

Agnition 系列產品可增加土微生物數量及活性

Agnition Products Increase Microbial Biomass and Diversity

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INTRODUCTION

- Crop productivity is vastly dependent on soil health.
作物的生產力和土壤健康有極大的關聯性。
- Besides sunlight and air, plants can receive everything they need from the soil environment.
- Within the last few decades, there have been many tools and tests
在過去的幾十年中，已經有許多工具和測試方法用於測量土壤健康，
created that claim to measure soil health, however the soil health industry
但這些技術及方法仍在改進中。
is still creating and bettering techniques.
- The phospholipid fatty acid (PLFA) analysis is used to estimate living
磷脂脂肪酸 (PLFA) 可用於評估活性微生物數量，並可被視為微生物群落的指紋。
microbial biomass, and can be considered a finger print of the microbial
community.
- These fatty acids are located in the cell membrane bi-layer of living
這些脂肪酸位於生物體的細胞膜雙層中，但在生物體死亡和細胞膜分解時，
organisms but after death and membrane break down the fatty acids
脂肪酸的降解速度相對較快，因此可用於計算活性微生物的數量。
degrade relatively fast, making it possible to exclusively measure the living
portion. ¹
- Phospholipid fatty acids are unique structures that can be used as
磷脂脂肪酸是獨特的結構，可用來辨識特定的微生物群如
signature biomarkers for specific functional groups of interest such as
細菌群、菌根真菌、根瘤菌、原生動物等生物標誌，
bacterial groups, mycorrhizal fungi, rhizobia, protozoa, etc. making it
此方法不僅可以計算總生物量，還可以了解特定微生物間的比例及數量。
possible to not only measure total biomass but the proportion of specific
communities in the population as well. ¹

MATERIALS AND METHODS 材料與方法

- Plants were grown in the greenhouse under controlled ideal conditions.
植物種植於可控制條件的溫室中。
- Four PLFA trials were conducted, with replicated check and Agnition
針對不同產品及處理進行四次PLFA測試，並進行重複試驗。
treated pots.
- All pots were handled and cared for exactly the same with the only
除了所使用的Agnition產品不同，其他所有種植條件及處理均相同。
exception of the Agnition product application.
- Soil samples were taken by placing a 3.5-inch long probe over the plant
使用3.5英寸長的採樣針來採集土壤樣品。
and inserting into the soil.
- All samples were analyzed by Ward Laboratories, Inc. in Kearney, NE.
所有樣品委託位在Kearney, NE的Ward Laboratories公司進行分析。

Trial Number	Trial Start Date	Agnition Product Tested	Crop	# of Replications /Treatment
1	4/3/15	Generate® (In-Furrow)	Corn	5
2	8/17/15	Commence® for Wheat	Wheat	5
3	9/15/15	Commence® for Soybeans	Soy	5
4	2/9/16	Commence® for Corn	Corn	5

- 試驗1. 菁大讚施用於玉米葉面, 共使用5次
 試驗2. Commence施用於小麥, 共使用5次
 試驗3. Commence施用於黃豆, 共使用5次
 試驗4. Commence施用於玉米, 共使用5次

RESULTS

Table 1. PLFA results from Ward Laboratories, Inc. from the average of Trials 1-4.
 表1. 試驗1-4平均值與對照組之差異

對照組平均值 試驗組平均值 提升比例

PLFA Value	Description	Total Average Check	Total Average Treated	% Change from Check	P value (*p≤0.1)
Total Biomass 總生物量	More Biomass = More 值越高=更多營養循環 Nutrient Cycling (ng/g)	2519.22	2984.15	18.46	0.29
Relative Diversity Index 相對多樣性指數	Higher Level = Healthier 值越高=更健康的土壤 Soil	1.42	1.57	10.42	0.002*
Total Bacteria Biomass 總細菌生物量	Release N and other 可釋放更多氮及營養物質 Nutrients (ng/g)	1390.39	1644.28	18.26	0.31
Actinomycetes Biomass 放線菌生物量	Decompose Tough Material 分解難利用的成分及固氮 & Fix Nitrogen (ng/g)	303.30	363.51	19.85	0.27
Rhizobia Biomass 根瘤菌生物量	Makes Root Nodules 產生根瘤及固氮作用 and Fix N (ng/g)	22.55	67.95	201.29	0.01*
Total Fungi Biomass 總真菌生物量	Break Down Complex 分解難利用的成分 Matter (ng/g)	207.92	325.50	56.55	0.05*
Arbuscular Mycorrhizal Biomass 叢枝菌根生物量	Penetrates Cortical Cells and Provides Nutrients and H ₂ O (ng/g) 穿透植物皮層細胞以提供營養物質及水分	74.37	111.60	50.07	0.10*

