HUMA GRO™

Huma Gro Products Research Data

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Outline

- **Benefits of humic, fulvic acids, and MCT®**
- **Research reports**
  - Super Phos®
    - I-Spring wheat
    - II-P column study
    - III-Vegetables
      - A- Lettuce
      - B- Potato
      - C- Tomato
  - Encapsalt™
    - I- Bermudagrass
  - Proud 3® and Triple Play ™
    - I-Whiteflies on Vebena
    - II-Direct spray studies
      - A- Pea aphids
      - B- Silverleaf whiteflies
      - C- Cabbage loopers

Natural Sources of Humic Substances

Natural Sources	Content of Humic and Fulvic Acids in %
Leonardite/Humate	40 - 85
Black Peat	10 - 40
Sapropel Peat	10 - 20
Brown Coal	10 - 30
Dung	5 - 15
Compost	2 - 5
Soil	1 - 5
Sludge	1 - 5
Hard Coal	0 - 1

Source: Humintech

Benefits of Humic Acids (HAs)

- Potato field experimental results illustrated both the direct and indirect benefits of HAs on plant growth and soil (Seyedbagheri, 2010)

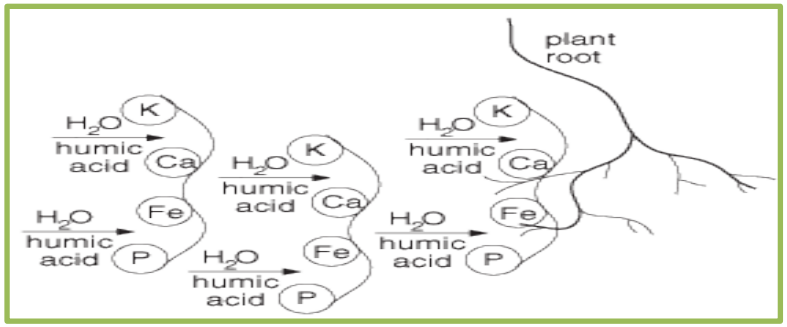
- Direct benefits on plant cell membrane:
  - Improved transport of nutritional elements
  - Enhanced protein synthesis, plant hormone-like activity, enhanced photosynthesis,and effects on enzyme activities

- Indirect benefits on plant growth:
  - Solubilization of microelements (i.e. Fe, Zn, Mn) and macroelements (i.e. K, Ca, P)
  - Reduction of active levels of toxic elements
  - Increased microbial populations

Benefits of Humic Acids (HAs) cont'd

- HAs can increase plant yield via:
  - Stimulation of microbial activity (Petrovic et al., 1982)
  - Amelioration of pH in alkaline soil (Li and Wang, 1988)

- Humic substances influenced the availability of phosphorus (P) for wheat via:
  - Increased P availability to wheat plants (Wang et al., 1995)
  - Decreased P fixation in soil
  - Increased P uptake
  - Increased wheat yield



Source: http://www.phelpstek.com/portfolio/samples/humic_acid.html

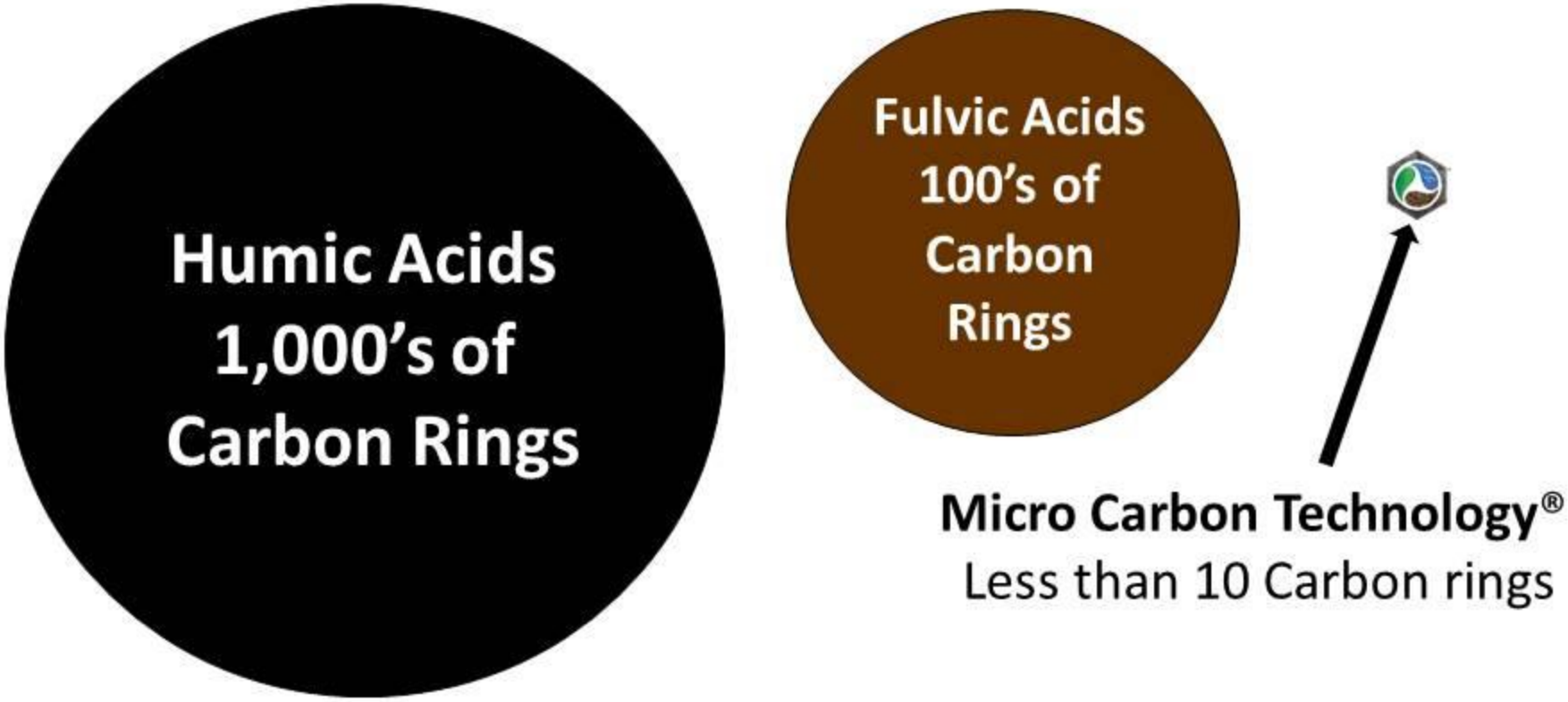
Functional Groups of Humic and Fulvic Acids Containing Oxygen

	Total Acidity	-COOH	Acid -OH	Weakly Acidic and Alcolholic -OH	-C=O
	Normal Range, cmol(+) per kg				
Humic Acids	**500-870**	150-300	250-570	270-350	90-300
Fulvic Acids	**900-1,400**	610-910	270-670	330-490	110-310

Source: Stevenson y Butler, 1969

Micro Carbon Technology® produces organic matter that is more chemically active than humic or fulvic acids

The Carbon Molecular Size Makes the Difference



Advantages of Huma Gro® (HG) Fertilizers with MCT®

- Micro Carbon Technology® (MCT) contains smaller molecules than HAs and has a powerful effect on soil nutrients uptake, soil properties, and plant growth.
- MCT protects nutrients from being tied up in soil.
- MCT can be applied via any type of irrigation systems.
- MCT can be applied via the leaves or roots.

