Why in the World is Enlist Corn Resistant to the Fop Herbicides?

Every now and then something comes up that reinforces my appreciation for the complexity and wonder of science. One of these has to do with the new 2,4-D resistant crops developed by Dow AgroSciences.

Dow scientists identified a class of bacterial enzymes (AADs) that metabolize 2,4-D. The gene for this enzyme was inserted into crops, therefore providing resistance to 2,4-D in soybean and greatly increasing corn's tolerance to this herbicide. The trait is referred to as Enlist.

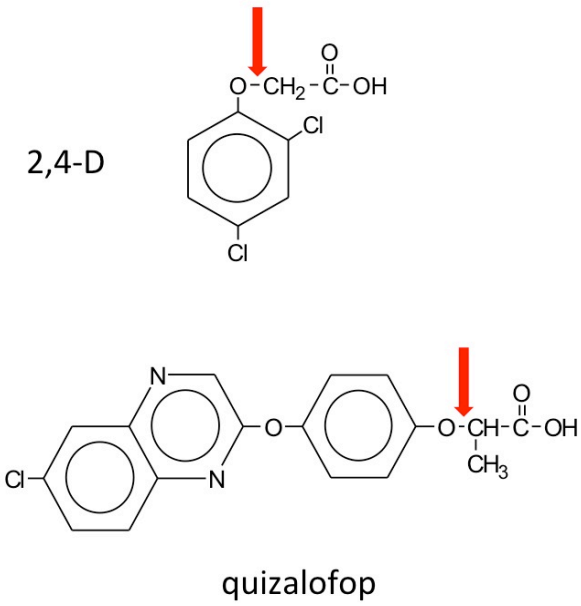
The thing about Enlist crops, specifically corn, that intrigued me is that the trait also provides resistance to one of the chemical families ('fops') in the Group 1 herbicides (Table 1). When I first learned of this, my initial thought was 'Why would Dow do that? That eliminates one of the better control options for dealing with volunteer Enlist corn.'

Table 1. Group 1 Herbicides (ACCase inhibitors)

'Fop' family	'Dim' family
Assure II (quizalofop)	Poast (sethoxydim)
Fusilade (fluazifop)	Select (clethodim)
Hoelon (diclofop)	

A quick google scholar search found the answer to this mystery (Wright et al. 2010). There are many versions of enzymes involved in degrading toxins, and each version has a different spectrum of molecules they degrade. Dow scientists identified a version of the AAD enzyme that not only metabolized 2,4-D, but also degrades the 'fop' herbicides. This ability is due to the 'fops' having a bond nearly identical to one present in 2,4-D (Figure 1). They chose to use this version of the enzyme in Enlist corn due to concerns that glyphosate resistant grasses would be widespread by the time Enlist crops reached the market. This would allow the 'fops' to be used to control grasses no longer controlled by glyphosate. Fortunately, the 'dim' herbicides do not have this bond so they remain an effective tool to control volunteer corn with the Enlist trait.

Figure 1. Chemical structures of 2,4-D and quizalofop, and catalytic activity of the AAD enzymes.



quizalofop

The AAD enzyme catalyzes the breakage of the bond between the oxygen (O) and carbon (C) at the arrow.

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Reference: T.R. Wright et al. 2010. Robust crop resistance to broadleaf and grass herbicides by aryloxyalkanoate dioxygenase transgenes. PNAS 107: 20240-20245.