

List of fungal species with resistance reports towards SDHI fungicides and mutations in the succinate dehydrogenase gene
(updated March 2012)

Species name	Reported from host	Origin	Resistance mechanism (Subunit-mutation)	Reference
<i>Ustilago maydis</i>	(Laboratory)	Laboratory mutants	B-H257L	1
<i>Mycosphaerella graminicola</i>	(Laboratory)	Laboratory mutants	B-H267Y/R/L, B-I269V, C-H152R, C-N86K, D-H139E and many others	2-6
<i>Aspergillus oryzae</i>	(Laboratory)	Laboratory mutants	B-H249Y/L/N, C-T90I, D-D124E	7
<i>Botrytis cinerea</i>	Different hosts	Laboratory mutants, Field	B-P225L/T/F, B-H272Y/R/L, B-N230I, D-H132R	8-11
<i>Botrytis elliptica</i>	Lilies	Field	B-H272Y/R	6, 12
<i>Alternaria alternata</i>	Pistachio	Field	B-H277Y/R, C-H134R, D-D123E, D-H133R	13, 14, 15

Species name	Reported from host	Origin	Resistance mechanism (Subunit-mutation)	Reference
<i>Corynespora cassiicola</i>	Cucurbits	Field	B-H287Y/R, C-S73P, D-S89P	16, 17
<i>Didymella bryoniae</i>	Cucurbits	Field	B-H277R/Y	12, 18
<i>Podosphaera xanthii</i>	Cucurbits	Field	B-H->Y	12
<i>Sclerotinia sclerotiorum</i>	Oilseed rape	Field	D-H132R	5, 12, 19
<i>Stemphylium botryosae</i>	Asparagus	Field	B-P225L, H272Y/R	12

1. Keon, J.P.R., White, G.A. and Hargreaves, J.A. (1991) Isolation, characterisation and sequence of a gene conferring resistance to the systemic fungicide carboxin from the maize smut pathogen, *Ustilago maydis*. *Current Genetics* **19**, 475-481
2. Skinner, W., Bailey, A., Renwick A., Keon, J., Gurr, S. and Hargreaves, J. (1998) A single amino-acid substitution in the iron-sulphur protein subunit of succinate dehydrogenase determines resistance to carboxin in *Mycosphaerella graminicola*. *Current Genetics* **34**, 393-398
3. Scalliet, G., Boehler, M., Bowler, J., Green, P.S., Kilby, P.M. and Fonne-Pfister, R. (2010) SDHIs and fungal succinate dehydrogenase. *Modern Fungicides and Antifungal compounds V. Proceedings 16th International Reinhardtsbrunn Symposium 2010*, 171-178
4. Scalliet G, Bowler J, Luksch T, Kirchhofer-Allan L, Steinhauer D, Ward K, Niklaus M, Verras A, Csukai M, Daina A, Fonné-Pfister R, (2011) Mutagenesis and Functional Studies with Succinate Dehydrogenase Inhibitors in the Wheat Pathogen *Mycosphaerella graminicola*., *PLoS ONE*, submitted
5. Stammler, G., Glättli, A., Koch, A. and Schlehuber, S. (2010) Mutations in the target protein conferring resistance to SDHI fungicides. *Modern Fungicides and Antifungal compounds V. Proceedings 16th International Reinhardtsbrunn Symposium 2010*, 195-198

6. Fraaije B.A., Bayon C., Atkins S., Cools H.J., Lucas J.A. and Fraaije MW (2011) Risk assessment studies on succinate dehydrogenase inhibitors, the new weapons in the battle to control Septoria leaf blotch in wheat. *Molecular Plant Pathology*, doi: 10.1111/j.1364-3703.2011.00746.x. [Epub ahead of print]
7. Shima, Y., Ito, Y., Kaneko, S., Hatabayashi, H., Watanabe, Y., Adachi, Y. and Yabe, Y. (2009) Identification of three mutant loci conferring carboxin-resistance and development of a novel transformation system in *Aspergillus oryzae*. *Fungal Genetics and Biology* **46**, 67-76
8. Stammler, G., Brix, H.D., Glättli, A., Semar, M. and Schoefl, U. (2007) Biological properties of the carboxamide boscalid including recent studies on its mode of action. *Proceedings of the XVI International Plant Protection Congress 2007*, 40-45
9. Yin, Y.N., Kim, Y. K. and Xiao, C.L. (2011) Molecular characterization of boscalid resistance in field isolates of *Botrytis cinerea* from apple. *Phytopathology* **101**, 986-995
10. Veloukas, T., Leroch, M., Hahn, M. and Karaoglanidis, G.S. (2011) Detection and molecular characterization of boscalid-resistant *Botrytis cinerea* isolates from strawberry. *Plant Disease* **95**, 1302-1307
11. Angelini, R.M.D., Habib, W., Rotolo, C., Pollastro, S. and Faretra, F. (2010) Selection, characterization and genetic analysis of laboratory mutants of *Botryotinia fuckeliana* (*Botrytis cinerea*) resistant to the fungicide boscalid. *European Journal of Plant Pathology* **128**, 185-199
12. Information provided at FRAC meeting by member of FRAC SDHI Working Group
13. Avenot H.F., Sellam, A., Karaoglanidis and G., Michailides T.J. (2008) Characterization of mutations in the iron-sulphur subunit of succinate dehydrogenase correlating with boscalid resistance in *Alternaria alternata* from California pistachio. *Phytopathology* **98**, 736-742
14. Avenot, H.F., Sellam, A. and Michailides, T.J. (2009) Characterization of mutations in the membrane-anchored AaSDHC and AaSDHD of succinate dehydrogenase from *Alternaria alternata* isolates conferring field resistance to the fungicide boscalid. *Plant Pathology* **58**, 1134-1143
15. Stammler, G. (2008) Mode of action, biological performance and latest monitoring results of boscalid sensitivity. *18th Symposium of Research Committee on Fungicide Resistance, Shimane, Japan*, 30-43
16. Miyamoto, T., Ishii, H., Seko, T., Tomita, Y., Kobori, S. and Ogawara, T. (2008): Occurrence of boscalid-resistant isolates of cucumber Corynespora leaf spot fungus (*C. cassiicola*). *Japanese Journal of Phytopathology* **74**, 37-38

17. Miyamoto T., Ishii H., Stammler G., Koch A., Ogawara T., Tomita T., Fountaine J., Ushio T., Seko T. and Kobori S. (2010) Distribution and molecular characterization of *Corynespora cassiicola* strains resistant to boscalid. *Plant Pathology* **59**, 873-881
18. Avenot H.F., Thomas A., Gitaitis R.D., Langston Jr. D.B. and Stevenson K.L. (2011) Molecular characterization of boscalid- and penthiopyrad-resistant isolates of *Didymella bryoniae* and assessment of their sensitivity to fluopyram. *Pest Management Science*, doi: 10.1002/ps.2311 [Epub ahead of print]
19. Glättli, A., Stammler, G. and Schlehuber, S. (2009) Mutations in the target proteins of succinate-dehydrogenase inhibitors (SDHI) and 14delta-demethylase inhibitors (DMI) conferring changes in the sensitivity – structural insights from molecular modelling. *9th International Conference on Plant Diseases, Tours, France 2009*, 670-681