Endo Prime®

Goes where roots can't.

Technical Manual

SUMITOMO CHEMICAL
AgroSolutions Division

Overview

- Endoprime® from sumitomo chemical is a plant and soil enhancement product that contains arbuscular mycorrhizal fungi (amf).
- Mycorrhizae are beneficial fungi that naturally exist in soils colonizing the root systems of plants.
- Endoprime includes 4 high performing amf species that have been proven to increase crop productivity, overall plant and soil health and nutrient availability.
- Endoprime also includes a bio-stimulant, humic acid.

EndoPrime is supplied in 500 g foil bags and in a 10 x 500 g shipper.

EndoPrime can assist plants through:

- Improved nutrient availability and utilization
- Improved Water Use Efficiency (WUE)
- Improved stress tolerance
- Improved soil health
- Increases plant productivity (yield and quality)
- Excellent insurance policy against non-ideal growing conditions.

EndoPrime formulation

1. WP formulation with excellent solubility.
2. Contains 4 key AMF strains plus humic acid.
3. The 4 AMF strains are glomus intraradices, glomus aggregatum, glomus mosseae and glomus etunicatum.
4. 2,250 AMF propagules per gram.
5. Humic acid has been shown to enhance the uptake of nutrients, and condition soil parameters such as carbon, pH and CEC.
6. Humic acid also acts as a highly soluble and effective carrier for the AMF propagules.
7. In vitro produced under sterile conditions at a high concentration for more user-friendly formulation.
8. Highly compatible with most seed treatment, in-furrow or drench products.

Input for Organic Production
ACO CERT. NO. 10332

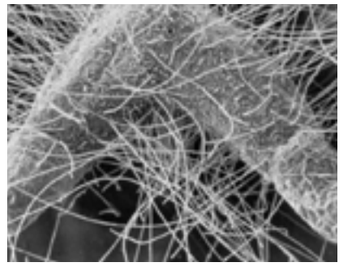
Extension of soil volume explored by mycorrhizal hyphae

How mycorrhizae works

- Within the soil, plant roots are limited in the area they can access and absorb nutrients and moisture (the depletion zone).
- Mycorrhizal hyphae grow out well beyond the depletion zone facilitating uptake of nutrients and moisture previously inaccessible to the plant.
- Absorption area is increased significantly with mycorrhizae (up to 50x).

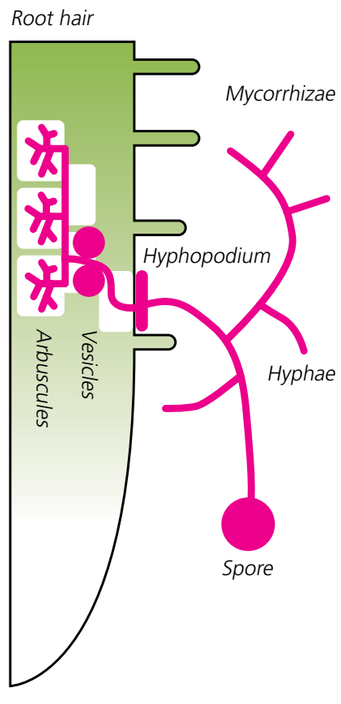
Root hair vs. mycorrhizal fungal hyphae

- Maximum length is several millimeters
- Cation absorption occurs only at the tips
- Mineral nutrient uptake only from available (soluble) pool
- The rate of nutrient inflow is low



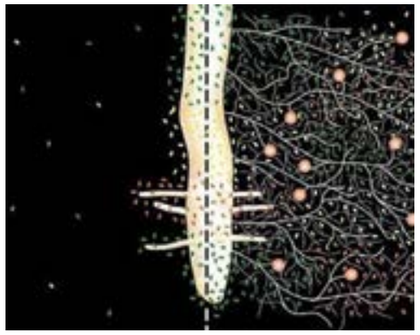
Mycorrhizal Fungal Hyphae

- Maximum length 65 cm
- Nutrient and water absorption occurs along the entire length of the hyphae
- Mineral nutrient uptake from the soluble and insoluble pool
- More efficient nutrient uptake (greater nutrient inflow)



