VelociGro | HYPERroots™

Comparison of HYPERroots™ With Substrates Based Upon Soil and Rockwool for Growth and Health of Spinach in Controlled Environment Agriculture

Jonathan M. Romo, BSc; Timothy J. Cuthbertson, PhD

Research Summary

IMPORTANCE Substrates based upon soil and rockwool are some of the most widely used plant growing media to grow spinach in controlled environment agriculture (CEA). Despite the common use of these media, efficacy, compostability and sustainability remain questionable.

OBJECTIVE To compare the growth and health of spinach in HYPERroots™ with spinach grown in substrates based upon soil and rockwool.

MAIN OUTCOMES AND MEASURES The primary outcomes were germination rate at 7 days, plant mass at 14 days, and a visual assessment of chlorosis.

STUDY DESIGN The HYPERroots™ formulation was optimized to maximize the germination and plant growth of leafy greens in 92 experiments using more than 18000 samples. Spinach was included in these experiments. Statistical Design of Experiments (DoE) using JMP software (licensed from SAS) was utilized to assess the effects of changing multiple formulation components simultaneously and to ensure product quality and process capability. After the formulation and process were locked, the performance of HYPERroots™ was evaluated for the growth and health of spinach (N=596). Soil-based substrate was purchased from Miracle-Gro. Rockwool-based plugs were purchased from Grodan. 200 x 1.75" Trays and the appropriate humidity domes were purchased from T.O. Plastics. During germination the plugs were placed under a humidity dome and spritzed with fertigation solution daily with an EC of 0.3 mS/cm. Lighting in the vertical nursery carts was set to 250 par and with a 20/4 hour day/night cycle. Climate in the nursery carts ranged from 70-75°F with a relative humidity of 80-90%. After 7 days, the humidity domes were removed, and the germination rates were assessed. The plant mass was assessed at 14 days. Upon harvest a visual assessment of plant health was completed with particular attention placed upon chlorosis. The spinach plants were cut at crown level and were immediately weighed for wet mass.

RESULTS HYPERroots™ outperformed soil and rockwool for the rate of growth of spinach (Table 1). Particularly notable was that use of HYPERroots™ tripled the average plant mass of spinach at 14 days compared to soil. The germination rate of spinach was significantly higher in HYPERroots™ (Table 2). Chlorosis was unremarkable in any of the samples.

DISCUSSION Substrates based upon soil and rockwool are widely used in CEA to grow spinach but have questionable efficacy, compostability and sustainability. Soil-based substrates are made of plant matter harvested from the environment and therefore can have pests contained within them and inconsistent composition. Rockwool is prepared from mined materials and is typically placed in a landfill after being used. HYPERroots™ is formulated from renewable polysaccharides and is the only plant growth medium that is certified compostable by the Biodegradable Products Institute (BPI).

HYPERroots™ was created using DoE and was optimized to grow leafy greens with a comparable rate of germination and a higher rate of growth than other plant growth media. These experiments with spinach confirm the superior performance of HYPERroots™ under the tested conditions and confirm the formulation process capability.

Table 1: The average mass of spinach plants (N=298) measured after 14 days of germination.

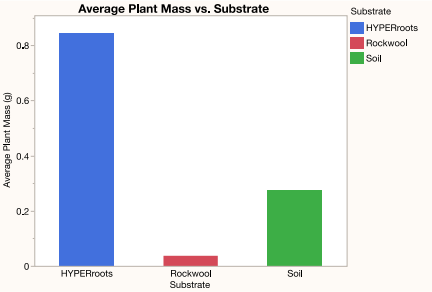
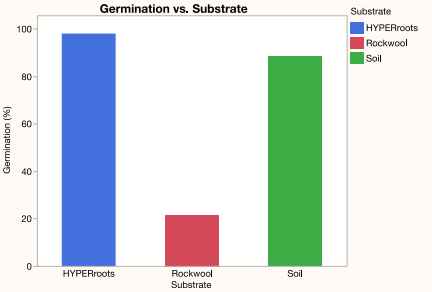


Table 2: The rate of germination of spinach plants (N=596) measured at 7 days.



