SUSTAINABLE SUNFLOWER BROOMRAPE CONTROL WITH A DUAL MODE OF ACTION APPROACH

Johannes BESSAİ, Matthias PFENNİNG*

BASF SE – Agricultural Products, 67117 Limburgerhof, Germany
**Corresponding author: matthias.pfenning@basf.com*

Abstract

Effective broomrape control is one of the main cornerstones for a viable sunflower production in Europe. Many different strategies to reduce the impact of broomrape on sunflower have been tested. Today only breeding for genetic tolerance against broomrape and the chemical control of the parasite in herbicide tolerant sunflowers remain.

Conventional weed control systems developed for non-parasitic weeds are not suitable for broomrape control due to the underground development of the host attached parasite. With the introduction of the herbicide tolerant Clearfield® Production System for sunflower, the first effective chemical tool against *Orobanche cumana* has become available. It was quickly adopted by sunflower farmers which are faced with difficult to control weeds and multiple, quickly changing races of broomrape. The Clearfield Production System, as well as the newly developed Clearfield® Plus Production System, are both based on altered target-site acetohyrdoxyacid synthase (AHAS) genes, natural and induced mutations which allow the utilization of customized imidazolinone herbicides in sunflower. Target-site herbicide tolerance of the host crop is important for *O. cumana* control, as it permits a longer duration of herbicide activity in the host plant, compared to a metabolism based tolerance with an accelerated degradation of the active ingredient. Effective control of broomrape requires herbicides which are systemic – to be translocated from the leaves to the roots and the host-attached parasite. An additional advantage for a lasting broomrape control is a certain residuality of the herbicide in the soil, which allows recharging of the active ingredient via the root system during the vegetation period. Herbicide concentration in the host plant determines the duration of efficacy and is strongly depending on the initial uptake rate of the herbicide. Therefore, herbicide formulation, dose rate, application timing and environmental conditions have substantial influence on the *O. cumana* efficacy. However, weed and broomrape management strategies based on a single mode of action with only ALS-inhibiting herbicides are not sustainable mid or long term and might result in resistance problems. Broomrape resistance breeding was and still is the foremost non-chemical strategy to be employed by most sunflower breeders. The resistance is mainly based on dominant, single race specific genes obtained from wild sunflower sources allowing single-cross hybrid breeding. The sole reliance on the single gene resistance has possibly accelerated the quick evolution of *O. cumana* populations to more virulent races, which requires a continuous search for new resistance sources. This problem increases the complexity of resistance breeding as it requires the combination of a strong genetic background to complement the dominant single gene specifically with the latest races F, G and more. Today, in specific areas with a high pressure of *Orobanche* and the presence of very virulent races, even this combination is not providing complete efficacy.

To avoid or delay the rapid development of new pathotypes of *O. cumana* and/or elude the evolution of herbicide resistance in broomrape, Clearfield and Clearfield Plus sunflowers should be, if not already, combined with the latest genetic broomrape resistance. This approach to the broomrape problematic is the current golden standard and allows for sunflower breeders to keep their hybrids longer in the market and frees up time for new developments in genetic tolerance. On the other hand, the genetic tolerance complements the herbicide activity and adds a second mode of action to prevent or at least to delay as long as possible the occurrence of broomrape herbicide resistance. This approach provides the most sustainable method of broomrape control and the

proper utilization of these technologies allows excellent weed control, including an effective control of *O. cumana* in sunflower.

Keywords: sunflower, broomrape, genetic tolerance, Clearfield