



Relationship between QoIs, QoSIs and QiI Fungicides

Currently agricultural fungicides can bind at three different sites within cytochrome b (complex III of the electron transport chain). The largest and best known group are the QoIs (FRAC group 11) which bind at the Quinone “outside” site. QoS fungicides also bind at the Quinone “outside” site but bind to the stigmatellin subsite (FRAC group 45). Members of the QoIs are not cross-resistant with members of the QoSIs. QiI fungicides act at the Quinone “inside” (Qi) binding site of the cytochrome b. Currently there are two active ingredients that are commercially available with this mode of action in FRAC group 21, cyazofamid and amisulbrom. QoIs are not cross resistant with either QoIs or QoSIs.

Research has been carried out indicating that both QoIs and QiIs can both activate alternative oxidase (AOX) in fungi belonging to the ascomycetes. Although it is easy to demonstrate under *in vitro* conditions that AOX can lower the fungicide sensitivity, it is difficult to demonstrate significant AOX effects under field conditions. Probably, the alternative respiration pathway cannot produce enough energy equivalents in order to allow the survival of plant pathogens during their pathogenic state.

Moreover, there is no evidence showing that the induction of the alternative respiration facilitates the occurrence of target site mutations under field conditions. Oomycetes (which are not true fungi) are the only pathogen group where both QoI fungicides and QiIs, are active. Studies on the role of AOX in Oomycetes are not available.

Therefore, evaluating the available knowledge, the practical relevance of AOX on the resistance risk of Oomycetes pathogens is considered low by FRAC. FRAC’s primary concern is with the risk and management of field resistance, and considers that in these terms, the QoIs, QoSIs, and QiIs clearly fall within two different resistance groups (i.e. 11, 45, and 21 respectively), and may be used together in effective disease control programmes.

To ensure the long-term effectiveness of all fungicides, measures to counteract the possible occurrence of resistance should be put in place. Therefore for all three groups of fungicides it is recommended that effective resistance management strategies are utilised, for example the use of effective mixtures or alternation partners.

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