Mycorrhizae benefit plants in many ways

Roots



- AMF fungi rapidly establish into plant roots
- Expands vascular network beyond root and into soil
- Provides more root surface area (up to 50x)

Nutrients

- AMF access, absorb & transport nutrients directly to the root
- AMF produce enzymes, organic acids and work with other beneficial organisms in releasing and absorbing nutrients that would be otherwise unavailable to the plant for uptake
- Phosphorus
- Nitrogen
- Micronutrients
- Potassium

Water

- AMF fungi filaments access, absorb and transport moisture widely dispersed in the soil to the plant root
- Moisture storage structures form in root (vesicles)
- Improved heat tolerance
- Improved drought tolerance

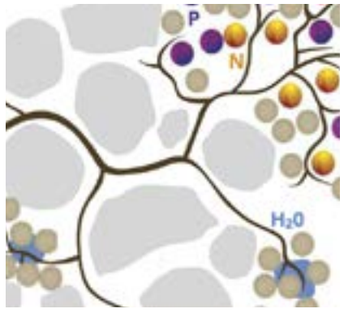
Vesicles are storage units produced by AMF that are developed to store nutrients and water when in excess to be utilized when the plant needs these components during stressful growing conditions.

Soil toxicities

AMF provide the plant the ability to be productive under unfavorable soil conditions such as low and high pH, salinity or sodic conditions, heavy metal and high soil temperatures. AMF are more tolerant of these conditions and can access nutrients and water in these conditions that would be otherwise toxic and detrimental to the plant's ability to be productive.

Root mass expansion

Hyphae attach to root hairs and access areas inaccessible to the plant alone allowing for a greater ability to overcome stress.

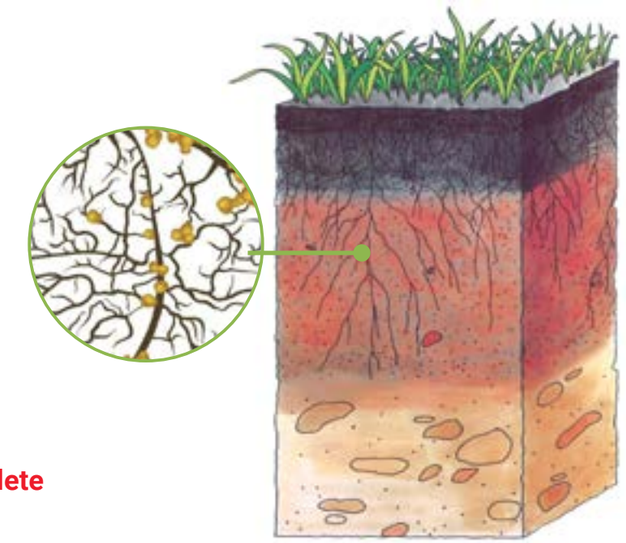


Improving Soil Structure

AMF improve soil structure by secreting Glomalin to form soil aggregates and pores, which are fundamental to Soil Health and optimum plant production.

Glomalin is a carbon rich protein substance secreted by AMF that can constitute a significant portion of the soil carbon pool.

Glomalin improve the soil structure across all soil horizons where roots and AMF have colonized.



Soil structure development occurs as the AMF hyphae expand into the soil secreting glomalin which binds microparticles into macroparticles forming soil aggregates and improved soil structure.

Modern farming practices can deplete mycorrhizae levels

AMF application is particularly beneficial after extended fallow, significant soil disturbance or having grown a non-mycorrhizal crop (a crop type known not to be colonised by AMF).

Many crops can show poor growth and inadequate P or Zn uptake after an extended fallow period (6 months or longer) and this is because AMF levels deplete quickly in soils without living plants as a host.

The same problem occurs following growth of non-mycorrhizal crops (cabbage, canola, spinach and beets). Rotational crops which form AMF symbioses will maintain soil infectivity (Seymour 2009).

Photo shows ground prepared ready for potato planting in an aggressive way, where AMF levels will be expected to be very low.

Aggressive field preparation practices that include tillage will severely impact the viability of AMF indigenous populations in the soil. These practices remove the host plant and disrupt the extensive hyphal network reducing populations and the ability for the sequential crop plant to benefit from these indigenous populations.

