Dear Editor,

We would like to submit for publication in *Science* our work entitled *“Plant decision-making coordinating root responses to nitrogen cues involves cytokinin”.* We believe that this is the first time that *plant decision-making* is experimentally tested in a complete physiological framework and that an essential compound for the *decision* is identified.

In our work, we study *Arabidopsis thaliana* root development and transcriptome responses to various conditions of nutrient supply and we choose to assess nitrate as the nutrient because it is known to be limiting and an important signaling molecule controlling development and metabolism.

As previously known, in a nitrate-deprived medium, the strategy of the plant is to proliferate its roots to explore the soil In this study, we study root proliferation in high nitrate, low nitrate, and mixed high-low nitrate using the split-root experimental set up. We show that the gene expression and consequent lateral development of the root part in the high-nitrate area of the mixed envirotnment behave like the root parts of totally nitrate-deprived plants. Thus, the first part of our study establishes robust physiological and transcriptomic evidence of plant decision making in heterogeneous settings.

In the second part of the study and by using reporter genes of the plant decision, we demonstrate that i) nitrate itself is the signaling molecule sensed and triggering the plant decision in high-low nitrate settings, and ii) that the shoots are the central integrator of the nitrate availability to the whole root system. Then, since interplay between root and shoot is the key component of the plant decision, we test whether cytokinins, the phytohormones known to be a nitrate induced root-to-shoot traveler, could be a part of the plant “central integrator system”. To this end, we demonstrate that in a cytokinin biosynthesis mutant (named *ipt3,5,7*), the ability to reprogram the roots at a molecular and morphological level specifically in the nitrate patch of the heterogeneous environment is lost. This demonstrates that in our framework this mutant is not impaired in growth but rather in its capacity to take the decision to grow preferentially in nitrate rich patch.

Thus, with this study, we believe that we provide a framework to assess decision process in plants that are able to integrate internal and external information in order to optimize their growth in the context of a nutrient fluctuating environments. We propose an in-depth analysis of the molecular events involved in such decision. Finally, we identify cytokinins as a key compound for plant decision.

We believe that this work will be of interest to the entire community of scientists, not just plant biologists, because we demonstrate that *decision-making* in plants is an important adaptation process to fluctuating environments having one class of hormones as a messenger. Also, because plants are the conduit for mineral nutrients toward the animal world, understanding their capacity to adapt to fluctuating environments and identifying molecular targets of this capacity are critical to major issues concerning pollution, ecological sustainability and human health.

Thank you for giving this submission your expert consideration.

Sincerely

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