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Effects of Arabidopsis thaliana Villin-4 mutations on root hair physiology, morphology and function

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Abstract
The protein VILIN (VLN) is found in both plants and animals across many taxa. In plants, one of the roles of VLN is to aid in root hair formation and function. They do this by assisting in maintenance of actin bundles in root hairs. It has been found that Arabidopsis thaliana with mutated VLN4 have compromised actin bundles and in certain cases shorter or dysfunctional root hairs. This study examines the affect that mutations in VLN4 has on parts of plant physiology. By examining the changes in responses of A. thaliana vln4 mutants to various external abiotic conditions, this study aims to uncover novel phenotypes. Specifically, this study looks at how VLN mutants affect the plant's ability to detect gravity in the presence or absence of salt, in addition to how vln mutants affect root hair growth and morphology in a sucrose environment. Although this study is ongoing, a potential phenotype has been identified. As of yet, the data suggests that sucrose and cold conditions have no apparent affect on root hair growth or morphology. However, the data is starting to suggest that the presence of 100 mM NaCl does affect A. thaliana gravitropism.

What are Villins and Why Study Them?
- Villins are a protein responsible for the dynamic nature of the cytoskeleton and its regulation in vertebrates and plants
- Villins are most likely an ancient protein evolved to regulate the cytoskeleton
- Research in the gelsolin/villin family began in the 1980s and has increased our understanding of actin’s role in many cytoskeletal functions across many taxa
- Villins are integral in actin filament bundling and severing

Effect of Sucrose on A. thaliana VLN mutations
Methods and Results:
Seeds were vernalized, surface sterilized, and then planted on either 100 mM NaCl, 1% Agar MS media (Salt condition) or 1% Agar MS media (MS condition.) Plants were allowed to grow one week and then turned exactly 90°, and allowed to grow for an additional week. After the two week growth period plates were photographed and measurements 1-5 and angle of curvature were recorded using ImageJ (Fig 3,4.)

Conclusions
Previous literature indicated that salt concentrations have an effect on VLN4 function (Zhao et al., 2013.) No significant differences were found for measurements 1,2,4,5 or angle of curvature for vln mutants when compared to the wild-type grown on media with or without salt. However, a significant difference was found for measurement 3 between vln mutants compared to the wild-type when grown on media with and without salt (Fig 5, Table 1.) Although preliminary, this suggests that mutations in VLN4 do not seem to affect overall growth (measurement 1) or ability to respond to gravity (measurement 2/angle), but that it potentially affects how long it takes the plants to respond to gravity (measurement 3.)

Although other literature indicates potential phenotypic differences in root hairs when grown on 3% sucrose, none were observed (Fig 2.) When combined, these data suggest that VLN4 functions in directional growth responses in elongating root cells rather than affecting root hairs.

Literature Cited