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Protein kinase sensors: an overview of new designs for visualizing kinase dynamics in single plant cells

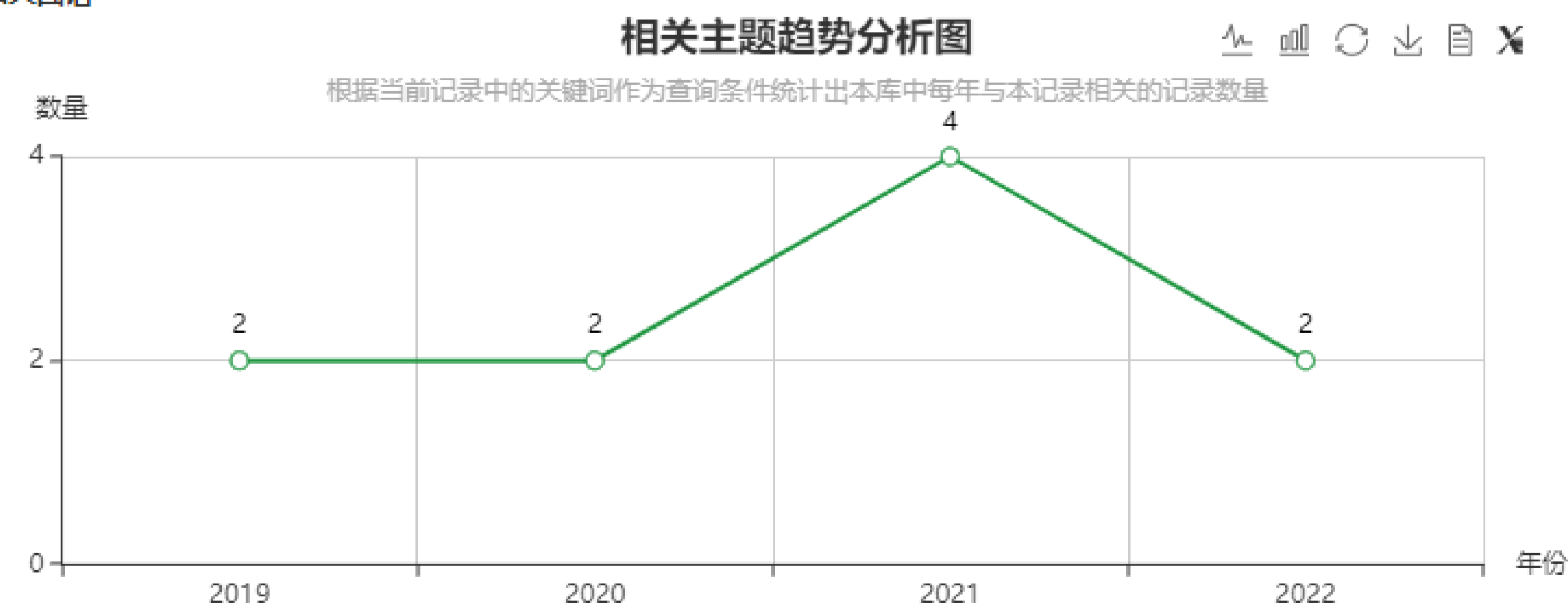
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摘要	Protein kinase dynamics play key roles in regulation of cell differentiation, growth, development and in diverse cell signaling networks. Protein kinase sensors enable visualization of protein kinase activity in living cells and tissues in time and space. These sensors have therefore become important and powerful molecular tools for investigation of diverse kinase activities and can resolve long-standing and challenging biological questions. In the present Update, we review new advanced approaches for genetically encoded protein kinase biosensor designs developed in animal systems together with the basis of each biosensor' s working principle and components. In addition, we review recent first examples of real time plant protein kinase activity biosensor development and application. We discuss how these sensors have helped to resolve how stomatal signal transduction in response to elevated CO ₂ merges with abscisic acid signaling downstream of a resolved basal SnRK2 kinase activity in guard cells. Furthermore, recent advances, combined with the new strategies described in this Update, can help deepen the understanding of how signaling networks regulate unique functions and responses in distinct plant cell types and tissues and how different stimuli and signaling pathways can interact.
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