For more information or to order please contact:

VelociGro, Inc
144 W Chestnut Ave
Monrovia, CA 91016

Email: info@velocigro.com

Phone: 323-490-7342

BPI COMPOSTABLE

VelociGro | HYPERroots™

Comparison of HYPERroots™ With Plugs Based Upon Peat, Coir, and Rockwool for Growth and Health of Lettuces in Controlled Environment Agriculture

Jonathan M. Romo, BSc; Timothy J. Cuthbertson, PhD

Research Summary

IMPORTANCE Plugs based upon peat, coir, and rockwool are the most widely used plant growing media in controlled environment agriculture (CEA). Despite the common use of these media, compostability and sustainability remain questionable.

OBJECTIVE To compare the growth and health of lettuces in HYPERroots™ with lettuces grown in plugs based upon peat, coir, and rockwool.

MAIN OUTCOMES AND MEASURES The primary outcomes were germination rate, plant mass at 34-40 days, and a visual assessment of chlorosis and tip burn.

STUDY DESIGN The HYPERroots™ formulation was optimized to maximize the germination and plant growth of leafy greens in 92 experiments using more than 18000 samples. Lettuces were included in 87 of these experiments. Statistical Design of Experiments (DoE) using JMP software (licensed from SAS) was utilized to assess the effects of changing multiple formulation components simultaneously and to ensure product quality and process capability. After the formulation and process were locked, the performance of HYPERroots™ was evaluated for the growth and health of three lettuce species (N=178): Fairly, Green Oakleaf, and Red Butter. Peat-based plugs were purchased from ihort. Coir-based plugs were purchased from Jiffy. Rockwool-based plugs were purchased from Grodan. 200 x 1.75" Trays and the appropriate humidity domes were purchased from T.O. Plastics. During germination the plugs were placed under a humidity dome and spritzed with fertigation solution daily with an EC of 0.3 mS/cm. Lighting in the vertical nursery carts was set to 250 par and with a 20/4 hour day/night cycle. Climate in the nursery carts ranged from 70-75°F with a relative humidity of 80-90%. After 7 days, the humidity domes were removed. The germination rate was assessed at 14 days and those plants that were transferable at that time were moved to deep water culture (DWC), nutrient film technique (NFT), and Zip towers to complete the 25 to 40-day growing cycle. In the hydroponic systems, the nutrient formulation had an EC of 0.9-1.4 mS/cm, the temperature ranged from 60-72°F, and the relative humidity was 50-80%. Plants received a daily light interval of 20 mols at 500 par. Upon harvest a visual assessment of plant health was completed with particular attention placed upon chlorosis and tip burn. The lettuce plants were cut at crown level and were immediately weighed for wet mass.

RESULTS HYPERroots™ outperformed plugs based upon peat, coir, and rockwool for the rate of growth of the three species of lettuce tested (Table 1). Particularly notable was that use of HYPERroots™ doubled the average plant mass of Green Oakleaf lettuce at 40 days. The germination rate of lettuces was generally higher in HYPERroots™, except HYPERroots™ significantly overperformed compared to the other plug types in Red Butter lettuce, and plugs based upon Rockwool greatly underperformed compared to the other plug types (Table 2). Chlorosis was unremarkable in any of the samples. Tip burn occurred in Green Oakleaf lettuce grown in all plug types, and this was likely due to the higher than recommend temperature of the fertigation solution.

DISCUSSION Plugs based upon peat, coir, and rockwool are widely used in CEA but have questionable compostability and sustainability. The collection of peat has deleterious effects on the ecosystems from which it is derived. Coir is more sustainable because it is manufactured from renewable husks of coconuts, however it can be contaminated, and it is difficult to compost. Rockwool is prepared from mined materials and is typically placed in a landfill after being used. HYPERroots™ is formulated from renewable polysaccharides and is the only plant growth medium that is certified compostable by the Biodegradable Products Institute (BPI).

HYPERroots™ was created using DoE and was optimized to grow leafy greens with a comparable rate of germination and a higher rate of growth than other plant growth media. These experiments with three species of lettuce confirm the superior performance of HYPERroots™ under the tested conditions and confirm the formulation process capability.

