TWINN CROP TRIAL

Soybean: Missouri, USA, 2007

KEY RESULTS

- A comparison of soybean plots at two USDA trial sites in Missouri that received TwinN showed an additional 8.6% yield increase in the TwinN treated sites at one site and a 12.8% yield increase at the second trial site.
- Measurement of specific classes of beneficial soil microbes showed that they were increased substantially in TwinN treated plots.
- Application of TwinN resulted in a large decrease in the number of Fusarium fungal colonies on roots compared to Roundup treated plots that did not receive TwinN. The decreases were 40% and 43% at the two trial sites respectively.
- Application of TwinN increased Rhizobium nodule weight per plant by 16% compared to Roundup treated plots not treated with TwinN.

TREATMENTS

	OSAGE			BOONE		
TREATMENT	Fertiliser (kg)	Roundup Application	TwinN Application	Fertiliser (kg)	Roundup Application	TwinN Application
No Herbicide	Nil	Nil	Nil	132	Nil	Nil
+ Roundup	132	1	2	132	1	2
+ TwinN + Roundup	132	1	2	132	1	2

TRIAL RESULTS: BOONE SITE

TABLE 1: Grain Yield Boone

TREATMENT	Kg/Ha	Increase Kg/Ha	% Increase
No TwinN or Roundup	3,880 a	0	0
+ Roundup	4,270 b	390	10
+ TwinN + Roundup	4,600 c	720	18.6
LSD (0.05)[1]		208	

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TABLE 2: Biological Parameters Boone

TREATMENT	Fusarium Root Colonisation[2]	Root Pseudomonads[3]	Mn-reducing Bacteria[4]	Mn-oxidising Bacteria[5]	Nodule Weight[6]
No TwinN or Roundup	67.5 a	116.9 a	73.25 a	104.75 a	828 ab
+ Roundup	106.4 b	28.2 b	35.12 a	169.5 b	745 a
+ TwinN + Roundup	64.0 a	80.0 a	56.25 a	101.5 a	866 b
LSD (0.05)[1]	19.2	62.9	41.8	50.0	99

TRIAL RESULTS: OSAGE SITE

TABLE 3: Grain Yield Osage

TREATMENT	Kg/Ha	Increase Kg/Ha	% Increase
+ Roundup	2,660 a	0	0
+ TwinN + Roundup	3,000 b	340	12.8
LSD (0.05)[1]		164.7	

TABLE 4: Biological Parameters Osage

TREATMENT	Fusarium Root Colonisation[2]	Root Pseudomonads[3]	Mn-reducing Bacteria[4]	Mn-oxidising Bacteria[5]
+ Roundup	100.9 a	56.6 a	113.3 a	289.3 a
+ TwinN + Roundup	57.6 b	121.3 a	166.6 b	283.3 a
LSD (0.05)[1]	17.2	69.3	50.6	65.6

[1] LSD means Least Significant Difference. Where the variation from one treatment to another is greater than the stated LSD, the variation has statistical significance. Data values that share adjacent letters **a, b,** or **c** are not significantly different and if they have different adjacent letters they are significantly different.

[2] Colonisation or infection of roots by Fusarium fungi expressed as fungal colonies per 100 cm of root.

[3] Root population of root pseudomonad bacteria expressed as colony-forming units (CFU) per gram rhizosphere soil x 10,000.

[4] Root population of root Mn-reducing bacteria expressed as colony-forming units (CFU) per gram rhizosphere soil x 10,000.

[5] Root population of root Mn-oxidising bacteria expressed as colony-forming units (CFU) per gram rhizosphere soil x 10,000.

[6] Rhizobium nodule weight per plant (mg/plant).

