

Increasing Crop Available  
Nutrients with proper timing of  
incorporation of Green Vegetation

Tim Kimpel

Tim Kimpel  
Roseville, Ohio

450 acre Certified Organic Farm

Corn, Soybeans, Barley, Spelt, Oats

Forages, Pasture

Beef Cattle, Hogs, Pastured Broilers & Hens

We specialize in Grass Finished Beef

Own & operate a small Health Food Store

Ray Rawson  
Farwell, Michigan  
Several Thousand Acres

Corn, Soybeans, Wheat

Limited use of chemical fertilizer & pesticides

Very conscious of the impact of tillage on Soil  
Micro-biology

# How did we come to be interested in this theory for research

- Several years of surprises with the cultivators
- Significant finding with an incorporation mistake in 2009
- Much discussion with Ray Rawson who is replicating these trials in Michigan on whole fields

# Early Cultivation 2005

## 50% increase



# Mud & Cultivation 2008

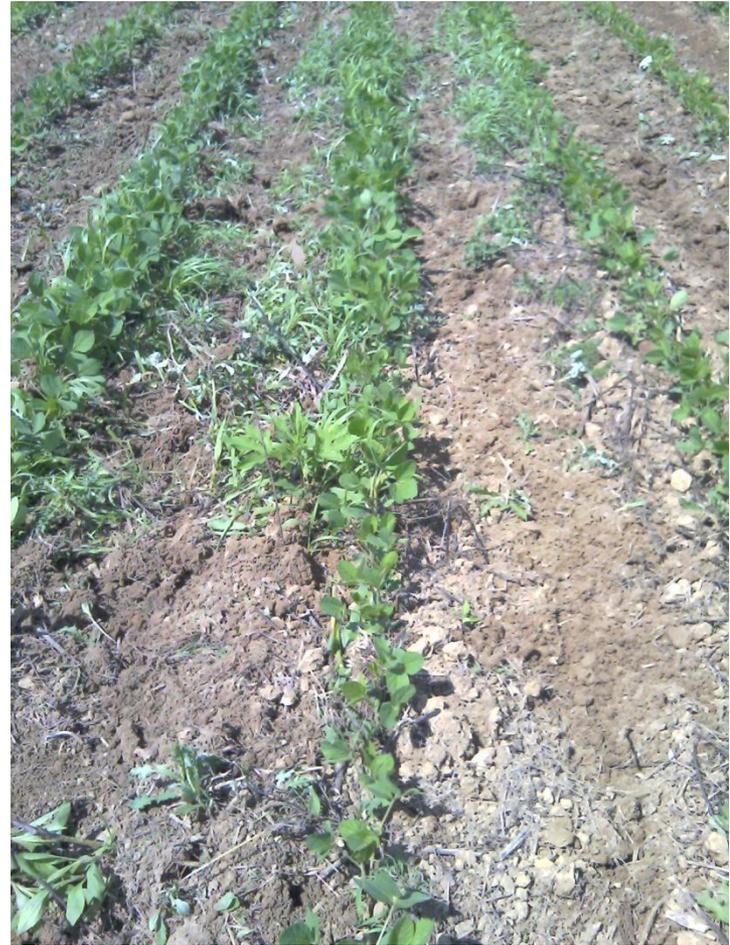
- Used moldboard plow
- Rained and Rained (weeds)
- Tried to cultivate when way too wet
  - Mud flying almost got stuck
- Results (rows next to each other)
  - Mycorrhizal Colonization 8% vs 45%
  - Yield 15 vs 60 bu per acre
- The Muddy cultivation was better
- All about getting air to the “Bugs”

# Early Cultivation 2009 approx 30% increase



# Early Incorporation 2009

## 30% Increase



# Early Incorporation 2009

## 30% Increase (the weedy side)



# My theory after 2009

## “ITS ALL ABOUT THE BUGS”

- Soil Bugs, Microbes, Soil Foodweb
  - Bacteria, Fungi, Protozoa, Nematodes, etc.
  - Bugs Need Oxygen
    - Subtiller
    - Dyna-drive
    - Aerator
  - Bugs Need Food
    - Carbohydrate
    - Protein
    - Green, succulent plant Material

