

Structure Determination of Strigolactones - Germination Stimulants for Root Parasitic Plants

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Strigolactones (SLs) are plant secondary metabolites that are structurally related to strigol, which was first identified as a germination stimulant for the root parasitic weed witchweed, *Striga lutea*. SLs induce seed germination not only in hemiparasites *Striga* spp. but also in holoparasites broomrapes (*Orobanche* and *Phelipanche* spp.), both of the Orobanchaceae. These root parasitic weeds cause enormous damage to agricultural production all over the world, because appropriate and economically feasible control measures have not yet been developed. Furthermore, these weeds are gradually invading crop lands in both developing and developed countries. Extensive studies on the characterization of SLs produced by various plant species have demonstrated that most land plants produce and release not a single but a mixture of SLs.

Striga germination stimulants produced by plants and structurally related to strigol were originally named “strigolactones (SLs).” Five SLs, strigol, strigyl acetate, sorgolactone, alectrol and orobanchol, were characterized in the latter half of the 20th century. To date, about 30 SLs have been identified, and it is now known that they function not only in the rhizosphere as chemical cues for symbiosis and parasitism but also as plant hormones regulating various aspects of plant growth and development through crosstalk with other hormones *in planta*. These (canonical) SLs contain an ABC-ring connected to the methylbutenolide D-ring *via* an enol-ether bridge, and all of them, except for 5-deoxystrigol (5DS) which was isolated as a branching factor for arbuscular mycorrhizal (AM) fungi, were first identified as germination stimulants for *Striga* and/or *Orobanche*. The canonical SLs are synthesized from carotenoids *via* a common intermediate, carlactone (CL), which lacks the B and C rings of the canonical SLs.

Recently, novel germination stimulants that are structurally distinct from canonical SLs have been identified. These include avenanol, methyl carlactonoate (MeCLA) and heliolactone, which lack the B and C rings and appear to be derived from CL. This group of stimulants seems to be widely distributed in the plant kingdom and some of them contain only the enol-ether-D ring moiety. CL itself and its oxidized metabolites, 19-hydroxy-CL and carlactonoic acid (CLA), exhibit weak but distinct germination stimulatory activities on *Striga* and *Orobanche* seeds. In this paper, chemical diversity of SLs and their biological activities are summarized.

References

- [1] Xie X, Yoneyama K and Yoneyama K (2010) The strigolactone story. *Annu Rev Phytopathol* 48: 93-117.
- [2] Xie X, Yoneyama K, Kisugi T, Uchida K, Ito S, Akiyama K, Hayashi H, Yokota T, Nomura T and Yoneyama K (2013) Confirming stereochemical structures of strigolactones produced by rice and tobacco. *Mol Plant* 6: 153-163.