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Interpreting Biological Parameters

- The level of Fusarium colonisation is an indicator of fungal infection of roots, possibly leading to root rot or wilt diseases.
- Fluorescent pseudomonad bacteria are generally associated with beneficial effects of the rhizosphere bacterial community including antagonism or suppression of fungal pathogens in the rhizosphere.
- Mn-reducing bacteria transform manganese (Mn) and similar micronutrients to plant-available forms. A high ratio of Mn-reducing to Mn-oxidising microbes is desirable for good soil heath and plant nutrition.
- Mn-oxidising bacteria immobilise Mn to insoluble, non-available complexes. A low count is desirable for good soil heath and plant nutrition.
- Rhizobium nodule mass per plant is directly correlated to the amount of atmospheric nitrogen fixed for crop growth by legumes. A large nodule weight indicates good soil and plant root health.

RESULTS: Yield

Application of TwinN in combination with Roundup herbicide resulted in statistically significant yield increases of 8.6% and 12.8% respectively compared to comparative plots that did not receive TwinN at the two trial sites.

RESULTS: Beneficial Microbes

Application of Roundup herbicide alone at the Boone site showed a strong suppressive effect on beneficial fluorescent pseudomonads that are generally associated with suppression of soil fungal pathogens including Fusarium. Application of TwinN and Roundup almost trebled the prevalence of these microbes compared to the plots treated with Roundup only. At the Osage trial site the application of TwinN with Roundup more than doubled the numbers of fluorescent pseudomonads compared with application of Roundup alone, although this was not statistically significant.

Similar effects of TwinN and Roundup were measured in the amounts and ratios of Mn-reducing to Mn-oxidising microbes, with TwinN driving a strong movement towards beneficial ratios. These effects are expected to assist in increasing availability of some micronutrients in soils.

At the Boone site the application of Roundup alone was associated with a 36% increase in Fusarium fungal counts which may be attributed to the decrease in fluorescent pseudomonads. Addition of TwinN applications to Roundup treated plots decreased the levels of Fusarium back to levels very similar to plots not receiving any Roundup. Similarly, at the Osage site, the addition of TwinN applications reduced Fusarium fungal counts by 43% compared to Roundup only treated plots.

Rhizobium nodule weights were only measured at the Boone site which showed a 16% increase in root nodule weights. This is significant since it demonstrates the capacity for TwinN to contribute to increased nitrogen fixation and yield accumulation in legumes via direct effects on nodulation by Rhizobium.

These independent trial results show clearly that application of TwinN was associated with increased levels of beneficial soil and plant root microbes and decreased levels of non-beneficial microbes and pathogenic Fusarium counts. The results suggest a useful role for TwinN in restoration of a balanced and productive soil microflora in high intensity cropping systems.

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TRIAL DETAILS

Trials were performed and analysed independently by the University of Missouri/USDA* at two sites in Missouri.

TRIAL DESIGN

Imposed research plots within an 8-hectare field as strip-blocks at 6 X 15 m; 4 replicates at Boone and 3 replicates at Osage.

BOONE	OSAGE
Planted: *25 May 2007* **Soils:** *Mexican silt loam* **Varieties:** *Pioneer 93M92* **Roundup Herbicide Applied:** *6 July 2007* **TwinN Applied:** *15 June & 22 June 2007* **Test Plots Harvested:** *29 October 2007*	**Planted:** *25 May 2007* **Soils:** *Jemerson silt loam* **Varieties:** *MorSoy (MFA)* **Roundup Herbicide Applied:** *7 July 2007* **TwinN Applied:** *13 June & 6 July 2007* **Test Plots Harvested:** *10 October 2007*

Fertiliser applications across all plots: Nitrogen applied at 112 kg N/ha (anhydrous ammonia) plus 20 kg credit from previous soybean crop. Soil analysis indicated sufficient P. K applied at 65 kg/ha as K_2O.

TwinN Application Conditions

Weather Conditions: Approximately 28°C onto dew, high humidity
Application Method: Backpack 370 litres/ha
Crop Stage: Boone first application V2; second application V4
Osage first application V2; second application V7

Missouri soybean yields: TwinN on the left.

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