

Synergy Internal Notes

What is Bacillus?

Bacillus is considered to be a root-colonizing biocontrol bacteria. They appear in colonies. It is capable of producing endospores allowing it to survive for extended periods of time. It is active in the soil root zone (rhizosphere) and is commonly found in soil ecosystems worldwide. Its functions (better soil health, better yield and disease control) are particularly useful for continuous cropping practice.

Microbes and Rhizosphere:

The rhizosphere is the narrow region of soil that is directly influenced by root secretions and associated soil micro-organisms.

Microbes can only impact plant health & growth if they colonize in this area. And Seawin's products are designed to maximise their colonization in the rhizosphere.

What are the common species of Bacillus?

Bacillus subtilis, Bacillus licheniformis and Bacillus amyloliquefaciens are some of the common species of Bacillus.

After selection, the strain presented in Synergy is **Bacillus subtilis subsp subtilis str.**

While Seawin's Synergy only contains Bacillus subtilis, with a strong R&D department and our own large manufacturing facilities, Seawin is also capable of manufacturing other strains of Bacillus.

What's the difference between spore form and vegetative form?

Microbials in spore form means they are in a dormant form. Think of them as a seed with a protective shell. They're able to tolerate a larger range of adverse conditions and only become active when conditions are favourable for propagation (proper moisture, food and temperature).

Microbials in a vegetative form means they are active and metabolising. Microbials products containing micro-organisms in vegetative form typically have a limited shelf life. However products containing micro-organisms in spore form will have an extended shelf life.

What do these microbials do exactly?

Biotic stress control:

A good population of Bacillus colonise the root zone and suppress bad pathogens, thus creates a health root zone environment and making plants stronger against biotic stress. They outcompete bad pathogens by competing with them for nutrients such as iron and by producing antibiotics or bacterial-destructive (lytic) enzymes. They also produce anti-fungal enzymes.

Disease Control Mechanism



海大生物集团
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1

Secrete Siderophore

Bacillus excretes Siderophore into the Rhizosphere, which is able to chelate Fe³⁺ and make it unavailable to other pathogens (by making it receptor specific to Bacillus). Other pathogens need iron to reproduce, therefore, when iron is not available to them, their population get controlled. Moreover, with this mechanism, more Fe in the soil is transformed to plants' available form of iron.

2

Produce anti-fungal enzymes

E.g. chitinase、protease、lecithinase、 β -1.3- glucanase

3

Produce antibiotics

The type of anti-biotics produced depends on the species and strains of Bacillus

4

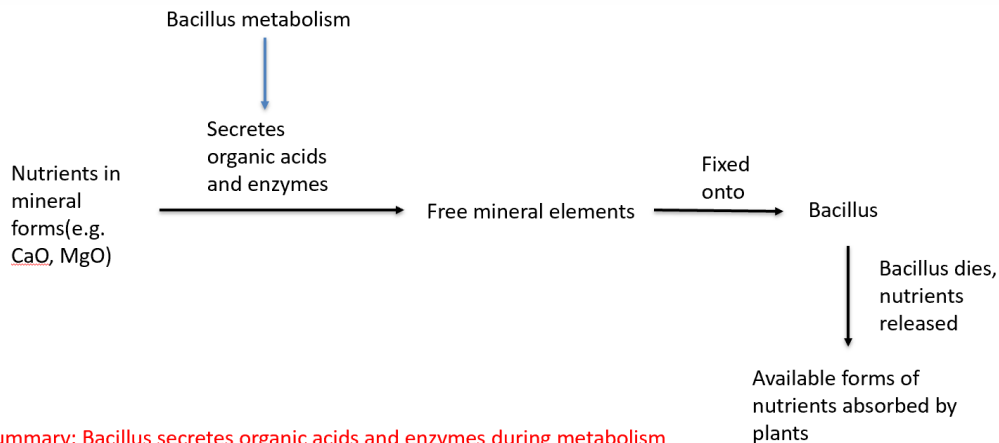
Competing mechanism

Compete for nutrients and ecological niche with other pathogens, so as to develop a layer of bio-barrier to protect the plants.