# Sare Grant

- Applied for in fall of 2009

Total \$5990

Testing & Shipping \$5220

2 Trips to Farwell Michigan \$770

– 2 year Program

# Corn 2010

## Layout of Test Plot

Corn rows run East – West

- Tillage variables run North – South
- Each planter pass Crosses each tillage variable as the rows go East – West
  - This minimizes the amount of other variables that impact the results
  - Each tillage strip variable is approx. 40 ft wide
- Think of this as a cross hatch pattern

# CORN 2010

## Green Material Incorporated



# 1<sup>st</sup> Tillage incorporation May 7

## Dyna-drive



# Sub Tiller used May 8



# Incorporated Strips not already incorporated May 29



# Field ready for diagonal tillage pass with the Dyna-drive



Planted May 30  
Used Tined Weeder 3 times  
Used Cultivators once



# 1<sup>st</sup> Soil Tests May 31

- Mehlick III
  - Standard soil test
- Saturated paste
  - Water soluble
  - Plant available
- Nitrogen
  - NH<sub>4</sub>
  - NO<sub>3</sub>
    - Totaled on sheet



# 2<sup>nd</sup> Soil tests Aug 9

- Saturated Paste
- Nitrogen
- Plant Tissue Test
- Soil Biology Test
  - Soil Food Web Inc.
  - Amounts and ratios of various micro-biology



# Corn 2010

## Analysis of Soil test results

- Soil Phos Was Low 3 to 4 ppm
- Soil Ca was a bit high 76 to 82 % base saturation
- Nitrogen averaged 14.5 ppm May 31 and 9.6 Aug 9 on the area NOT incorporated early.
- Nitrogen averaged 28.3ppm May 31 and 12.9 ppm Aug 9 on the area incorporated early
- Can Not see much difference on Saturated Paste test.
- Can not see much difference on Tissue tests

# Corn 2010

- The Soil Foodweb results showed:
  - The ratios of Fungi to Bacteria were generally low for Fungi
  - The Protozoa Increased with biologicals
  - Less Tillage may produce more Fungi

# Harvest yield Data collected Nov 9



2010 corn Harvest Data Worksheet						
1	7.6	7.9	6.5		101.9	104.9
	18000	17000	13000			
2	8.9	10.5	9.6		134.3	138.2
	15000	21000	19000			
3	9.6	10.7	8.9		135.2	139.2
	18000	15000	21000			
4	9	5.9	7.1		101.9	104.9
	18000	19000	15000			
5	9.8	9.5	10.7		138.9	143.0
	22000	20000	18000			
6	10.5	8.5	8.6		127.8	131.6
	21000	16000	18000			
7	11.1	11	11.4		155.1	159.7
	22000	21000	20000			
8	9.6	10.5	11.3		145.4	149.7
	16000	19000	20000			
9	10.3	9.5	9.6		136.1	140.1
	17000	16000	18000			
10						
11	9.4	7.2	9.8		122.2	125.8
	19000	21000	18000			
12	10.9	11.6	10.5		152.8	157.3
	20000	23000	16000			
fert	5	5				71.5
	13000	15000				

# Corn 2010

- Harvest yield Analysis Nov 9
  - Yield from area NOT incorporated early  
**105 Bushels Per Acre**
  - Yield from area that was incorporated early  
**137.3 Bushels Per Acre**  
**31 % increase**

