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AMINO ACIDS AS OROBANCHICIDES: AN INNOVATIVE APPROACH FOR BIOCONTROL OF BROOMRAPE WEEDS

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Broomrapes (*Orobanche* and *Phelipanche* spp) are obligate, chlorophyll-lacking, root parasitic weeds that obtain all their nutrient resources by feeding off many important crops via their haustoria. France suffers from severe infestations of three broomrape species, *O. cumana* Wallr. infecting sunflower, *O. minor* Sm. infecting forage legumes and *P. ramosa* L. (syn *O. ramosa*) infecting hemp, oilseed rape, and tobacco. Several broomrape traits such as mass seed production, their easy dispersal and longevity, germination induced by host root exudates, specialized host range, and physical and metabolic overlap with the host make the management of these weeds very difficult. Successful control strategies must target parasitic subterranean stages in order to hamper both the main parasitic sink for nutrients and the subsequent parasitic seed production. An effective strategy to control broomrape is the foliar application of systemic herbicides to herbicide-resistant crops. The crop will deliver the herbicidal effect into the broomrape attached to their roots by translocating the herbicide systemically to the young parasite via the haustorium at the host-parasite interface. Among those herbicides, glyphosate, imidazolinones and sulfonylureas specifically inhibit either the aromatic or the branched-chain amino acid synthesis in the parasite by targeting key enzymes in their synthesis pathways. This method is one of the few available strategies efficient for broomrape control however it presents two main drawbacks. First, herbicide resistance is not available for many important crops and second, increasing concerns for environmental pollution. An environmental-friendly alternative to this method could be the use of broomrape-specific inhibitory amino acids. Amino acid synthesis pathways are regulated by feedback inhibition of controlling enzymes by some of the amino acid end-products resulting in starvation of other amino acids in the same pathway and as consequence growth inhibition. The suppressive activity of amino acid end-products varies according with species and life stages. Laboratory experiments revealed that methionine and lysine inhibit the germination and radicle elongation of the broomrape species affecting French agriculture. This developmental inhibition hampers the infective potential of broomrape seedbank in the host crop. Additional mechanisms such as elicitation of resistance by methionine against *Orobanche* root penetration as well as the use of selected and characterized strains of *Fusarium oxysporum* f. sp. *orthoceras* are being investigated. Methionine and lysine are produced in large scale as animal feed supplements and can be delivered to the soil during the short infective period in which broomrape germination and host infection occur. The persistence of the amino acid is predicted to be low beyond this short time frame due to soil microbial metabolization. The *Orobanche* Biocontrol Project at INRA-Dijon is carrying out in vitro, rhizotron and field experiments aimed to optimize the potential use of methionine and lysine as orobanchicides. This project is funded by Santé des Plantes et Environnement division (SPE-www.spe.inra.fr).