Nutrient cycling:

Nutrient Mechanism

1. Microbes themselves contains C, N, P, S, so it is a storage place for nutrients, and when they're dead, roots can uptake these nutrients.
2. Microbes feed on sloughed-off plant cells which are organic(e.g. root part, epidermal cells), and other organic nutrients around the root, and transfer them to inorganic nutrients which are available for the plants.
3. Microbes feed on root exudates and its metabolites contain amino acids, organic acids, carbohydrates, vitamins and growth promoting hormone(IAA, Gibberinlins etc), which are important for plant growth.

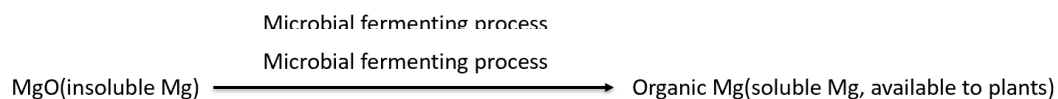


Summary: Bacillus secretes organic acids and enzymes during metabolism and during this process, it is able to transform nutrients from unavailable forms to available forms for plant uptake.

Nutrition more info:

13.5% of Magnesium added into this product, and 6.5% of Mg is in plant available forms.

Reason being:



Improve soil structure:

Bacillus can help to improve soil structure for soils which were negatively affected by too much fertiliser input. Too much fertiliser input destroys organic and inorganic soil colloids. These colloids play an important role in forming soil aggregate structure.

How:

Bacillus decomposes biomass to humus (a type of organic soil colloid). Humus binding with polysaccharide and other secondary and trace nutrients (Ca, Mg, Mn, Fe), which then form soil aggregate structure. With improved soil structure, soil is also better at water retention and nutrient retention, better porosity and better water permeability. The gradual increase on soil health will bring long-term benefits for the farm.

Role of polysaccharide on soil improvement:

Since polysaccharide is negatively charged, it is able to bind with Ca, Mg & humus to form soil colloids, which then forms soil aggregates, and over the years, better soil structure.

Why choose Seawin's Synergy?

1. Strong R & D Background and leading technology support

Certification

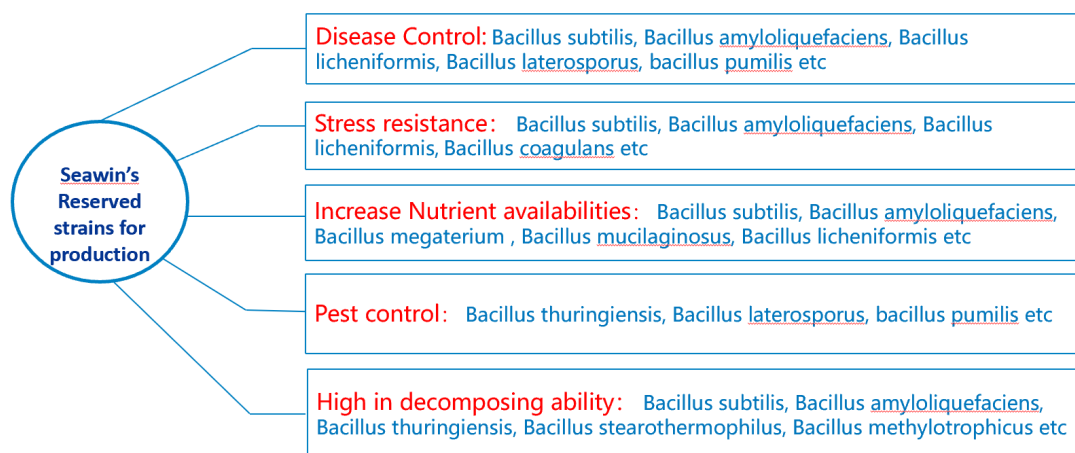
Seawin's microbial fertilisers all passed the NY/T 1109-2017 microbial fertilizers biosafety Code of Conduct(China).

The Chinese government runs a strict scheme on microbial fertilisers to make sure they're non-toxic and safe to use.