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SUPER PHOS®

I- Efficiency Test of HUMA GRO® SUPER PHOS® in Spring Wheat (Olga Walsh, PhD, Montana State University)

Objective:

Evaluate the relative efficiency of topdress and foliar application of SP and traditional P fertilizers (i.e. ammonium polyphosphate (APP), diammonium phosphate (DAP), and triple superphosphate (TSP)) in spring wheat.

Materials and Methods

- The experimental site was Montana State University's Western Triangle Agricultural Research Center (WTARC), near Conrad, MT.
- Choteau spring wheat variety was used.
- Eleven treatments were replicated four times.
- Nitrogen was applied to SP treatments to compensate for the N content in DAP and APP.

Treatments

- Treatment 1 was established as a check plot unfertilized with P.
- Treatments 2-7 involved application of liquid APP and two granular P fertilizers (DAP and TSP) with the seed at planting.
- Treatments 8-9 involved application of SP (diluted with water at a concentration of no greater than 5% (v/v)) at seeding by dribbling it over the top of the seed.
- Treatments 10-11 involved foliar application of SP at tillering (Feekes 5) using an all-terrain-vehicle (ATV)-mounted stream-bar sprayer.

Results: SP on Spring Wheat

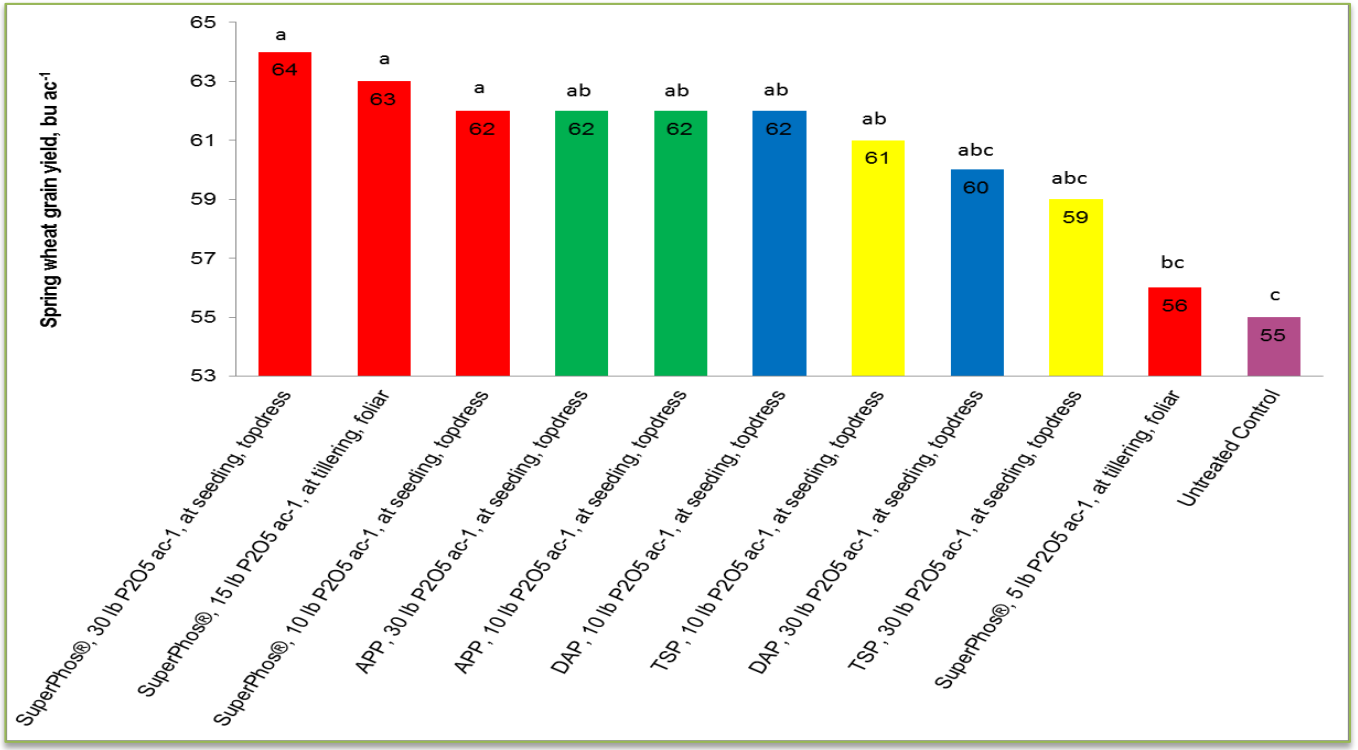


Figure 1: Spring wheat grain yield as a function of P fertilizer source, rate, time, and placement, Conrad, MT, 2013. Data points followed by the same letter are not significantly different at $p<0.05$.

Conclusion: SP on Spring Wheat

- Application of SP at seeding at both 10 and 30 lb P_2O_5/ac resulted in significantly higher grain yields compared to the untreated control.
- Tripling the application rate from 10 to 30 lb P_2O_5/ac increased yield by 2 bu/ac.
- Foliar application of SP at 15 lb P_2O_5/ac at tillering also produced higher grain yields compared to the untreated control.