# Interesting



SARE Grant Research for 2010

Kimpel Farms

Corn

Green manure crop 20 % alfalfa 30% clover 25% orchard grass 25% Blue grass

Corn row	Incorporation	No variables with planter	AEA Program with planter	No variables with planter	Hiland Naturals Program with planter	No variables with planter	Organic fertilizer with planter	No variables with planter
Direction	Direction							
East West	North/South			Main project rows		early cultivation		
	<<<< >>>>	5 rows	10 rows	10 rows	10 rows	10 rows	5 rows	5 rows
	Sub tilled May 8	<< incorporation pattern direction>>		#1 105 Bu/A			<< incorporation pattern direction>>	
	Incorporated May 29			Start total N =9.5ppm				
	(NOT incorporated EARLY)			Aug total N=9.5 ppm				
	Planted May 30							
	Sub tilled May 8		#8 150 Bu/A	#2 138 Bu/A	#7 160	#9 140 Bu/A		
	Incorporated May 7		Start total N=36.7	Start total N=33.2	Start total N=28.5	Start total N=30.6		
	(Incorporated EARLY)		Aug total N=12.9	Aug total N=14.9	Aug total N=10.9	Aug total N=20.2(high)		
	Planted May 30							
	Mowed with lawnmower May 7			#3 139 Bu/A				
	Sub tilled May 8			Start total N =15.1				
	Incorporated May 29			Aug total N=13.8				
	Planted May 30			(not sure what this means)				
	Not Sub tilled	Baseline for project		#4 105 Bu/A		#10		
	Incorporated May 29			Start total N=19.5		Start total N=18.6		
	(NOT incorporated EARLY)			Aug avg. total N=9.6		Aug total N=13.5		
	Planted May 30							
	Sub tilled May 8							
	Incorporated May 7			#5 143 Bu/A				
	(Incorporated EARLY)			Start total N=25.8				
	Planted May 30			Aug total N=13.3				
				#6 131 Bu/A				
				Start total N=26				
				Aug total N=10.7				
	rest of field							
	Application of hog manure			#11 126 Bu/A		#11		
	26-May			(pig weed)		Aug total N=16.3		
	Application of beef manure			#12 157 Bu/A		#12		
	26-May					Aug total N=12.1		
	Forage test	1st soil tests day after planting		2nd tests at pollination		Yield Checks were the average of 3 Hand harvest checks		
	9-May	Base soil test		Saturated paste test		per variable. (for example #6 is the average from harvesting		
	20.85%Protein	Saturated past test		Ammonium & nitrate		the ears from 17ft 4in of row, 3 separate times, weighing each		
		Ammonium & nitrate		Whole plant tissue test		and calculating the average for the final yield)		
				Soil Food Web test				

Kimpel Farms		Soybean Plots	
Green manure crop: Giant Ragweed & other			
Not incorporated early	no biologicals added	24.5 Bu/A	Rawson Farms Farwell, Michigan
Incorporated early	no biologicals added	49.7 Bu/A	Not incorporated early 55 Bu/A
			Incorporated early 90+ Bu/A
Not incorporated early	Hiland Program	26.9 Bu/A	
Incorporated early	Hiland Program	41.9 Bu/A	

# Soybeans 2010

## Layout of Test Plot

- 23 acre field
- Rows run North – South
- Area with Late Incorporation is a rectangle approx. 40 ft wide and 300 ft long
- The rows run across the rectangle
- There was a very well defined edge on the south side of the rectangle
- Research was done on both sides of this edge

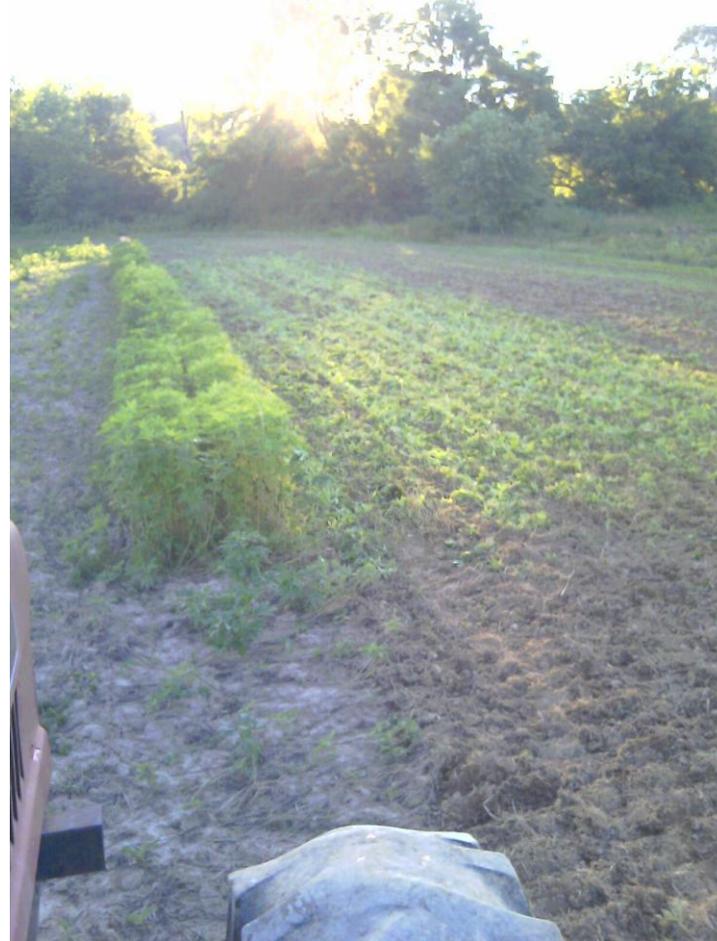
# Soybean Trial 2010

## Tillage & Incorporation schedule

- 5/22 Sub tilled entire field
- 6/12 Incorporated all except  $\frac{1}{2}$  of trial area
- 7/3 Incorporated remaining  $\frac{1}{2}$  of trial area
- 7/3 Worked entire field at Diagonal
- 7/4 Planted entire field with rows running perpendicular and across the trial area

