Protecting crops sustainably with fungicides

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The right balance for better yield

Yield that is valued by society

More biodiversity protection

Higher yield with lower environmental impact

Less CO₂ per ton of protein produced

Help farmers make a living
Controlling key fungal diseases is essential for better yield

The multiple facets of crop production require a new approach in R&D
Transformative approach in crop protection R&D focuses on three elements

Parallel approach
optimizing performance and regulatory requirements

Digitalization of R&D
accelerating screening and development

Addressing crop system needs
offer a combination of solutions

Designed to meet the highest level of performance & regulatory standards
Historically, industry used a linear approach to maximize performance prior to environmental testing

- Performance and cost optimization first to find most promising candidates
- Regulatory tests to ensure safety for humans and the environment only with finalized candidates
- In case of negative results, candidates had to be stopped late in the process leading to fewer advancing molecules

BASF adapted research process to a parallel approach
New research process better meets sustainability requirements in an early stage

- Identify potential off-target effects early on
- Develop in-vitro tox predictors to minimize animal testing
- Optimize regulatory requirements and performance in parallel
- Support chemical optimization with 3D modelling

Newly implemented research process increases effectiveness to align environmental requirements with field performance
Disease control and off-target effects were decoupled with the help of molecular modelling

**Structure design supported by 3D-Modelling**

**Desired inhibition**
Molecular target of triazole fungicides fungal CYP51

- target assay developed

**Undesired inhibition**
Aromatase (CYP19$^2$) affected by triazoles

- in vitro / in vivo correlation successful

Enables

- maximizes selectivity

**Design & synthesis of novel triazole with**

- Increased target (CYP51) inhibition
- Reduced off-target (CYP19) inhibition

This new methodology in the R&D approach led to the discovery of Revysol$^\text{®}$

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$^1$CYP51 (Lanosterol 14 alpha-demethylase): enzyme in fungal membrane

$^2$CYP19 (estrogen synthase): enzyme in the biosynthesis of mammalian estrogens
Understanding the molecular properties was key to optimizing delivery and performance through formulation

- Higher solubility of active ingredients
  - enables easy uptake by the plant
  - is susceptible to washout in rain events
- Revysol® active ingredient has a lower solubility than other azoles
- Special formulation of Revysol® enhances uptake despite low solubility

A targeted approach was necessary to reach the fungicidal target in the plant
Formulation innovation needed to enable outstanding stability and uptake

- Standard formulation practices could not dissolve Revysol® sustainably and durably

- Computer-aided simulation with different emulsifiers used to predict optimal behavior of Revysol® in water

- Over 100 different formulations tested for uptake and translocation

Through computer modeling, a customized emulsifying system was found to turn the low solubility into long-lasting protection.
Tailor-made formulation protects Revysol® from weather effects, reducing application per hectare

BASF’s formulation experts increased sustainability by optimizing the behavior of the molecule in the plant.
Transformative approach in R&D enables sustainable, new-generation solutions like Revysol®

- Revysol® enables farmers to protect their crops and farm sustainably
  - Yield protection and resource efficiency: up to 1/3 less active ingredient per wheat hectare
  - Productive land use and protection of natural habitats: 4% less wheat area needed
  - Beyond wheat, Revysol® was optimized on more than 40 crops

- Successful market introductions across the globe confirm blockbuster potential of > €1 billion projected peak sales

- Strong support of our target of reduce CO₂ emissions per ton of crop by 30%