Crop selection

While over 80% of the worlds plant species form a beneficial bond with Mycorrhizae it is known that some plants can be much more reliant on this relationship than others and a small percentage do not form a bond at all.

Highly preferred plant species:

1. Solanaceous crops (tomato/capsicum)
2. Legume vegetables
3. Tuber and root crops (carrot/potato)
4. Onion & garlic
5. Citrus
6. Apples
7. Melons
8. Corn/Sorghum
9. Mungbeans
10. Cotton
11. Pigeon Peas
12. Faba Beans
13. Hemp
14. Lab Lab
15. Linseed
16. Chickpeas
17. Sunflower
18. Soybeans

Known to benefit from Mycorrhiza:

1. Rice
2. Wheat
3. Banana
4. Sugarcane
5. Field Peas
6. Oats
7. Barley
8. Triticale

Plants that DO NOT form a bond with Mycorrhiza:

1. Beet
2. Carnation
3. Spinach
4. Canola & Mustard
5. Cabbage
6. Lupins

Crop rotation considerations

Growing crops known to be nonmycorrhizal like brassica species can be highly beneficial in disease and pest management strategies, but its important to understand mycorrhizae levels will be significantly depleted following these crops.

For a full list of commercially important mycorrhizal and non-mycorrhizal plant species contact your local Sumitomo representative.

Rates and application

Rates

Vegetable Transplants	
<37,500 plants per ha	100-150 g/ha
37,500-75,000 plants per ha	150-200 g/ha
75,000-112,500 plants per ha	200-250 g/ha
>112,500 plants per ha	250-300 g/ha
Onion Transplants	100-150 g/ha
Seeded Vegetables	100-150 g/ha
Potato & Sweet Potato	100-150 g/ha
Strawberries, Rasberry & other berries (excluding Blueberries)	150-200 g/ha
Field Crops including Sorghum, Cotton, Mungbeans, Wheat, Soybeans, Barley, Oats, Corn, Chickpeas, Faba Beans, Lentils, Rice, Sugarcane, Pigeon Peas, Lablab, Sunflowers, Linseed, Field Peas, Triticale, Navy Beans, Peanuts, Hemp, Poppies & Pyrethrum	100 g/ha
Trees & Vines (new plantings)	
Bare root spray or dip	50 g/1,000 plants
Container drench	80 g/1,000 plants
In-field drench	100 g/1,000 plants
Trees & Vines (established)	
In-field drench (use higher rate on plants above 2 years)	100-150 g/1,000 plants
Directed spray (over root zone)	
1 year old or less	100 g/1,000 plants
2-4 years of age	150 g/1,000 plants
5+ years of age	400 g/1,000 plants

Refer to product label for full details on rates and uses.

Rates and application (continued)

Endoprime is easy to use and can be applied by various methods

- Seed dressing
- Seedling dip
- In furrow spray
- Drip irrigation
- Bare root spray/dip
- Fertiliser mixing
- Growing media

EndoPrime formulation benefits relating to application:

- Fine sprayable powder
- Minimal non-soluble substrates (suitable for drip systems*)
- Quality consistency (Propagule count)
- Longer shelf life
- Easy to use (can be used by various application methods)
- Comes from the world leaders in Mycorrhizae production.






** Where application is being made through drip irrigation Sumitomo recommend adding EndoPrime downstream of any sand and/or screen filters finer than 50 mesh.*

When should I use EndoPrime

- When growing a mycorrhizae dependent crop.
- When yield and quality improvements are desired.
- When field has been devoid of vegetation for any length of time, 6 months or more.
- When soil nutrition is not expected to be ideal or limited due to soil tie up and availability.
- When soil moisture stresses are expected during the growing season.
- When soil constraints are present such as sodicity or salinity.
- When soil structure is in decline and needs improving or after significant cultivation.
- When non-mycorrhizal crops have been grown which have depleted AMF levels.
- When soil carbon is low and increased carbon levels are desired.
- When a soil fumigant has been used.

