Changes of Residue Function and Signaling Regrowth after Forage Cutting

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Introduction The world is facing big challenges that farming field keeps reducing; water resource becomes shorter and limited resource degrades continuously. Grassland stockbreeding is more efficient than simple cultivation, so it has been considered an effective solution in agriculture. Cutting (or mowing, foliating and even grazing) is one of the most constant methods to utilize grassland, especially artificial grassland. The regrowth after cutting is essential to the utilization of forage and grassland. The changes in residue function and the signal transduction during regrowth is still not fully understood and is attracting more and more attentions.

Changes of residue function After forage is cut, the compounds stored in residues will be activated and reallocated among remained parts of the plant. The reallocation will help residue regrow as soon as possible. Most importantly, the reallocation will stimulate the remained residues, altering their functions. And in response to the actual stimulus, cutting, the residue also has to change its original function to adapt new situation. Photosynthesis is essential for residue living. With this process, substance and energy can be produced and the residue can regrow smoothly. Photosynthetic rate of the aboveground parts will increase, resulting in more production and accumulation of carbohydrates. Meanwhile, the residue will keep higher rate of photosynthesis for a longer period after cutting. Intriguingly, new tillers and shoots also have greater rate than the control. Compounds reallocation and photosynthesis enhancement lead to smooth regrowing of the aboveground part, but restrict the growth of roots. However, this restriction happens without weakening its function. After cutting root absorption and uptake can be enhanced (Osmond et al., 1997). In addition, the transmission distance is shortened after cutting, so it is understandable that translating ability is to be enhanced.

Signaling regrowth after forage cutting Many evidences have been shown that signals will appear when plant encounters environmental stimuli, including biotic and abiotic stimuli. These signals conclude phytohormones, ions, and secondary metabolites. Cutting (and grazing) is also one kind of abiotic stimulus. So, some of the signals functioning in plant response to known stimuli will be reasonably effective in the signal transduction of regrowth after forage cutting. It is understandable that phytohormones, such as ABA, IAA, GA_3 and CKs, play important roles in the regrowth after cutting. And also cytosolic Ca^{2+} is expected a fundamental signal in this signaling. In addition, some secondary metabolites, such as amino acid, protein, simple carbohydrate, may also act as signals to elicit the regrowing response. The hypothesized signal transduction in forage regrowth should include all these elements. Phytohormones, such as IAA and GA_3, will affect the reallocation of reserves and the translocation of newly synthesized carbohydrates. ABA and Ca^{2+} concentration will be involved in the regulation of stomatal movement (Yang et al., 2004), leading to change in photosynthesis. The pH variation in xylem sap leads to changes in transmission of xylem. However, most of the aforementioned signals and signaling are just supposed to work in the regrowing process. Further investigation needs to be done.

Concluding remarks What signal does connect cutting stimulus with residue regrowth? Further work has to be done to investigate which the right one is and how it does. From the viewpoint of methodology, analytic chemistry and biophysics should be integrated to investigate the substances working beneath the regrowth. And, stomatal regulation and photosynthesis variation can be put more attentions. In addition, change in root function is also worth of further exploration.

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