# Soybeans 2010

## Green material incorporated (giant ragweed)



# Soybean trial 2010

- Soybeans in area not incorporated early came up about 3 to 5 days later



# Soybeans 2010



# Soybeans 2010



# Soybeans 2010



# Soybeans 2010

- Soil tests were taken August 9
- Nitrogen
- Saturated Paste
- Tissue Test
- Soil Biology Tests



# Soybeans 2010

## Analysis of Soil test results

- Soil Phos levels are low 2 to 6 ppm
- Potassium is low 1.9 to 1.5 % base sat.
- Soybeans seem to pull more NO<sub>3</sub> from the soil
- Incorporating early seemed to Increase the Saturated paste levels for:
  - Mg, K, Na, B, Mn, Zn,

# Soybeans 2010



Sare Grant Worksheet for fall Harvest 2010															
		Soybeans	Plants/ 10 Ft						Total seeds	Plants per foot	Avg seeds per plant				
N N 1	Not Incorporated early	No Additions	40	126	93	115	105	62	501	4	100.2	0.8	0.085	27.3	
N N 2	Not Incorporated early	No Additions	41	123	42	92	87	89	433	4.1	86.6	0.8	0.085	24.1	24.5
N N 3	Not Incorporated early	No Additions	33	80	151	100	45	116	492	3.3	98.4	0.8	0.085	22.1	
N H 1	Not Incorporated early	Hiland Program	35						558	3.5	111.6	0.8	0.085	26.6	
N H 2	Not Incorporated early	Hiland Program	33	150	132	73	62	31	448	3.3	89.6	0.8	0.085	20.1	26.9
N H 3	Not Incorporated early	Hiland Program	40	125	72	200	97	130	624	4	124.8	0.8	0.085	33.9	
Y N 1	Early Incorporated	No Additions	77	145	80	93	94	67	479	7.7	95.8	0.8	0.085	50.2	
Y N 2	Early Incorporated	No Additions	67	104	117	79	94	137	531	6.7	106.2	0.8	0.085	48.4	49.7
Y N 3	Early Incorporated	No Additions	72	130	97	99	102	88	516	7.2	103.2	0.8	0.085	50.5	
Y H 1	Early Incorporated	Hiland Program	54						460	5.4	92.0	0.8	0.085	33.8	
Y H 2	Early Incorporated	Hiland Program	83	115	60	101	109	82	467	8.3	93.4	0.8	0.085	52.7	41.9
Y H 3	Early Incorporated	Hiland Program	66	73	81	93	105	84	436	6.6	87.2	0.8	0.085	39.1	

# Soybeans 2010

Harvest yield Results Nov 9

Yield from area NOT incorporated early

**24.5 Bushels Per Acre**

Yield from area that was incorporated early

**49.7 Bushels Per Acre**

**103 % Increase**

# Soybeans 2010

## Ray Rawson - Michigan

- Ray had several trials in relatively large fields
- Each variable was at or near 100 acres
  - Various cover crops
  - Various types of tillage
  - Combine Harvest with Yield Monitor