II- SP Column Study (Vimala Nair, PhD, University of Florida)

Hypothesis:

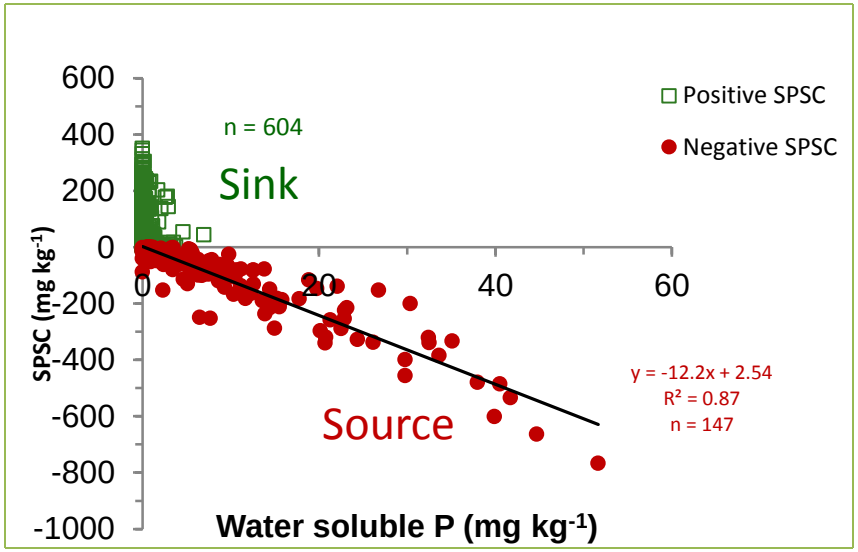
- Micro Carbon Technology®(MCT) increases P mobility in acidic soil.

Concepts:

- P saturation ratio (PSR) measures P retention in the soil.
- Soil P Storage Capacity (SPSC) refers to mg of P that can be added to a kg of soil before a threshold of PSR is reached.

$$SPSC = (0.10 - \text{soil PSR}) * M3\ [Fe + Al] * 31$$

SPSC and Water Soluble P



- When SPSC is positive, soil is a P sink
- When SPSC is negative, soil is a P source

Source: Chrysostome M, VD Nair, WG Harris and RD Rhue. 2007. Soil Sci. Soc. Am. J. 71:1564–1569.
Nair VD and WG Harris. 2014. Advances in Agriculture. doi:10.1155/2014/723064.

Treatments

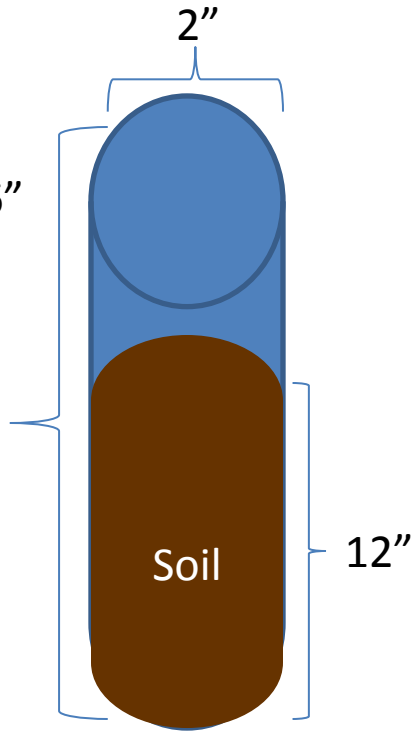
Two soil types: Candler (pH = 4.8) and Apopka (pH = 5.4)

Table 1. Amount of fertilizer (liquid or solid) applied per column

Fertilizer #	Fertilizer	Fertilizer applied per column (mg)
1	SUPER PHOS™, (SP), 0-50-0 (liquid)	2.89
2	Phosphoric acid, 0-52-0 (white, liquid)	2.70
3	Ammonium polyphosphate, 10-34-0 (liquid)	4.28
4	Diammonium phosphate, 18-46-0 (solid)	2.81
5	Triple superphosphate, 45% P_2O_5 (solid)	3.27
6	Monoammonium phosphate, 11-52-0 (solid)	2.48

Materials and Methods

- Total number of columns = 2 soils x 7 treatments (6 + control) x 3 reps = 42
- Liquid fertilizers were diluted with distilled water to 1 gallon SP/ac and applied with the first 4” of water.
- Solid fertilizers were mixed in the top inch of soil to a concentration equivalent to that in SP solution.



Materials and Methods

- 4” of water were added (7 days apart) for 4 times.
- Leachate were collected and analyzed.
- A week after the fourth water application, soil columns were sectioned into 6 increments (3 cm = 1.18 ”), and soil samples (42x6=252) were air-dried for lab analyses (WSP, M3-P, Fe, and Al).