Saprophytes 腐生菌含量 Biomass	Decays Organic Matter 腐爛的有機物質 (ng/g)	133.55	213.89	60.15%	0.03*
Protozoa Biomass 原生生物量	Release Nutrients Tied up 釋放細菌中的營養物質 in Bacteria (ng/g)	14.69	27.46	86.90%	0.04*
Fungi:Bacteria 真菌:細菌比例	Higher Ratio = More 較高的比例=更活躍的土壤 Developed Soil	0.14	0.19	35.32%	0.004*

Table 2. PLFA results from Ward Laboratories, Inc. from Trial 1 using Generate® in-furrow on corn.

表2 試驗1菁大讚施用於玉米葉面之結果 (施用5次)

<i>PLFA Value</i>	<i>Description</i>	<i>Total Average Check</i>	<i>Total Average Treated</i>	<i>% Change from Check</i>	<i>P value (*p≤0.1)</i>
Total Biomass	More Biomass = More Nutrient Cycling (ng/g)	2427.71	2440.97	0.55	0.96
Relative Diversity Index	Higher Level = Healthier Soil	1.53	1.62	6.05	0.13
Total Bacteria Biomass	Release N and other Nutrients (ng/g)	1380.28	1402.00	1.57	0.90
Actinomycetes Biomass	Decompose Tough Material & Fix Nitrogen (ng/g)	301.73	329.18	9.1	0.46
Rhizobia Biomass	Makes Root Nodules and Fix N (ng/g)	30.92	68.05	120.04	0.14
Total Fungi Biomass	Break Down Complex Matter (ng/g)	247.39	295.97	19.63	0.18
Arbuscular Mycorrhizal Biomass	Penetrates Cortical Cells and Provides Nutrients and H2O (ng/g)	85.83	97.48	13.58	0.38
Saprophytes Biomass	Decays Organic Matter (ng/g)	161.56	198.49	22.85	0.16
Protozoa Biomass	Release Nutrients Tied up in Bacteria (ng/g)	17.50	25.03	43.08	0.05*
Fungi:Bacteria	Higher Ratio = More Developed Soil	0.18	0.21	14.62	0.24

Table 3. PLFA results from Ward Laboratories, Inc. from Trial 2 using Commence® for Wheat.

表3. 試驗2 Commence施用於小麥之結果 (施用5次)

<i>PLFA Value</i>	<i>Description</i>	<i>Total Average Check</i>	<i>Total Average Treated</i>	<i>% Change from Check</i>	<i>P value (*p≤0.1)</i>
Total Biomass	More Biomass = More Nutrient Cycling (ng/g)	1784.62	2171.19	21.66	0.09*
Relative Diversity Index	Higher Level = Healthier Soil	1.30	1.49	14.01	0.12
Total Bacteria Biomass	Release N and other Nutrients (ng/g)	1007.95	1252.21	24.23	0.11
Actinomycetes Biomass	Decompose Tough Material & Fix Nitrogen (ng/g)	224.78	281.63	25.29	0.19
Rhizobia Biomass	Makes Root Nodules and Fix N (ng/g)	3.44	47.53	1281.69	0.11
Total Fungi Biomass	Break Down Complex Matter (ng/g)	99.79	197.35	97.76	0.12
Arbuscular Mycorrhizal Biomass	Penetrates Cortical Cells and Provides Nutrients and H2O (ng/g)	23.98	61.65	157.14	0.10*
Saprophytes Biomass	Decays Organic Matter (ng/g)	75.82	135.70	78.97	0.15
Protozoa Biomass	Release Nutrients Tied up in Bacteria (ng/g)	4.66	14.42	209.49	0.13
Fungi:Bacteria	Higher Ratio = More Developed Soil	0.10	0.15	60.29	0.16

Table 4. PLFA results from Ward Laboratories, Inc. from Trial 3 using Commence® for Soybeans.