Rules of thumb when using EndoPrime

- Apply at seeding, transplanting or as early in the crop cycle as possible.
- Ensure good seed/root contact with the inoculant.
- Do not over fertilise the crop when inoculating with EndoPrime.
- Ensure the spray, dip or drench solution is agitated well.
- If applying through surface drip, follow with adequate irrigation to wash into the root zone.
- If applying through soil drench ensure adequate volume and wet the root zone evenly.

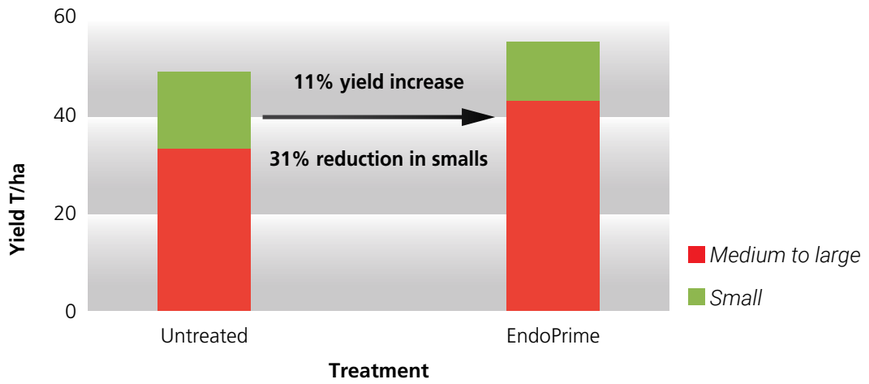
Trials

Effect of EndoPrime on Kipfler potatoes: Mornington Peninsula, Vic 2019

- EndoPrime applied at 100 g/ha at sowing
- Sandy loam soil
- EndoPrime was applied in furrow with Amistar (its compatible)
- Visual difference was obvious from second half of growing season
- Very high fertiliser rates used
- 1 tonne of 7,7,15 (plus added Mg & B) pre-planting
- 1 tonne of 7,7,15 (plus added Mg & B) at planting
- 800 kg of 15, 0, 17 early season OTT (with added Sulfate of Potash)

Differences in growth evident at mid growth stage

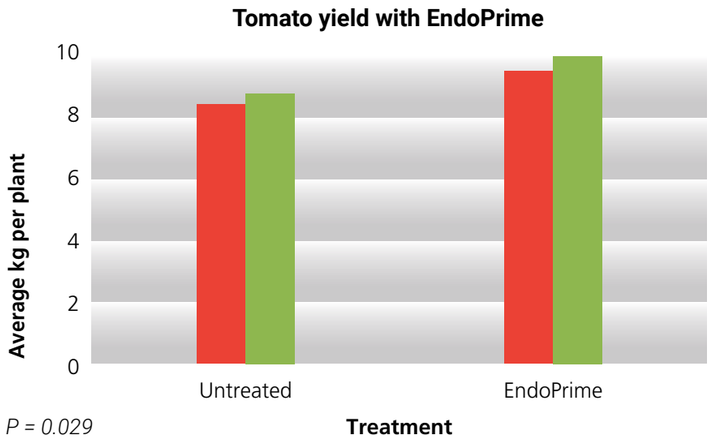
EndoPrime on Kipfler Potatoes



EndoPrime treated tubers were similar length but were noticeably fatter.

Effect of Endoprime on tomatoes: Tatura, VIC 2018

- Endoprime applied at 150 g/ha on trays of Roma tomato seedlings (as a seedling drench).
- Red ferrous soil.
- EndoPrime-treated seedlings planted in 1.0 ha block and compared to rest of field.
- Increase of 1.19 kg of tomatoes per plant (13.5%).



P = 0.029

EndoPrime (average of 10 kg per plant)