Results: P Column Study

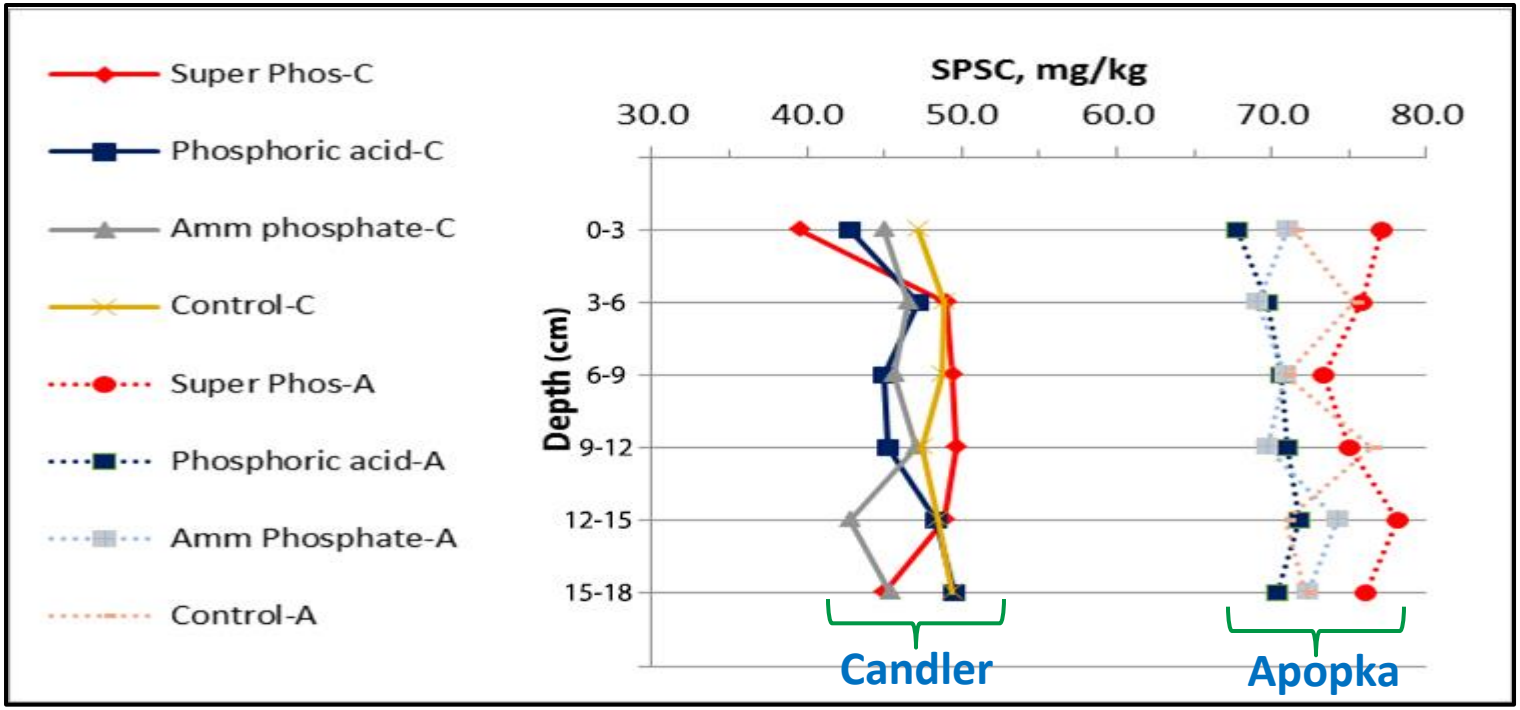


Figure. 1: Soil P storage capacity (SPSC) changes with depth for the various liquid fertilizer treatments. “C” and “A” in the legend indicate the soils, “C” for Candler and “A” for Apopka.

Conclusion: P Column Study

- Changes in SPSC within the soil columns indicate that SP likely moves faster than white phosphoric acid and ammonium poly phosphate.
- We can postulate that due to SP's organic factor (MCT), P does not react with Fe and Al at low pH to the extent that other P fertilizers do.

III- Response of Vegetable Crops to SP

(Charles Sanchez, PhD, UA)

Objective:

To evaluate phosphorous (P) use efficiency resulting from SP®on:

A- Lettuce

B- Tomato

C- Potato

Materials and Methods

- The studies were conducted on soil mapped as Casa Grande (fine-loamy) at the Maricopa Agricultural Center, AZ .
- RCBD, 4 replicates

A-Lettuce

- Soil was low in P.
- SP plots received 11 kg N/ha as urea at planting to compensate for the N in mono ammonium phosphate (MAP).
- Fertilizer treatments:

1. Control (No P)
2. 100 kg P/ha as MAP
3. 50 kg P/ha as MAP
5. 6.25 kg P/ha as SP
6. 12.5 kg P/ha as SP
7. 25 kg P/ha as SP
8. 50 kg P/ha as SP

Results: Lettuce

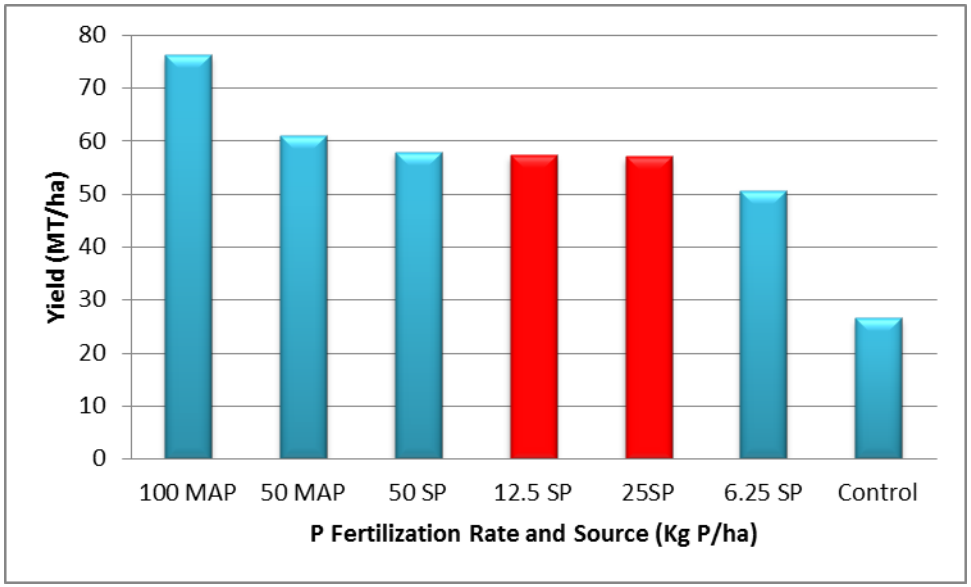


Figure 1. Lettuce marketable yield.

- The highest yield was associated with the 100 kg P/ha rate as MAP, which corresponds to the University recommendation of P fertilizer for lettuce on a low testing soil.
- The next highest yield was associated with the 50 kg P/ha rate as MAP. This yield was not significantly different from the 12.5 to 50 kg P/ha rates as SP.

Conclusion: Lettuce

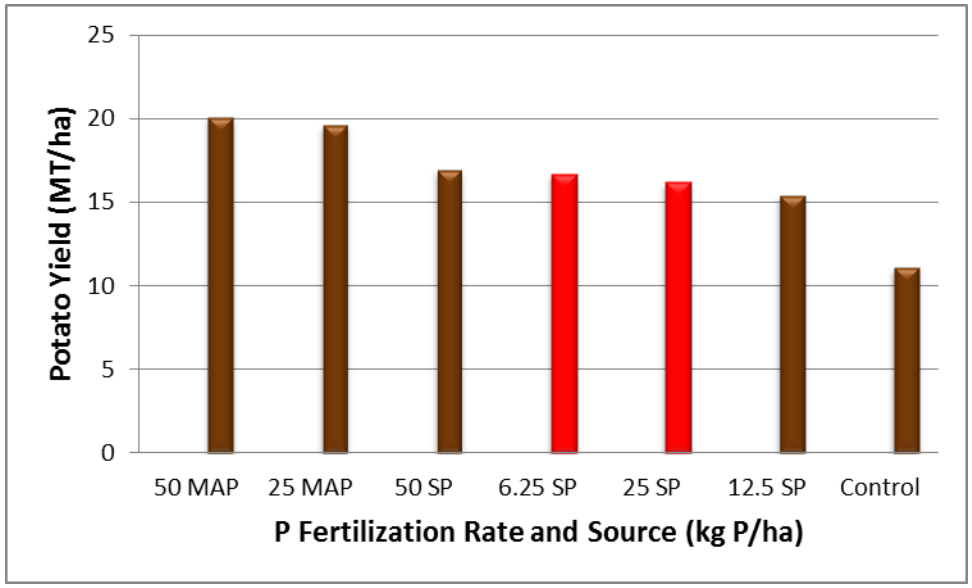
The observation that only 12.5 kg P/ha as SP produced yields similar to the 50 kg P/ha rate as MAP suggests enhanced efficiency associated with SP.

