ABSTRACT

PLANTS SHARE with animals and yeast the principle of cyclin-dependent kinase (CDK) governed progression through the cell cycle. Especially the entry into mitosis is tightly controlled by the master regulators of the PSTAIRE-containing CDK family. Their activity is precisely regulated and in animals and yeast it has been found that in particular phosphorylation of two domains of the kinase play pivotal roles for its function, namely the T-loop and the P-loop.

In this study, it is shown that the *Arabidopsis thaliana* Cdk1 homolog CDKA;1 has to be phosphorylated at the conserved Thr161 residue in the T-loop to achieve full activity similar to animals and yeast. The phospho-mimicry *T161D* substitution displayed a dramatically reduced kinase activity but homozygous *cdka;1* mutant plants could be recovered displaying various developmental abnormalities. Thus, the *T161D* substitution represents a weak loss-of-function mutant of CDKA;1 that allowed adressing the postembryonic requirements of CDK activity during plant development. For instance, it demonstrated that CDKA;1 is not only a major regulator of mitosis but also of the meiotic program. Interestingly, the CDKA;1 requirements for a meiotic cell cycle appeared to be higher than for a mitotic cell cycle.

A key regulatory event of Cdk1 of metazoans and *S. pombe* is their activation by the removal of inhibitory phosphate groups in the P-loop catalyzed by Cdc25 phosphatases. In contrast to all other multicellular organisms analyzed so far, this study showed that in *Arabidopsis*, cell cycle control does not depend on the dephosphorylation of CDKA;1 and a *T14V*/*Y15F* dephospho-substitution could completely complement *cdka;1* mutants. Furthermore, in metazoans, P-loop phosphorylation is of utmost importance to arrest cell cycle progression upon DNA damage. However, here it is shown that in plants the DNA damage checkpoint can operate independently of this phospho-regulatory mechanism.

Taken together, the observations reveal a surprising degree of divergence in the circuitry of highly conserved core cell cycle regulators in multicellular organisms. Moreover, a large set of tools was generated in this study to further explore the regulation of CDKA;1 and the interplay between cell cycle regulation and plant development.