表4. 試驗3 Commence施用於黃豆之結果 (施用5次)

<i>PLFA Value</i>	<i>Description</i>	<i>Total Average Check</i>	<i>Total Average Treated</i>	<i>% Change from Check</i>	<i>P value (*p≤0.1)</i>
Total Biomass	More Biomass = More Nutrient Cycling (ng/g)	1792.65	1903.85	6.2	0.55
Relative Diversity Index	Higher Level = Healthier Soil	1.40	1.56	10.91	0.09*
Total Bacteria Biomass	Release N and other Nutrients (ng/g)	874.80	950.39	8.64	0.58
Actinomycetes Biomass	Decompose Tough Material & Fix Nitrogen (ng/g)	179.33	207.41	15.66	0.48

Rhizobia Biomass	Makes Root Nodules and Fix N (ng/g)	14.86	26.37	77.48	0.47
Total Fungi Biomass	Break Down Complex Matter (ng/g)	128.76	191.60	48.80	0.18
Arbuscular Mycorrhizal Biomass	Penetrates Cortical Cells and Provides Nutrients and H2O (ng/g)	46.04	66.33	44.07	0.28
Saprophytes Biomass	Decays Organic Matter (ng/g)	82.72	125.26	51.43	0.15
Protozoa Biomass	Release Nutrients Tied up in Bacteria (ng/g)	5.89	12.59	113.71	0.17
Fungi:Bacteria	Higher Ratio = More Developed Soil	0.14	0.20	42.9	0.08*

Table 5. PLFA results from Ward Laboratories, Inc. from Trial 4 using Commence® for Corn.

表5. 試驗4Commence施用於玉米之結果 (施用5次)

<i>PLFA Value</i>	<i>Description</i>	<i>Total Average Check</i>	<i>Total Average Treated</i>	<i>% Change from Check</i>	<i>P value (*p≤0.1)</i>
Total Biomass	More Biomass = More Nutrient Cycling (ng/g)	4071.91	5420.59	33.12	0.12
Relative Diversity Index	Higher Level = Healthier Soil	1.45	1.61	11.31	0.08*
Total Bacteria Biomass	Release N and other Nutrients (ng/g)	2298.52	2972.54	29.32	0.13
Actinomycetes Biomass	Decompose Tough Material & Fix Nitrogen (ng/g)	507.37	635.81	25.31	0.20
Rhizobia Biomass	Makes Root Nodules and Fix N (ng/g)	40.99	129.86	216.8	0.08*
Total Fungi Biomass	Break Down Complex Matter (ng/g)	355.73	617.07	73.46	0.07*
Arbuscular Mycorrhizal Biomass	Penetrates Cortical Cells and Provides Nutrients and H2O (ng/g)	141.62	220.95	56.02	0.12
Saprophytes Biomass	Decays Organic Matter (ng/g)	214.11	396.12	85.01	0.05*
Protozoa Biomass	Release Nutrients Tied up in Bacteria (ng/g)	30.72	57.80	88.13	0.07*
Fungi:Bacteria	Higher Ratio = More Developed Soil	0.15	0.20	37.84	0.09*

CONCLUSION 結論

- When comparing untreated soil to Agnition treated soils, there was an overall beneficial increase of total microbial biomass, relative diversity, and individual microbial communities. With the overwhelming positive PLFA results; nutrient cycling, pathogen resistance, soil structure, and residue break down would be benefited in the rhizosphere.
將未經處理的土壤與Agnition系列產品處理的土壤進行比較時，Agnition組土壤中總微生物數量，相對多樣性及各種微生物數量均增加。在PLFA試驗中獲得壓倒性的正面效益，增加營養循環、病原體抗性、土壤結構和殘留成分分解均有利於根系發展。
- As seen in Table 1, the Agnition products were able to significantly increase the relative diversity index, rhizobia biomass, total fungi biomass, arbuscular mycorrhizal biomass, saprophytes biomass, protozoan biomass, and the fungi:bacteria ratio. The most common benefits of these microbial parameters are listed in Table 1.
如表1所示，Agnition產品能夠顯著 (p<0.1) 增加相對多樣性指數、根瘤菌生物量、總真菌生物量、叢枝菌根生物量、腐生菌生物量、原生動物生物量和真菌：細菌比例。表1也列出了這些微生物參數的代表效益。
- Overall increase in beneficial microbial parameters, measured through the PLFA test demonstrate that the soil environment where the Agnition products were applied were healthier, which would ultimately result in a healthier growing environment for the plants.
通過PLFA測試顯示土壤有益微生物參數總體增加，顯示使用Agnition產品的土壤環境更健康，這表示植物生長的环境更健康。

Works Cited

1. "Biotesting Information." *Ward Laboratories Inc.* Lance Gunderson. Web. 22 July 2016.