

# Zenotan<sup>®</sup>



2013



Korea Biochemical Co. Ltd

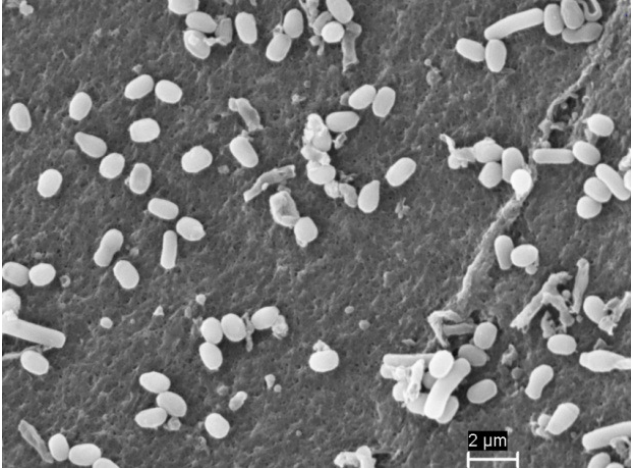
# Zenotan<sup>®</sup>

## Feature

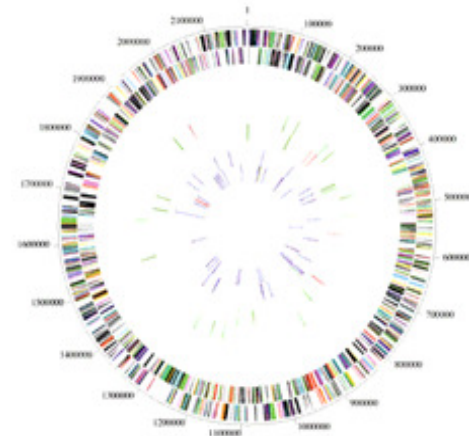
Zenotan<sup>®</sup> is a biopesticide produced and commercially distributed by Korea Biochemical Co. LTD. (KBC). This product was registered in Rural Development Administration of Korea as effective microbial fungicide to control the gray mold, anthracnose diseases and rhizoctonia diseases. The active ingredient of Zenotan<sup>®</sup> is wettable powder of *Bacillus subtilis* kbc1010 which is characterized and patented by KBC. Zenotan<sup>®</sup> was proved officially showing no harmful effect to soil and water environment and no phyto-toxicity nor residual effect. It is strongly recommended to use in golf courses. because the biocontrol agent *B. subtilis* kbc1010 strongly inhibits mycelial growth of *Rhizoctonia solani* and readily colonize in soil and rhizosphere of turfgrass,

## Active Ingredient (The Biocontrol agent)

The biocontrol agent of Zenotan<sup>®</sup> is a gram positive spore forming bacteria which isolated from soil and named *Bacillus subtilis* kbc1010. The characters of bacteria was investigated and prepared as wettable powder form for agricultural use. Once the bacteria transformed into endospore it can survive more than 2 years in room temperature condition. The bacteria produce many useful second metabolites such as hydrolytic enzymes and antifungal substances. Consequently the bacteria show significant inhibition to plant pathogenic fungi especially to *Rhizoctonia solani*. It is presumed that antifungal substances produced by *B. subtilis* kbc1010 might be elicited by presence of *Rhizoctonia solani*. The whole genome sequence of the bacteria was analyze and confirmed many meaningful genetic sequences and gene fragments are included.



Endospores and vegetative cells of *B. subtilis* kbc1010



Genome map of *B. subtilis* kbc1010

## Product

The most common package of Zenotan<sup>®</sup> is 500g of wettable powder of ingredients in aluminium bag. The ingredients are readily dissolve in cold water and nicely suspended in water. The suspended particles are less than 10 $\mu$ m and can be passed most fine nozzles of sprayer. KBC Co. Ltd guarantee the quality and efficacy of the products for 2 year at room temperature condition unless otherwise the pack is opened.



## Disease Control Efficacy

Zenotan<sup>®</sup> was registered as microbial fungicide in of RDA of Korea. And approved officially it controll effectively gray mold diseases in cucumber, ginseng, strawberry in farmer's fields and large patch disease in golf courses. Most of all, Zenotan<sup>®</sup> is remarkably effective to control large patch disease of zoysiagrass. During the last 3 years, we made the experiments to test control efficacy of large patch at 5 different sites and partially applied in 20 different commercial golf courses. The most of the results were successful with few exceptions where the sites were located in poor drainage, under shading, or too much fertilized soil. in summer season. Besides, Zenotan<sup>®</sup> showed remarkable control efficacy to anthracnose disease of hot pepper in several field experiments.