Not Incorporated early

**55 Bushels per Acre**

Incorporated early

**90+ Bushels per Acre**

**67% increase**

# 2011 Corn

- Rain
- Rain
- Rain

# We Changed our Subtiller



# Hoped To Destroy More Weeds



# Notice the Amount of Cover Crop



# May 21 Tillage



# Final tillage June 1&2



# Planting June 3



# Old Deadfurrow



# North Side



# September 24 Plant Health



2011 Corn Yield Data for Sare Grant Research							compare to	bu.
Trial	Row	# Plants	# Ears	Lbs.	yield/acre	avg yield	nearest check	Increase
#1	13	18	18	11.2	160.2		#5	
S.T.E	14	22	22	13.6	194.5		106.5	CHECK
<b>Sub tilled 14 days before planting</b>						177.3		<b>70.8</b>
#2	13	19	22	12.4	177.3		#5	
S.T.E.E.	14	22	22	13	185.9		106.5	
<b>Sub tilled 27 days before planting</b>						181.6		<b>75.1</b>
#3	13	16	17	10.7	153.0		#5	
S.T.E	14	21	22	13.4	191.6		106.5	
<b>Sub tilled 14 days before planting</b>						172.3		<b>65.8</b>
#4	13	8	11	6.5	93.0		#5	
Ar.E	14	5	20	10.6	151.6		106.5	
<b>Aerated 14 days before planting</b>						122.3		<b>15.7</b>
#5	13	13	15	8.5	121.6		CHECK	
NONE	14	8	14	6.4	91.5			
<b>Check area Nothing done early</b>						106.5		
#6	13	7	8	4.8	68.6	cult. Issue	#5	
S.T.E	14	13	16	9.2	131.6		106.5	
<b>Sub tilled 14 days before planting</b>						131.6		<b>25.0</b>
#7	13	22	22	12.4	177.3		#8	
Ar.E	14	21	21	10.5	150.2		100.8	
<b>Aerated 14 days before planting</b>						163.7		<b>62.9</b>
#8	13	19	17	10.1	144.4		CHECK	
NONE	14	9	7	4	57.2	not cult.issue		
<b>Check area Nothing Done Early</b>						100.8		
#9	13	15	15	8.3	118.7		#8	
Ar.E	14	15	19	9.5	135.9		100.8	
<b>Aerated 14 days before planting</b>						127.3		<b>26.5</b>

Average increase over Check For Sub tilled 27 days before planting  
**72.9 BU. Per Acre** 1 replication

Average increase over Check For Sub tilled 14 days before planting  
**53.9 BU. Per Acre** 3 replications

Average Increase over Check for Aerated 14 days before planting  
**35.0 BU. Per Acre** 3 replications

All was sub tilled again 1 day before planting to eliminate the effect of compaction on the Trial data.

All was planted to the same hybrid at the same time. June 3.

No plant nutrition was applied to any part of this field this season.

Nothing was used on this field but seed corn and diesel fuel

The 2011 season was very wet.

We got 5 1/2 inches 3 days after planting.

Cultivating and weed control was very difficult due to wet conditions.

I believe the big open spot that affected #6 was due to plugging of the tine weeder with mud.

EAST end of north strip							Nearest	
S.T.E	30	19	18	8.6	123.0		Comparative	
S.T.E	29	18	15	7.2	103.0		rows 20&19	
<b>Sub tilled 14 days before planting</b>						113.0	25 ft south	
S.T.E.E.	20	21	22	14.5	207.4			
S.T.E.E.	19	25	26	12.7	181.6		113.0	
<b>Sub tilled 27 days before planting</b>						194.5		<b>81.5</b>
Middle of north strip								
S.T.E	30	17	18	8.7	124.4			
S.T.E	29	18	18	8.5	121.6	123.0		
<b>Sub tilled 14 days before planting</b>								
S.T.E.E.	20	19	20	12.3	175.9			
S.T.E.E.	19	22	21	12.9	184.5		123.0	
<b>Sub tilled 27 days before planting</b>						180.2		<b>57.2</b>
WEST end of north strip								
S.T.E	30	17	15	6	85.8			
S.T.E	29	17	17	6.2	88.7	87.2		
<b>Sub tilled 14 days before planting</b>								
S.T.E.E.	20	16	20	11.1	158.7			
S.T.E.E.	19	20	21	11.3	161.6		87.2	
<b>Sub tilled 27 days before planting</b>						160.2		<b>72.9</b>

Average increase over Sub tilled 14 days before planting  
of Sub Tilled 27 days before planting

**70.5 BU. Per Acre** 3 replications

This area was not planned as a trial area.

I made several trips with the sub tiller on this north side of the field before sub tilling the plot area 27 days before planting.

This was intended to scour the plow but it was obvious from the time the corn came up that there was a significant difference between those first few rows and the rows to the south.

This area was noticeably taller and greener all season. It stayed green longer at dry down.

At time of yield check the higher yielding area had ear placement 12 to 14 inches higher and plant height 12 to 14 inches higher.