Microbial Strains Cryopreservation Bank



Seawin microbial strains cryopreservation bank, keeps more than 1000 microbial strains



2. Strict strain selection against different properties

- Stress tolerance property
- Cellulose decomposing property
- Disease suppression property

Tolerance Selection



**Seawin's Bacillus are carefully selected
-high tolerance levels in many aspects:**

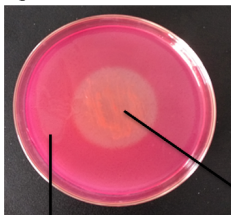
- 1.High temp tolerant:** Able to endure 60 degrees for a long period of time, able to survive for 20 mins under 120 degrees.
- 2.Low temp tolerant:** After 24 hrs freeze treatment at -10 degrees, germination rate is >95%
- 3.Saline tolerant:** 20% salinity solution, after 3 months, Bacillus germination is still above 80%. 15% salinity solution, after 3 months, Bacillus germination is still above 90%.
- 4.PH tolerant:** Able to germinate and colonise properly with PH ranging from 1.5-10.

Cellulose Decomposing Selection



Seawin's Bacillus strain is carefully selected to make sure it's has strong ability to decompose cellulose. This is because only if it is highly capable to decompose cellulose, it can feed on the food sources in the rhizosphere and establish successfully colonisation.

Agar Plate Demonstration:



Congo Red Agar Medium(The only carbon source in this plate is cellulose)

Beaker Demonstration:



Treatment(7th day)

Control

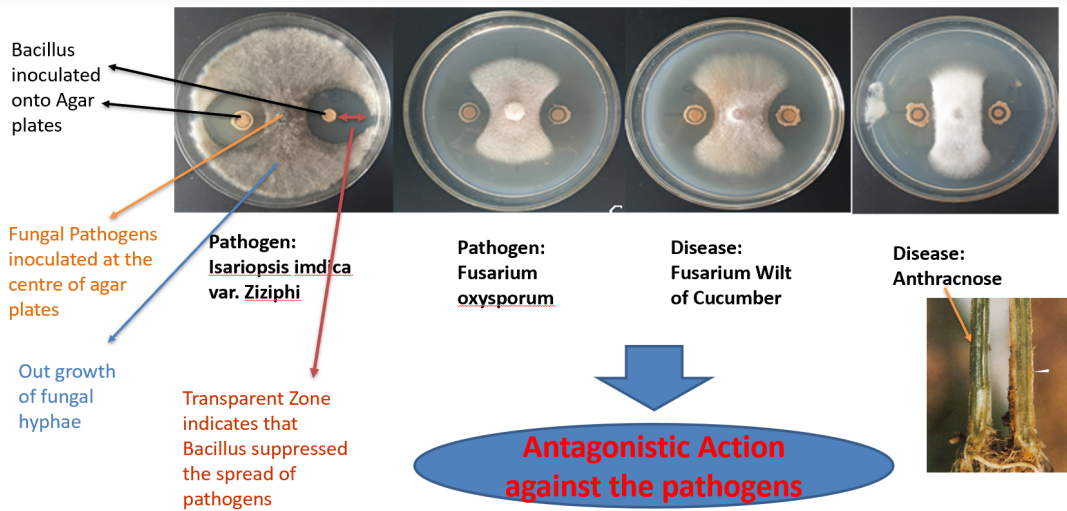
Treatment(11th day)

Transparent zones formed by Bacillus->indicates that cellulose has been decomposed in this region.



**Successful
Colonisation**

Disease Suppression Selection



3. Strong Carrier to enhance colonisation and antagonistic effect

Carrier-provides nutrients

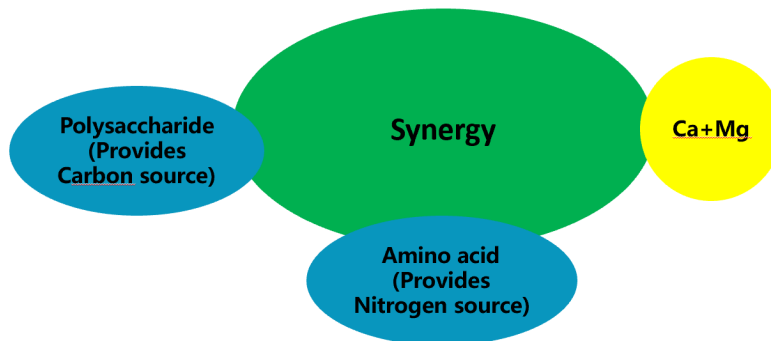


Why do we need a carrier?



