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Interactions between cytokinin and nitrogen contribute to grain mass in wheat cultivars by regulating the flag leaf senescence process

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Abstract: Premature senescence after anthesis reduces crop yields. Delaying leaf senescence could maintain photosynthetic activity for a longer period and lead to a higher photosynthetic rate. Recent studies have provided some insights into the interaction between cytokinin and nitrogen (N) in the regulation of plant development. In the present study, foliar application of exogenous 6-benzylaminopurine (6-BA) and lovastatin, an inhibitor of cytokinin synthesis, was combined with three N rates [0 kg ha^{-1} (low nitrogen, LN), 240 kg ha^{-1} (normal nitrogen, NN), and 360 kg ha^{-1} (high nitrogen, HN)] in two wheat cultivars, Wennong 6 (with a staygreen phenotype) and Jimai 20 (with a non-staygreen phenotype). Flag leaf senescence was assessed using a Gompertz growth curve. Grain mass, dry matter accumulation and distribution, total N of flag leaf, and concentrations of zeatin riboside (ZR) and abscisic acid (ABA) were also used to evaluate the functional characteristics of flag leaves. Grain mass was negatively correlated with initial senescence rate (r_0) and duration of rapid chlorophyll loss (Chl_{loss}), whereas it was positively correlated with maximum senescence rate (r_{max}), average senescence rate (r_{aver}), persistence phase (Chl_{per}), total duration of flag leaf (Chl_{total}) and inflection point cumulative temperature (M). Compared to Jimai 20, Wennong 6 had larger r_{aver}, Chl_{per}, and Chl_{total}. The concentration of ZR was highest under the 6-BA×NN treatment, followed by the 6-BA×HN and 6-BA×LN treatments. However, the concentration of ABA showed the opposite trend. It was concluded that the staygreen phenotype Wennong 6 was associated with greater grain mass and altered cytokinin metabolism and could be classified as a functional staygreen type. Foliar application of 6-BA interacting with N at the NN level (240 kg ha^{-1}) may be a beneficial strategy for improving grain yield of wheat by regulating endogenous hormones and the flag leaf senescence process. Increasing endogenous cytokinin promoted the transport of dry matter to grain.

Keywords: *Triticum aestivum* L.; Interaction; Cytokinin; Nitrogen; Staygreen wheat; Flag leaf senescence

1. Introduction

Leaf senescence is a developmental process that involves degradation of macromolecules such as nucleic acids and proteins, accumulation of reactive oxygen species, and a transition from nutrient assimilation to nutrient remobilization [1–3]. Premature senescence can lead to a reduction in canopy size, loss of light use efficiency, and decreased crop yield [4]. Delaying leaf senescence may enhance drought tolerance and improve the productivity of crop plants [4, 5]. Recent findings have indicated that flag leaves are major photosynthetic organs during the grain-filling period in cereal crops such as wheat (*Triticum aestivum* L.) and rice (*Oryza sativa* L.), making a major (41%–43%) contribution to crop yield [6, 7]. Accordingly, most studies of leaf senescence have focused on flag leaf senescence.

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