation is provided by Agroscope.

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