In order for germination to happen, it need Carbon, Nitrogen and suitable moisture and temperature.

Carrier is to provide the nutrient requirement for **spore germination and successful colonisation in the Rhizosphere.**



Carrier enhances the antagonist action



Carrier enhances the antagonist action

Seawin Bacillus subtilis on its own

Bacillus subtilis from another brand

Pathogen attacked this region

Bacillus subtilis from another brand

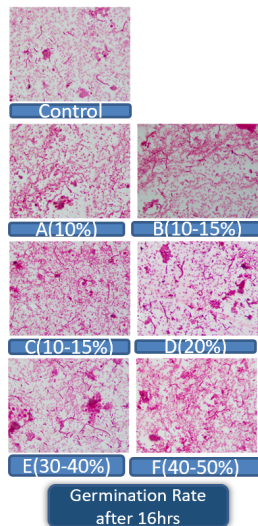
Carrier on its own

Seawin Bacillus subtilis+carrier

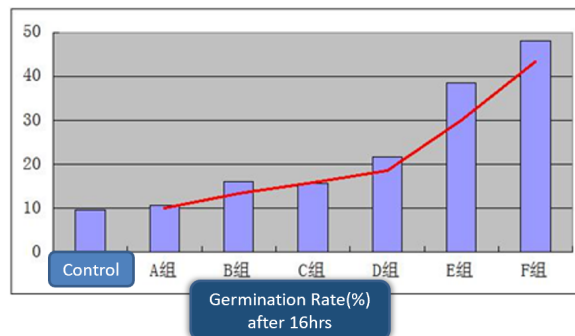
With Carrier, the antagonistic effect is the most distinctive, as observed from here, a bigger barrier was created to prevent the pathogen from spreading to this region.

Fusarium oxysporum(Cucumber) inoculated onto the centre of the plate

Carrier selection: enhances the germination rate



Different combinations of Polysaccharide+Ca & Mg have been tested against germination rate after 16 hours, as demonstrated in the graphs below. And the combination we selected is group F, which demonstrated the highest germination capability after 16hrs in the lab trial.



Activation: Activation usually happens after 16hrs being put into the soil. Spores will be activated naturally when the environments are favourable.

Application Rates:

Suitable for Vegetable crops, berries and tree crops.

Fertigation: 0.5-2kg/ha.

Tree Rates: 10-20g per tree applied as drench at planting.

Location: It needs to be placed no further than 13cm from roots. Repeat applications may be beneficial at 3-4weeks intervals.

Apply through water wheel or drip irrigation. If using drip irrigation, inject the product towards the end of the cycle to ensure proximity to the roots if possible.

What else to take note of regarding applications?

Can be applied together with fertilisers, but not advised to pre-mix with fertilisers and then store it for more than 2 days in the storing tank. Best to apply by itself, or with other organic fertilisers.

Best application condition:

Can survive in low temps but warm to hot condition with little direct sunlight is the best.

For other application methods, please contact Seawin technical support.

Compatibility:

It can be mixed with common fertilisers and pesticides. When unsure, check with Seawin technical support.

Compatibility test from China shows that, the survival rate when mixed with the following fungicide/bactericide/pesticides are low:

Product	Survival rate
cupric nonyl phenolsul fonate	47.04%
Chlorothalonil	57.37%
Bismethiazol	58.89%
Azoxystrobin	49.29%
Deltamethrin	52.08%
Matrine	32.08%
Avermectin	8.33%

For other fungicide and pesticides done from HQ, the survival rates are higher, see below:

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SEAWIN
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Marine Based Fertilizer

Product	Survival rate
Mancozeb	87.75%
Carbendazim	100%
myclobutanil	62.45%
chlorpyrifos	79.58%
polyoxins	100%
Metriam	89.33%
Procymidone	82.81%
cypermethrin	72.92%
Imidacloprid	100%
Acetamiprid	89.17%
Bacillus thuringiensis	100%
Chlorbenzuron	69.58%
Pyridaben	86.67%