B- Potato

- Soil was low in P.

- Fertilizer treatments:
  1. Control (No P)
  3. 50 kg P/ha as MAP
  4. 25 kg P/ha as MAP
  5. 6.25 kg P/ha as P
  6. 12.5 kg P/ha as SP
  7. 25 kg P/ha as SP
  8. 50 kg P/ha as SP

Results: Potato



- The highest yields was associated with the 50 kg P/ha rate as MAP which corresponds to the University P fertilizer recommendation for potato on this soil.
- The next highest yield was associated with the 25 kg P/ha rate as MAP.

Figure 2. Potato marketable yield.

Conclusion: Potato

The observation that only 6.25 kg P/ha and 25 kg P/ha as SP produced yields similar to the 50 kg P/ha as MAP suggests enhanced efficiency associated with SP.

C- Tomato

- Soil P > 10mg P/kg.
- Fertilizer treatments:
  1. Control (plus UAN 32)
  2. Control with N Supernitro
  3. MAP 100% Program (plus UAN 32)
  4. 75% P as SP/Supernitro
  5. 50% P as SP/Supernitro
  6. 25% P as SP/ Supernitro

Results: Tomato

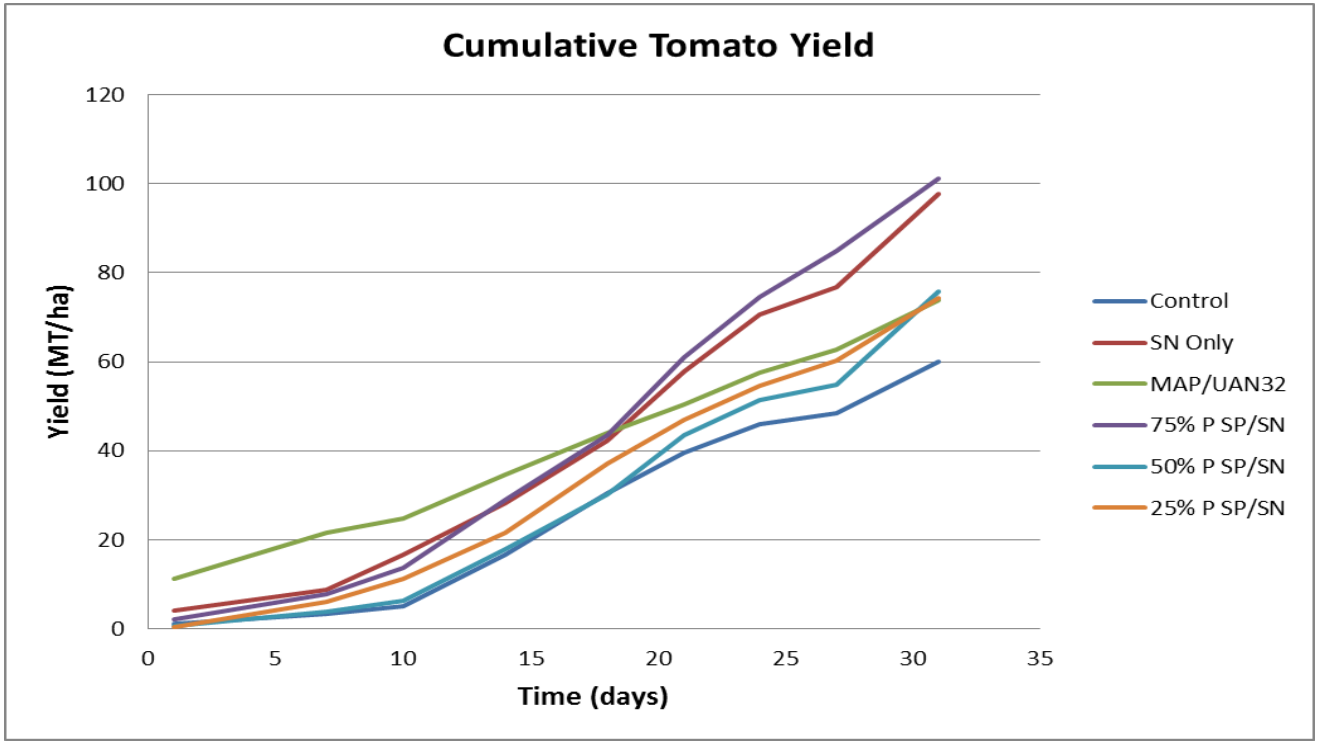


Figure 3. Tomato cumulative yield.

Conclusion: Tomato

- The total cumulative yield associated with SP at 25% or 50% rate was as good as MAP at 100% rate.
- The highest total cumulative yields were associated with treatments 2 (SN only) and 4 (75% P SP/SN), suggesting that Supernitro may be a better in-season N source than UAN32.

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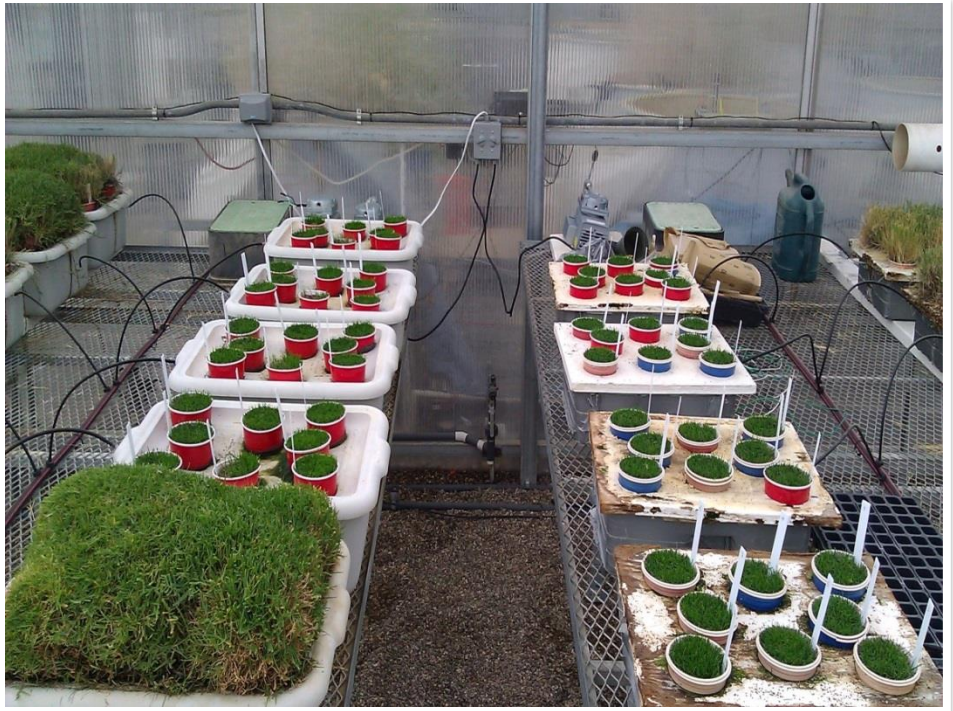
Encapsalt™

