

Mini Review

Strobilurins: New group of fungicides

Rasha E Selim* and Mohamed S Khalil

Agricultural Research Center, Central Agricultural Pesticides Laboratory (CAPL), El- Sabaheya, Alexandria, Egypt

Abstract

Strobilurin is a group of natural products and their synthetic analogs have been widely used to control and prevent fungal diseases. Strobilurins were firstly isolated in 1977 from the mycelium of *Strobilurus tenacellus*, a saprobic Basidiomycete fungus causing wood-rotting on forest trees. This group of pesticides was designed to manage fungal pathogens classes such as Ascomycetes, Basidiomycetes, and Oomycetes. Also, Strobilurin commercialized included derivatives such as are azoxystrobin, kresoxim-methyl, picoxystrobin, fluoxastrobin, oryzastrubin, dimoxystrobin, pyraclostrobin and trifloxystrobin. This group is a part of the larger group of QoI inhibitors, which act to inhibit the respiratory chain at the level of Complex III. Strobilurins group control an unusually wide array of fungal diseases, included water molds, downy mildews, powdery mildews, leaf spotting and rusts. This group are used on cereals, field crops, fruits, tree nuts, vegetables, turfgrasses and ornamentals. Also, Strobilurins found to enhance the plant growth in some cases.

More Information

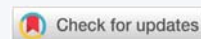
***Address for Correspondence:** Rasha E Selim, Agricultural Research Center, Central Agricultural Pesticides Laboratory (CAPL), El-Sabaheya, Alexandria, Egypt, Email: salah.capl@gmail.com

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Introduction

Strobilurin compounds are fungicides which belong to group of natural products and their synthetic analogs. Fungicides have been widely used in agricultural fields for decades. These pesticides are designed to manage fungal pathogens, although their broad-spectrum mode of action also produces non-target impacts [1]. Moreover, strobilurins are part of the larger group of QoI (quinone outside inhibitor), which act to inhibit the respiratory chain at the level of Complex III [2]. Strobilurine compounds isolation and structure elucidation of strobilurin A from wood-rotting mushroom fungi [1]. Some compounds such as azoxystrobin (Quadris), trifloxystrobin (Flint), pyraclostrobin (Cabrio), or Pristine (pyraclostrobin + boscalid) are belong to older strobilurins.

Strobilurin (QoIs) is very important class of respiration inhibitors that the biggest companies of pesticides have it in their portfolio, with a distributor sales value of US\$ 3.4 billion in 2016, they currently represent almost one-fourth of the world fungicide market (US\$ 15.3 billion in 2016). At the meaning time, 11 different strobilurins have been introduced into the world fungicide market in countries.

Recently, several new strobilurins have been announced as being developed or launched in China only (e.g. enestroburin, fenamistobin, pyraoxystrobin). One strobilurin has also been commercialized as an acaricide (fluacrypyrim) according

to McDougall [3]. strobilurins cause acute toxicity against germinating fungal spores, and relatively low toxicity for terrestrial animals.

Antifungal activity of strobilurins

Strobilurins are control a wide range of fungi classes such as; Ascomycetes, Basidiomycetes and Oomycetes. strobilurins control certain diseases which caused by water molds, downy mildews, powdery mildews, leaf spotting and blighting fungi, fruit rotter and rusts. Also, they are used on a wide variety of crops, including cereals, field crops, fruits, tree nuts, vegetables, turfgrasses, and ornamentals [4-6]. Kresoxim-methyl and trifloxystrobin are only moderately active against many Oomycete diseases, such as grapevine downy mildew [7,8] and give less activity against number of Basidiomycete classes, such as wheat and barley brown rusts [9], Metominostrobin also is moderately active against Oomycete classes [10].

Strobilurins recorded some beneficial physiological effects on crop yield due to promotion of net carbon assimilation, nitrate reductase enzyme activity, stress tolerance and hormonal balance. In a study, kresoxim-methyl has been shown to cause changes in the hormonal system of wheat which results in increased grain yield, apparently from delayed leaf senescence and water-conserving effects [11].

Strobilurin fungicides recorded physiological changes in wheat and barley plants such as induced the antioxidative

enzymes [12,13] and nitrate reductase [14,15], as well as changes in phytohormones levels [16]. However, it was found that Strobilurins inhibits sterol biosynthesis in some plants [12,13].

The fungicidal action of strobilurins

Strobilurins have site-specific mode of action, through inhibiting fungal respiration at the Q_o site in mitochondria [17-21]. In another word, strobilurins act on fungal mitochondrial respiration, causing electron transport blockage in the cytochrome bc1 complex (complex III of electron transport chain), between cytochrome b and cytochrome c1, at the Q_o site. By inhibiting ubiquinol-cytochrome c-oxide reductase, they reduce the respiratory process blocking the fungus cell's energy supply (ATP), leading to its death, thus, they are also known as QoIs or inhibitors of the bc1 complex [10,20]. Because this complex is present in all eukaryotic organisms, there is at least partial inhibition of electron transport in plants when they come in contact with strobilurins such as pyraclostrobin and azoxystrobin which isolated from mitochondria in wheat plants [22].

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