Table 1: The average mass of lettuce plants (N=178) measured after 14 days of germination and 20-26 days in deep water culture.

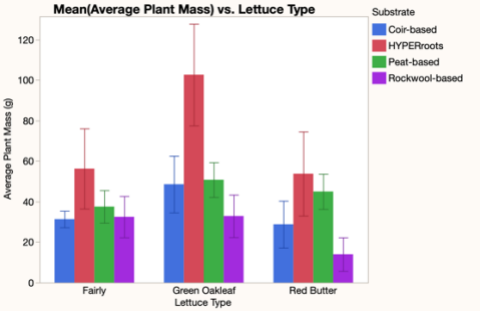
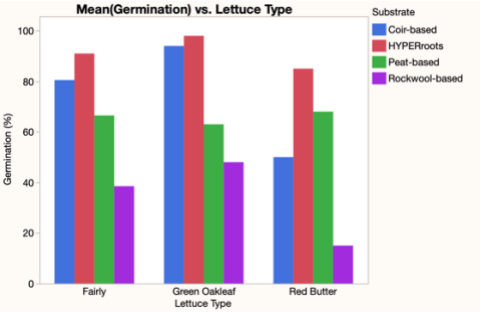


Table 2: The rate of germination of lettuce plants (N=1862) measured at 14 days.



For more information or to order please contact:

VelociGro, Inc
144 W Chestnut Ave
Monrovia, CA 91016

Email: info@velocigro.com

Phone: 323-490-7342

BPI COMPOSTABLE

VelociGro | HYPERroots™

Comparison of HYPERroots™ With Plugs Based Upon Peat, Coir, and Rockwool for Growth and Health of Kale in Controlled Environment Agriculture

Jonathan M. Romo, BSc; Timothy J. Cuthbertson, PhD

Research Summary

IMPORTANCE Plugs based upon peat, coir, and rockwool are the most widely used plant growing media in controlled environment agriculture (CEA). Despite the common use of these media, compostability and sustainability remain questionable.

OBJECTIVE To compare the growth and health of kale in HYPERroots™ with kale grown in plugs based upon peat, coir, and rockwool.

MAIN OUTCOMES AND MEASURES The primary outcomes were germination rate, plant mass at 35 days, and a visual assessment of chlorosis.

STUDY DESIGN The HYPERroots™ formulation was optimized to maximize the germination and plant growth of leafy greens in 92 experiments using more than 18000 samples. Kale was included in 49 of these experiments that included using deep water culture, vertical grow towers, nutrient film technique (NFTs), and ebb and flow systems. Statistical Design of Experiments (DoE) using JMP software (licensed from SAS) was utilized to assess the effects of changing multiple formulation components simultaneously and to ensure product quality and process capability. After the formulation and process were locked, the performance of HYPERroots™ was evaluated for the growth and health of four kale species (N=136): Lacinato, Red Russian, Scarlet, and Toscano. Peat-based plugs were purchased from ihort. Coir-based plugs were purchased from Jiffy. Rockwool-based plugs were purchased from Grodan. 200 x 1.75” Trays and the appropriate humidity domes were purchased from T.O. Plastics. During germination the plugs were placed under a humidity dome and spritzed with fertigation solution daily with an EC of 0.3 mS/cm. Lighting in the vertical nursery carts was set to 250 par and with a 20/4 hour day/night cycle. Climate in the nursey carts ranged from 65-82°F with a relative humidity of 50-90%. After 7 days, the humidity domes were removed. The germination rate was assessed at 14 days and those plants that were transferable at that time were moved to deep water culture (DWC) to complete the 35-day growing cycle. In the DWC system, the nutrients formulation had an EC of 0.9-1.4 mS/cm, the temperature ranged from 72-82°F, and the relative humidity was 50-65%. Plants received a daily light interval of 20 mols at 500 par. Upon harvest a visual assessment of plant health was completed with particular attention placed upon chlorosis. The kale plants were cut at crown level and were immediately weighed for wet mass.