I- Growth Responses of Bermudagrass to Various Bio-Stimulants Under Sodium Chloride Stress (Mohammad Pessarakli, PhD, UA)

- Bermudagrass *(Cynodon dactylon* L.), cv. Tifway growth responses to three bio-stimulants were determined (4 replicates/treatment, RCB design):
  - Bio-Turf-Pro
  - Encapsalt™
  - Ferrogrow
- Grasses were grown hydroponically for 12 weeks in half-strength Hoagland solution in a greenhouse.
- At week 7, shoots and roots were clipped, and grasses were exposed to salt stress (EC of 15 dS/m).

Experimental Settings



Measurements

- Shoot and root lengths, weekly
- Shoot fresh and dry weights, weekly
- Root fresh and dry weights, at harvest

Results: Encapsalt on Bermudagrass

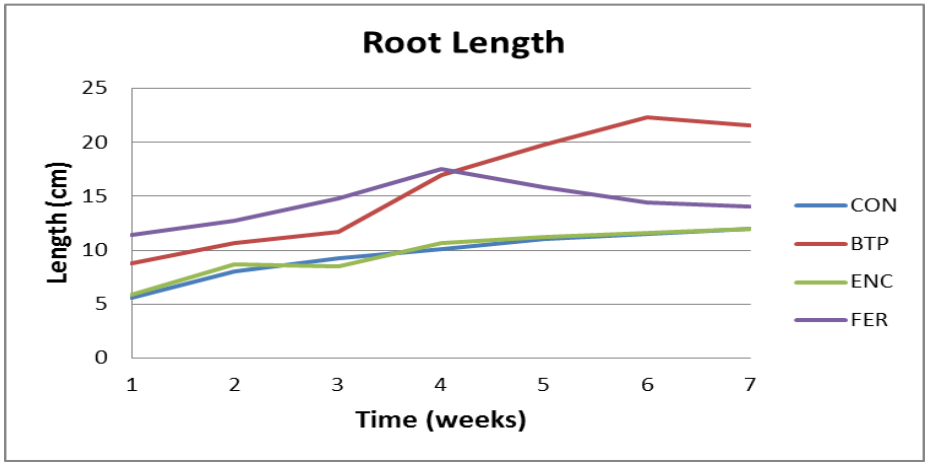


Figure 1. Bermudagrass Shoot and Root Lengths

Results: Encapsalt on Bermudagrass cont'd

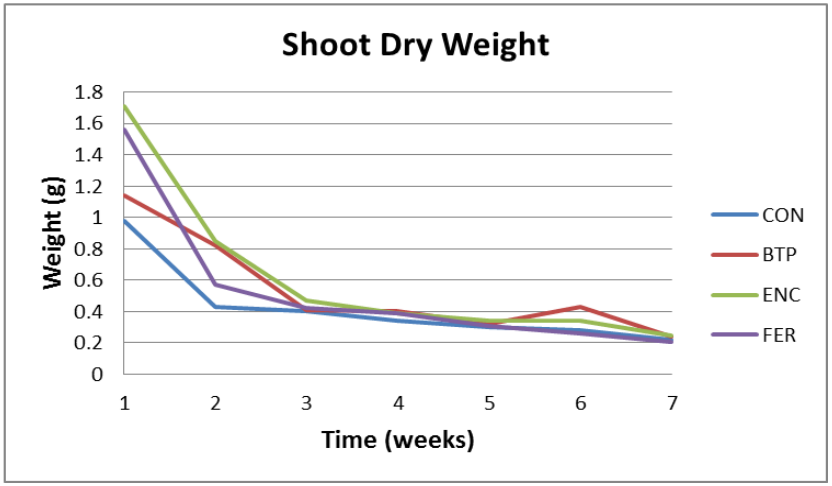


Figure 2. Bemudagrass Shoot Fresh and Dry Weight

Results: Encapsalt on Bermudagrass cont'd

Table 2. Means of root fresh weight (FW) and dry weight (DW) at harvest.

Bio-stimulant	Root FW (g)	Root DW (g)
CON	0.10b	0.04a
BTP	0.18a	0.05a
ENC	0.12b	0.04a
FER	0.15ab	0.04a

Conclusion: Encapsalt on Bermudagrass

- Among the three bio-stimulants, Encapsalt resulted in numerically the lowest enhancement on shoot and root heights, but higher enhancement in shoot and root weights than the control.
- Importantly, lower shoot height and higher grass weights are the most desirable quality factors in turfgrass management.

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Proud 3® and Triple Play™

I- Efficacy of HUMA GRQ® PROUD3® to Control Whitefly on Verbena

(Lucia Villavicencio, PhD, Center for Applied Horticultural Research, CA)

- The trial was conducted with 6 replicates/treatment in a climate-controlled greenhouse with set points of 65/75°F (°C) night/day temperature and under natural irradiance and photoperiod.
- The trial involved foliar application of PROUD 3® at 1:100 dilution rate for weeks 0-4.
- Adults and nymphs were counted prior to treatment application and once a week for a total of 7 weeks.

Photo of Whitefly Nymphs by Fub.Jreco Bioscience
http:flruturecobbscien::e.comen.fleaf.lbiopesti::ide-tl)fly-is-h8rmless-to-naturaJ-enemies-of-insect-pests-7G. htni

Materials and Methods Cont'd

- To count the number of adults, each plant was carefully lifted immediately before treatment application, and the adults were counted on the underside of all leaves.
- To count the number of nymphs, two fully extended leaves were excised from the lower section of each plant and brought to the laboratory for enumeration using a stereomicroscope.

