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Purple Acid Phosphatase2 Stimulates a Futile Cycle of Fatty Acid Synthesis and Degradation and Can Mitigate the Negative Growth Effects of Triacylglycerol Accumulation in Vegetative Tissues

Background/Objective

- Storage lipids such as triacylglycerols (TAGs) are important plant energy and carbon reserve, but hyperaccumulation of TAG in vegetative tissues can cause negative growth effects.
- Purple acid phosphatase2 (PAP2) was shown previously to affect carbon metabolism and boost plant growth. However, the effects of PAP2 on lipid metabolism were unknown.

Approach

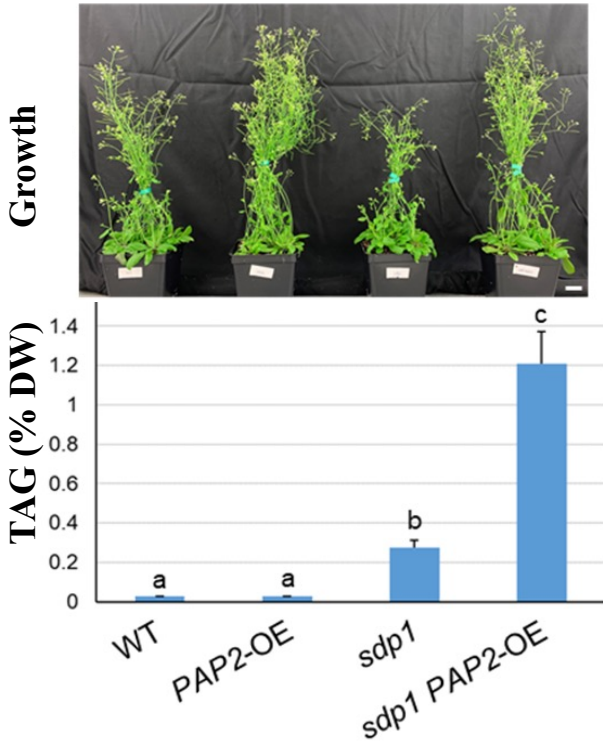
We combined PAP2-OE with a TAG lipase mutant (*sdp1*) or a PDAT1-overexpression to suppress lipid degradation or convert membrane lipids into TAG, respectively, to test if increasing the fatty acid (FA) synthesis rate can drive enhanced membrane lipid synthesis to support fast growth in PAP2-OE.

Results

We demonstrated that PAP2 stimulates a futile cycle of FA synthesis and degradation while mitigating negative growth effects associated with TAG accumulation in vegetative tissues. Constitutive expression of PAP2 in Arabidopsis enhanced both lipid synthesis and degradation in leaves and led to substantial increase in seed oil yield.

Significance/Impacts

These results highlight the potential of combining PAP2 with TAG-promoting factors to enhance carbon assimilation, FA synthesis, and allocation to TAGs for optimized plant growth and storage lipid accumulation in vegetative tissues.



Overexpression of PAP2 increases biomass production and stimulates a cycle of synthesis and degradation of lipids. Inactivation of *sdp1* lipase blocks the futile cycle and restores biomass.

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