RESULTS HYPERroots™ outperformed plugs based upon peat, coir, and rockwool for the rate of growth of the four species of kale tested (Table 1). Particularly notable was that use of HYPERroots™ more than doubled the average plant mass of Red Russian and Scarlet kales at 35 days. The germination rate of kale was generally comparable between the plug types, except HYPERroots™ slightly overperformed compared to the other plug types in Red Russian kale, HYPERroots™ slightly underperformed compared to plugs based upon coir and rockwool in Scarlet kale, and plugs based upon peat greatly underperformed compared to the other plug types in Lacinato, Red Russian, and Scarlet kales (Table 2). Chlorosis was unremarkable in any of the samples.

DISCUSSION Plugs based upon peat, coir, and rockwool are widely used in CEA but have questionable compostability and sustainability. The collection of peat has deleterious effects on the ecosystems from which it is derived. Coir is more sustainable because it is manufactured from renewable husks of coconuts, however it can be contaminated, and it is difficult to compost. Rockwool is prepared from mined materials and is typically placed in a landfill after being used. HYPERroots™ is formulated from renewable polysaccharides and is the only plant growth medium that is certified compostable by the Biodegradable Products Institute (BPI).

HYPERroots™ was created using DoE and was optimized to grow leafy greens with a comparable rate of germination and a higher rate of growth than other plant growth media. These experiments with four species of kale confirm the superior performance of HYPERroots™ under the tested conditions and confirm the formulation process capability.

Table 1: The average mass of kale plants (N=136) measured at 35 days.

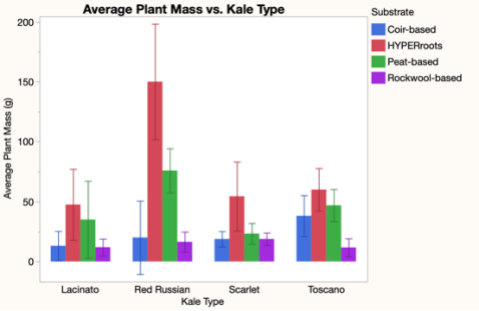
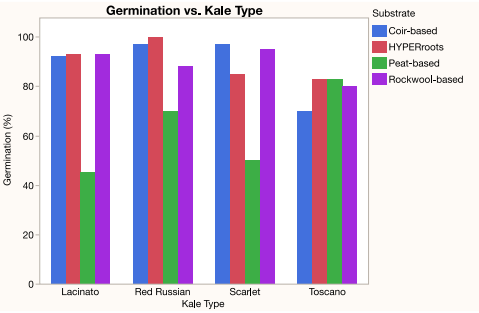


Table 2: The rate of germination of kale plants (N=615) measured at 14 days.



For more information or to order please contact:

VelociGro, Inc
144 W Chestnut Ave
Monrovia, CA 91016

Email: info@velocigro.com

Phone: 323-490-7342

BPI® COMPOSTABLE

VelociGro | HYPERroots™

Comparison of HYPERroots™ With Plugs Based Upon Peat, Coir, and Rockwool for Growth and Health of Basil in Controlled Environment Agriculture

Jonathan M. Romo, BSc; Timothy J. Cuthbertson, PhD

Research Summary

IMPORTANCE Plugs based upon peat, coir, and rockwool are the most widely used plant growing media in controlled environment agriculture (CEA). Despite the common use of these media, compostability and sustainability remain questionable.

OBJECTIVE To compare the growth and health of basil in HYPERroots™ with basil grown in plugs based upon peat, coir, and rockwool.

MAIN OUTCOMES AND MEASURES The primary outcomes were germination rate, plant mass at 14-35 days, and a visual assessment of chlorosis.