August 14, 2009

Before the application of Zenotan<sup>®</sup>



September 25, 2009

After the application of Zenotan<sup>®</sup>

## Application (golf course)

Spring time - When the new leaves of zoysiagrass are emerging, the pathogen of large patch is also become activated from dormant state. This is the most vulnerable time to be attacked by large patch to grasses. On the other hand, it is the most suitable to apply Zenotan<sup>®</sup> to control the large patch. Because *B. subtilis* kbc1010 readily grow at temperatures under 20°C, it inhibits successfully the mycelia of pathogenic fungus which is newly emerging from dormant state. Two or three times application of Zenotan<sup>®</sup> is recommended from end of April to middle of May with 10 days interval, at rate of 1g per m<sup>2</sup>.



Autumn - During the hot summer is temporally ceased period of large patch disease because the pathogen is favored relatively in cool season fungus and zoysia grass is vigorously grow in hot weather. But when it comes cool weather, the situations faced to host and pathogen become opposite. It is another best time to get rid large patch disease from the lawn of golf courses biologically. Two or three times application of Zenotan<sup>®</sup> is recommended from end of August to middle of September.

## Prevention & Treatment

A lawn care program is suggested to prevent large patch or brown patch in the lawn.

This is much easier and less expensive than the use of chemical fungicides and more effective to control the diseases.

The detailed practices are follows:

- Avoid high rates of nitrogen fertilizer on warm-season grasses in the spring and early summer.
- Water should be supplied in early morning.

The disease spread rapidly when free moisture is remained, especially over than 10 hours.

- Remove clippings if the weather is warm and moist to prevent spread of diseases to other areas during mowing.
- Try to keep your lawns are in regular height. Lower than optimum mowing height may increase disease severity.
- Facilitate good drainage for both surface and subsurface of soil. Improve soil compaction by core aeration to prevent excessive thatch buildup.
- When the disease occurrence is negligible, 4 times / year application of Zenotan<sup>®</sup> with 45 days interval is enough.
- Sufficient water should be supplied after application of Zenotan<sup>®</sup>

# MANAGEMENT OF RHIZOCTONIA LARGE PATCH



by Zenotan®

**Preventive** fungicide applications are recommended in spring and fall seasons.  
- 1g/0.5L/m<sup>2</sup>, 45 days control

**Early curative** fungicide applications are recommended in spring and fall seasons.  
- 1g/0.5L/m<sup>2</sup>, 14 days control

**curative** fungicide applications are recommended in spring and fall seasons.  
- 2g/0.5L/m<sup>2</sup>, 10 days control



## ZENOTAN®

### Recommendation



Biopesticide with *Bacillus subtilis* KBC1010 is intended for the control of grey mold and *Rhizoctonia* diseases.

Crops	Pathogen	Timing of application	Application method
Cucumber	<i>Botrytis</i>	Signs of early disease	Foliage treatment
Strawberry	<i>Botrytis</i>	Signs of early disease	Foliage treatment
Ginseng	<i>Botrytis</i>	Signs of early disease	Foliage treatment
<b>Turf grass</b>	<b><i>Rhizoctonia</i></b>	<b>Signs of early disease</b>	<b>Irrigation treatment</b>

## Safety

### Summary of mammalian toxicity study

Study (period)	Species /Strain	Method of administration	Amount of administration	Result
Acute oral toxicity/ Pathogenicity study (14 days)	SD rat	Oral administration	$2.0 \times 10^6$ conidia/animal	Negative
Acute dermal toxicity study (14 days)	SD rat	Dermal application	$2.0 \times 10^6$ conidia/animal	Negative
Dermal irritation study (72 hours)	New Zealand White rabbit	Dermal application	$1.0 \times 10^6$ conidia/ml	none irritant
Primary eye irritation study (72 hours)	New Zealand White rabbit	Administration to the eye	0.1g/animal	Acute Ocular Irritation Index 8.3 (mild irritant)
Dermal sensitization study(48 hours)	Hartley guinea pig	Injection of internal skin	$1.0 \times 10^6$ conidia/ml	Sensitization index(mean dermal response grade) "0"Frequency index(rate of sensitization) 0% Class I

### Summary of ecological toxicity study

Organism	Test species	Test material	LC <sub>50</sub> /EC <sub>50</sub> (cfu/ml(g))
Fresh water fish	Carp ( <i>Cyprinus carpio</i> )	$6.67 \times 10^6$ (cfu/l)	Negative
birds	Broiler	$6.67 \times 10^6$ (cfu/l)	Negative
honeybees	honeybees	$6.67 \times 10^6$ (cfu/l)	Negative
soil microorganisms	soil microorganisms	$6.67 \times 10^6$ (cfu/l)	Negative
Bioaccumulation	On 6 plants	$6.67 \times 10^6$ (cfu/l)	Negative

## Patent

- Composition for anti plant pathogen containing *Bacillus subtilis* KBC1010 or its culture fluid as an active ingredient. KP 1011842960000 PCT KR 2012/010162
- Culture media for microorganism containing apricotseeds. KP 1003928530000
- Composition, method and application for anti-plant pathogen. KP 1020130018512 PCT KR 2013/001375