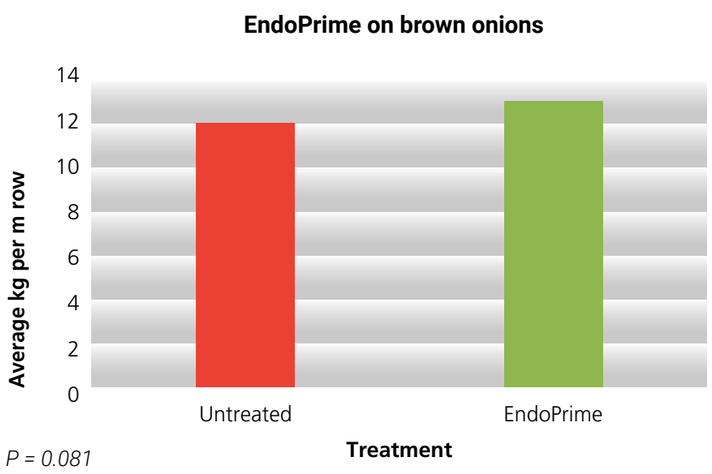
UTC (average of 8.81 kg per plant)

Marketable kg/plant

Total kg/plant

Effect of Endoprime on brown onions: Forth, TAS

- 100 g of EndoPrime mixed dry with fertiliser.
- Applied in-furrow with onion seed 3.8 kg seed/ha.
- Applied in June 2018.
- EndoPrime treated block planted in 1 Ha block in centre of field and rows running north-south.
- Yield assessed at harvest in February 2019 (7.5% increase vs UTC)



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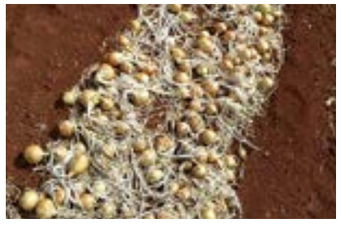
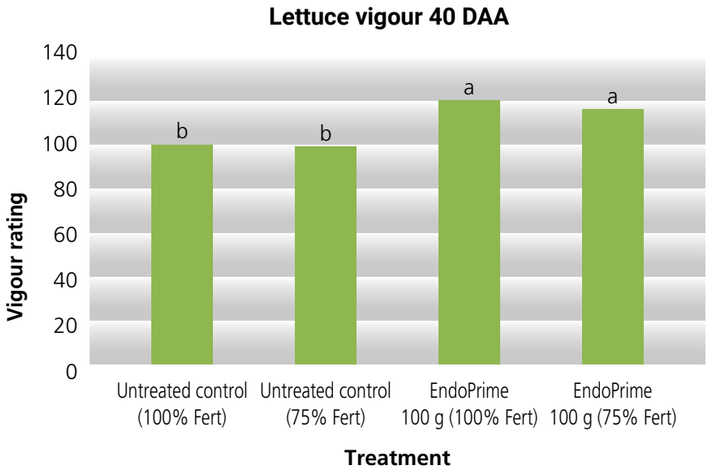
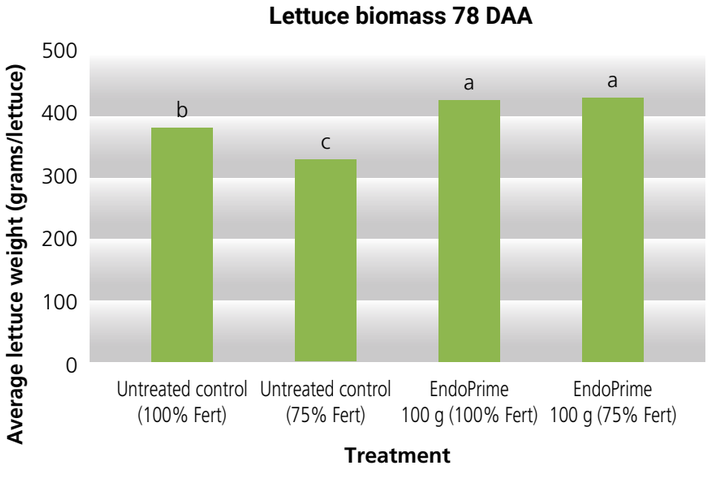


Effect of EndoPrime on Lettuce: Forthside, TAS 2018

- EndoPrime applied as a seedling drench at 100 g/ha.
- Red ferrosol soil
- Lettuce cv Exponent
- Transplanting date: 19-9-2018
- Harvest date: 21-11-2018
- Irrigated
- Plant density 60,000/ha
- EndoPrime increased ave. lettuce weight 11.6% vs UTC in 100% fert plots. In 75% fert plots EndoPrime increased weights 23.5%.





Endo Prime®

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Scan here to see more information about EndoPrime

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