STUDY DESIGN The HYPERroots™ formulation was optimized to maximize the germination and plant growth of leafy greens in 92 experiments using more than 18000 samples. Statistical Design of Experiments (DoE) using JMP software (licensed from SAS) was utilized to assess the effects of changing multiple formulation components simultaneously and to ensure product quality and process capability. After the formulation and process were locked, the performance of HYPERroots™ was evaluated for the growth and health of seven basil species (N=2517): Amethyst, Aroma 2, Cinnamon, Emily, Genovese, Lemon, and Sweet Thai. Peat-based plugs were purchased from ihort. Coir-based plugs were purchased from Jiffy. Rockwool-based plugs were purchased from Grodan. 200 x 1.75" Trays and the appropriate humidity domes were purchased from T.O. Plastics. During germination the plugs were placed under a humidity dome and spritzed with fertigation solution daily with an EC of 0.3 mS/cm. Lighting in the vertical nursery carts was set to 250 par and with a 20/4 hour day/night cycle. Climate in the nursery carts ranged from 70-75°F with a relative humidity of 80-90%. After 7 days, the humidity domes were removed. The germination rate was assessed at 14 days and those plants that were transferable at that time were moved to deep water culture (DWC), nutrient film technique (NFT), and zip towers to complete the 21 to 35-day growing cycle. In the hydroponic systems, the nutrient formulation had an EC of 0.9-1.4 mS/cm, the temperature ranged from 60-72°F, and the relative humidity was 50-80%. Plants received a daily light interval of 13mols at 500 par. Upon harvest a visual assessment of plant health was completed with particular attention placed upon chlorosis. The basil plants were cut at the crown and were immediately weighed for wet mass.

RESULTS HYPERroots™ outperformed plugs based upon peat, coir, and rockwool for the rate of growth of the seven species tested in 10 of the 11 trials (Table 1). Particularly notable was that use of HYPERroots™ nearly doubled the average plant mass of Amethyst basil at 35 days, more than doubled the average plant mass of Emily, Genovese, and Sweet Thai basil at 35 days, and nearly quadrupled the average plant mass of Aroma 2 basil at 32 days. The germination rate of basil was generally similar in HYPERroots™ compared to the other plant growth media (Table 2). Chlorosis was unremarkable in any of the samples.

DISCUSSION Plugs based upon peat, coir, and rockwool are widely used in CEA but have questionable compostability and sustainability. The collection of peat has deleterious effects on the ecosystems from which it is derived. Coir is more sustainable because it is manufactured from renewable husks of coconuts, however it can be contaminated, and it is difficult to compost. Rockwool is prepared from mined materials and is typically placed in a landfill after being used. HYPERroots™ is formulated from renewable polysaccharides and is the only plant growth medium that is certified compostable by the Biodegradable Products Institute (BPI).

HYPERroots™ was created using DoE and was optimized to grow leafy greens with a comparable rate of germination and a higher rate of growth than other plant growth media. These experiments with seven species of basil confirm the superior performance of HYPERroots™ under the tested conditions and confirm the formulation process capability.

Table 1: The % of average plant mass of basil (N=2517) measured after 14, 21, 28, 32 or 35 days of growth.

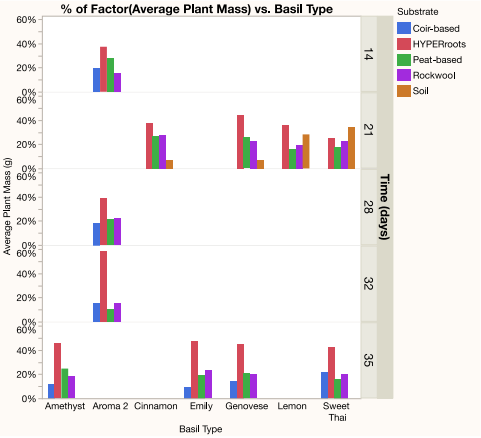
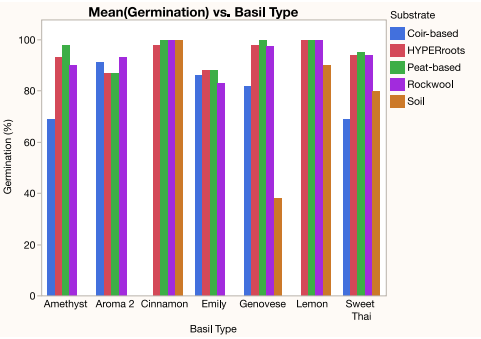


Table 2: The rate of germination of basil plants (N=3972) measured at 14 days.



For more information or to order please contact:

VelociGro, Inc
144 W Chestnut Ave
Monrovia, CA 91016

Email: info@velocigro.com

Phone: 323-490-7342

BPI® COMPOSTABLE