Photo of Whitefly Adults by Visuals Unlimited
http://visualsunlimited.photoshelter.com/image/I0000BnAvh7FZIEA

Results: Whiteflies on Vebena

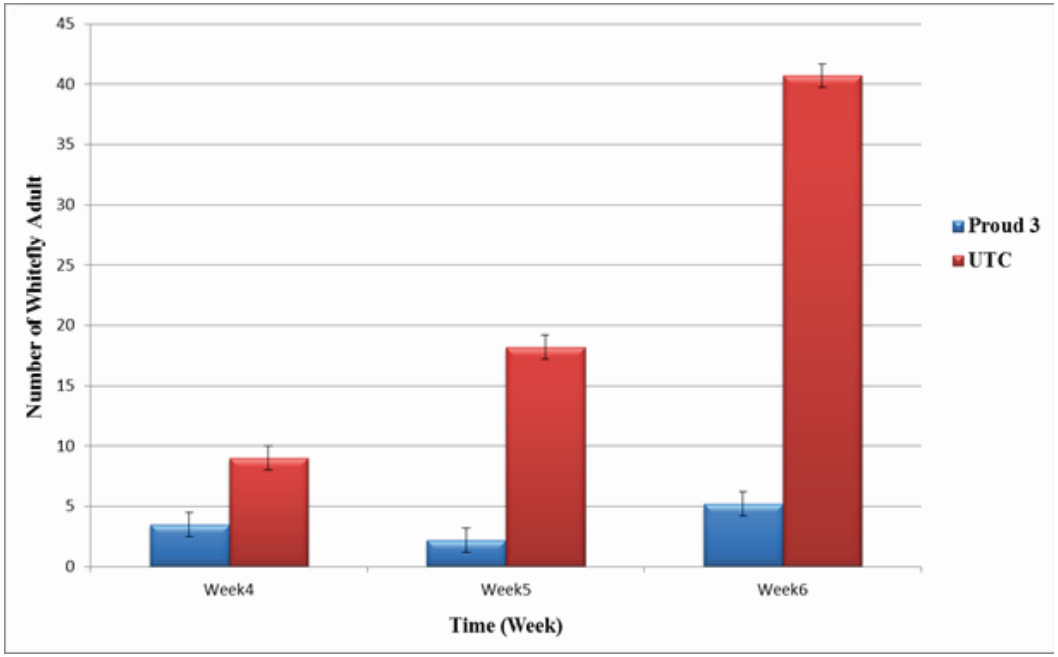

Figure 2. Number of whitefly adults during weeks 4-6

Conclusion: Whiteflies on Vebena

- During the 4th, 5th, and 6th weeks of the trial, the number of whitefly adults were **8** times lower in the Verbena plants treated with the OMRI-listed PROUD 3® product than in the untreated controls.

II- Efficacy of Proud 3 ® and Triple Play™ when applied as direct spray

(Snell Scientifics, LLC)

Objective:

To test the efficacy of Proud 3® and Triple Play™ to control:

A- Pea aphids (*Acyrthosiphon pisum*)

B- Silverleaf whiteflies (*Bemisia argentifolii*).

C- Cabbage loopers (*Trichoplusia ni*)

Materials and Methods

- Alive pea aphids were placed into test arenas (10 aphids/arena, 4 arenas/treatment).
- Treatments were diluted at 1:100 and included Proud 3®, Triple Play™, and a control.
- Each replicate was sprayed with 2 trigger pulls using a “mist” setting from approximately 12’’ (= 30 cm) distance.
- The number of alive, knocked down, or dead aphids was recorded at 30 min, 1 hr, 2 hr, 4 hr, and 24 hr intervals.
- Alive: Insects exhibited normal motion.
- Knock down: Insects exhibited some movement but could not crawl.
- Dead: Insects exhibited no movement even when stimulated.

Experimental Setting

Insects in Treatment Arenas

Insects in Post-Treatment Arenas

A- Results: Pea Aphids

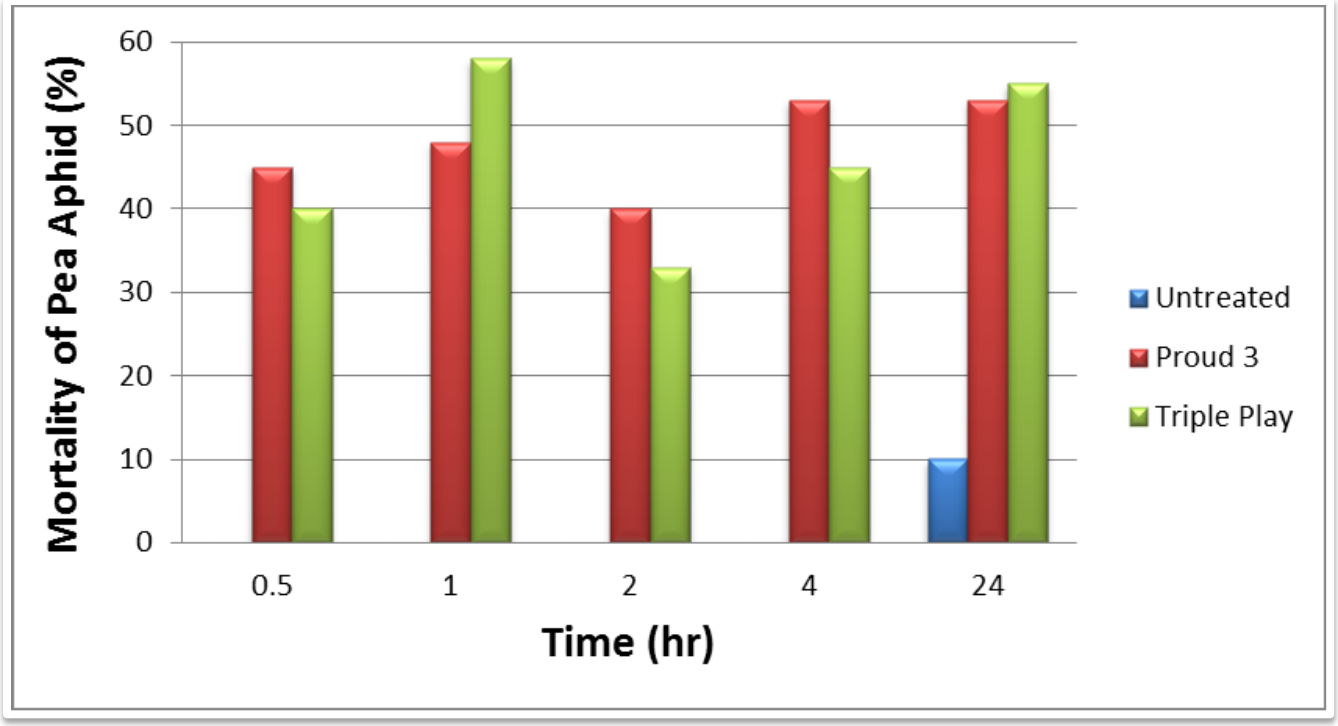

Figure 1: Pea Aphid Mortality

Conclusion: Pea Aphids

- The OMRI-listed Proud 3® resulted in 5.3 times greater mortality of pea aphid than the control at 24 hrs after treatment.
- Triple Play™ resulted in 5.5 times greater mortality of pea aphid than the control at 24 hrs after treatment.

B- Results: Silverleaf Whiteflies

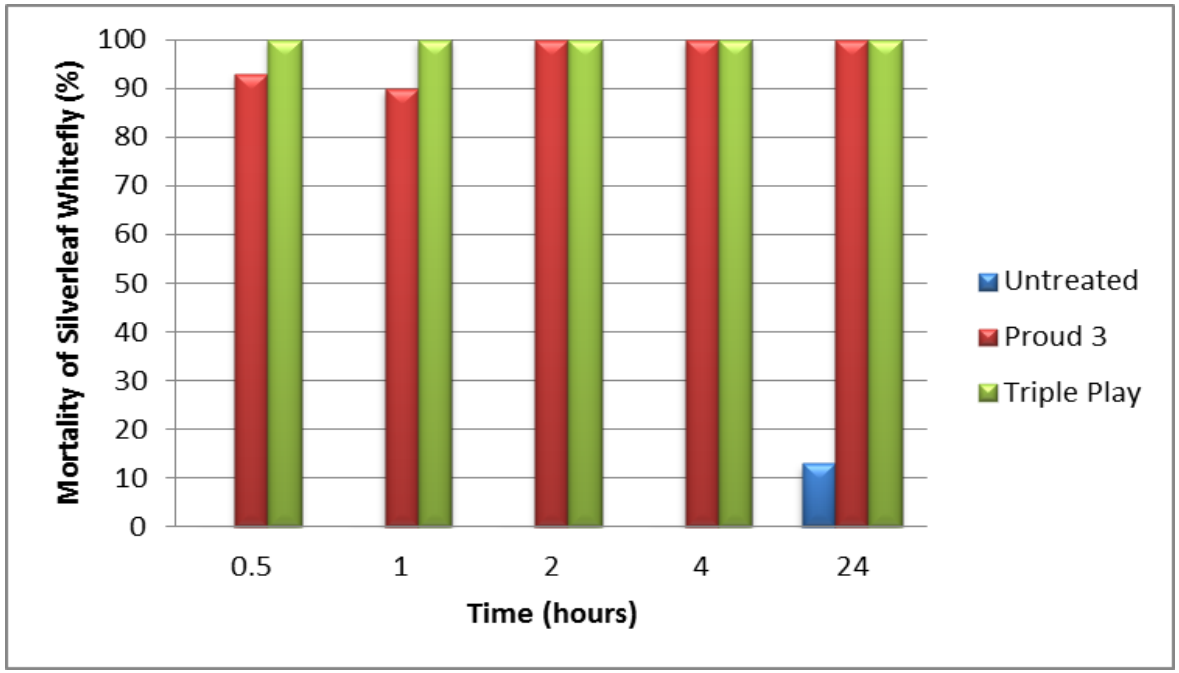

Figure 2: Silverleaf whiteflies Mortality

Conclusion: Silverleaf Whiteflies

- The OMRI-listed Proud 3® and Triple Play ™ resulted in Silverleaf whiteflies mortality of 93% and 100%, respectively, after 30 min of application.
- The OMRI-listed Proud 3® and Triple Play ™ resulted in 7.7 times greater mortality of Silverleaf whiteflies than the control at 24 hrs after treatment.

C- Results: Cabbage Loopers

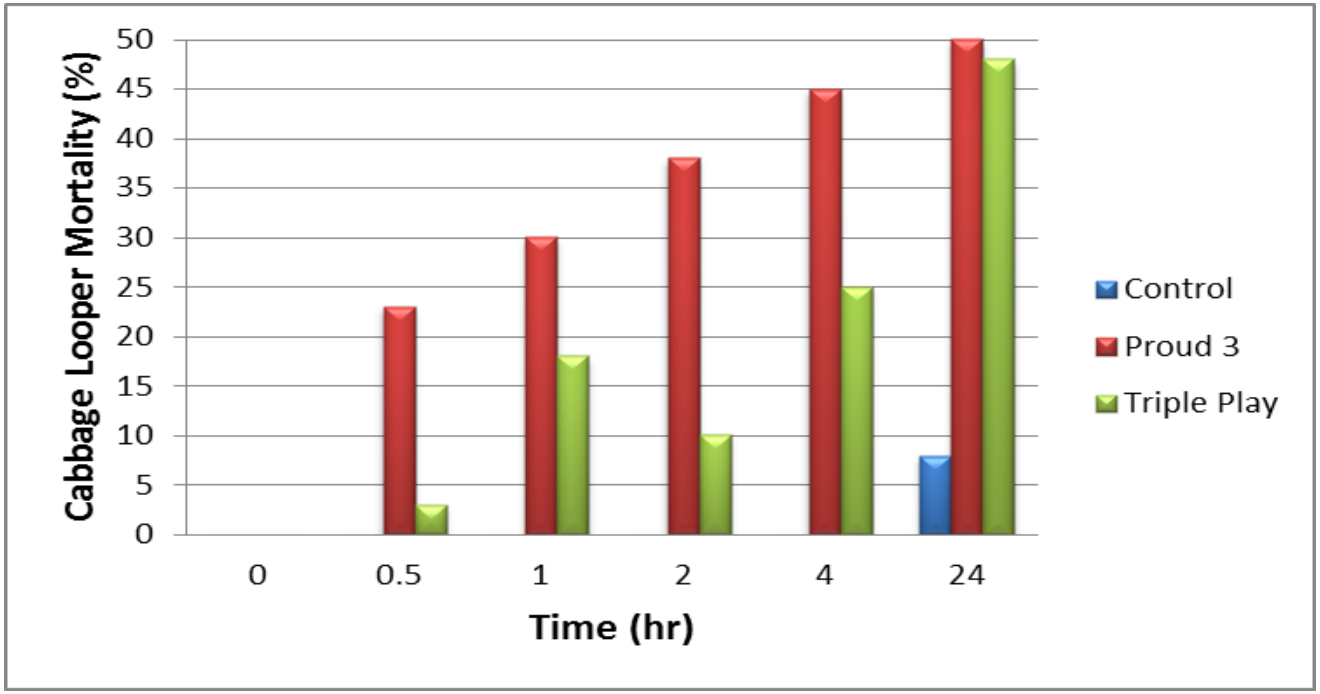

Figure 3: Cabbage Looper Mortality

Conclusion: Cabbage Loopers

- The OMRI-listed Proud 3® resulted in 6.2 times greater mortality of cabbage loopers than the control at 24 hrs after treatment.
- Triple Play™ resulted in 6 times greater mortality of cabbage loopers than the control at 24 hrs after treatment.

Thank you for your attendance!