

Horticulture Research Reports – 2016

TITLE:

Impact of different fertility programs on the yield and storage of Buckeye Galas grown in a high density apple orchard in Central Michigan. 16-801G

Experiment Information:

Planted: 2012

Harvested: 9-1-2016

Yield Goal: 1500 bushels

Target Fertilizer: ----

Variety: Buckeye Gala

Population: 1100 trees / acre

Row Width: ----

Previous Crop: ---

Plot Size: 10 trees

Replications: 4

Rootstock: Bud 9

Other: ----

Soil Test Values:

pH: 7.3

CEC: 8.5

%OM: 1.6

Bray P1: 45

Bicarb P: 67

K: 97 ppm

S: 18 ppm

%K: 2.9%

%Mg: 16.9 %

%Ca: 79.2 %

%H: 0.0%

Zn: 1.6 ppm

Mn: 4 ppm

B: 0.5 ppm

Objective:

Determine the effects various soil fertility applications have on yield and storage of Buckeye Gala grown in a high density apple orchard in Central Michigan.

Materials & Methods:

In the spring of 2012, the apple trees were planted at a spacing of 3.5 feet between trees and 11 feet between rows. All the trees are trained to slender spindle. Within the row, the plots are separated by ornamental crab apple trees to be used as a border tree and as an additional source of pollen at the time of flowering. Within each plot, a total of ten research Gala trees are in a replication, with a total of four replications used randomly split throughout the orchard planting. In the spring of 2014, all of the trees were headed at 18" above the soil and new tops were trained to the trellis. The 2016 was the first large scale harvest of the gala for the orchard.

All treatments were developed based off the soil sample analysis and from academic sources to construct the following table used to calculating the amount of nutrients need to produce the crop.

Nutrition Requirements*											
	Nitrogen (N)	Phosphorus (P2O5)	Potassium (K2O)	Calcium (Ca)	Magnesium (Mg)	Manganese (MN)	Copper (Cu)	Sulfur (S)	Zinc (Zn)	Boron (B)	Iron (Fe)
Removal	30-50	30-60	75-120	8 - 13	5 - 8	-	-	10 - 16	5-11*	0-3	???
Total Uptake	90-120	45-80	150-240	50-80	20-32	-	-	20-32	???	???	1.0*

**Data from Spectrum Analytic Inc., Michigan State University, Cornell, & Washington State University*

Several experimental treatments were developed for this orchard using this information. All of the different fertility products were applied before bloom in the spring in a band next to the trees. Dry fertilizer products were applied to the soil surface under the trees in the spring by hand to allow for equal amount of material spread. Conventional liquid fertilizer was mixed and applied using a rate controlled sprayer that allowed the material to be banded under the vines next to the drip irrigation system. The Agroliquid products were applied in the similar way using the same sprayer. All foliar treatments were applied as designed in the experiment. Most material was applied at three times during the growing season at specific physiological stages (bloom, the first fully expanded leaf, and at 35mm fruitlet size). Several treatments had applications only at the time of bloom or applied on a monthly basis. All of this information can be found in below table. The foliar applications were made using a backpack air blast sprayer to allow for controlled coverage of specific plots. The various applied fertility programs and rate of products can be found in Table 2 and Table 3 (all rates are per acre).

Treatment Number	Treatment name	Fertilizer used	Rate of application (Rate per Acre)
1	Conventional (Dry Only)	Urea + DAP + SOP + Micro mix	65 lbs. + 109 lbs. + 100 lbs. + 5 lbs.
2	Conventional (Dry + Liquid)	SOP + Micro mix 28% UAN + 10-34-0	100 lbs. + 5 lbs. 12 gal + 13 gal
3	Agroliquid	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal
4	Agroliquid (+20%)	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese	14.5 gal + 6 gal + 6 gal + 0.75 gal + 0.125 gal + 0.125 gal
5	Agroliquid + Foliar (+Fase2 @ 3 apps.)	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + Fase2	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal 2 Quarts per application applied 3 times
6	Agroliquid + Foliar (+Fase2 + Liberate Ca)	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + Fase2 + Liberate Ca	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal 2 Quarts = 1 Quart per application applied 3 times
7	Conventional (Dry + Liquid) + Foliar Z-16	SOP + Micro mix 28% UAN + 10-34-0 + Z-16	100 lbs. + 5 lbs. 12 gal + 13 gal + 2 quarts per acre applied 3 times
8	Conventional (Dry + Liquid) + Foliar Fase2	SOP + Micro mix 28% UAN + 10-34-0 + Fase2	100 lbs. + 5 lbs. 12 gal + 13 gal + 2 quarts per acre applied 3 times
9	Agroliquid + Foliar MicroLink Boron	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + Boron	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal + 1 quart per acre applied at bloom
10	Fase1 Only	Fase1	18 gal

Treatment Number	Treatment name	Fertilizer used	Rate of application (Rate per Acre)
11	Agroliquid + C-Tech Low Rate	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + C-Tech	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal + 1.0 gal
12	Agroliquid + Foliar (Fase2, monthly apps)	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + Fase2	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal 2 Quarts per application applied monthly during growing season
13	Conventional (Dry + Liquid)	SOP + Micro mix 28% UAN + 10-34-0	100 lbs. + 5 lbs. 12 gal + 13 gal
14	Conventional (Dry + Liquid) + Foliar (Fase3)	SOP + Micro mix 28% UAN + 10-34-0 + Fase3	100 lbs. + 5 lbs. 12 gal + 13 gal +1.5 gal applied 10 prior to harvest
15	Agroliquid + C-Tech High Rate	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + C-Tech	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal + 2.0 gal
16	Agroliquid (Replace High Nrg- N with 28%UAN + eNhance)	28%UAN + eNhance + Pro-germ + Micro 500 + Boron + Manganese	13.5 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal
17	Agroliquid (Replace High Nrg- N with N-Response)	N-Response + Pro-germ + Micro 500 + Boron + Manganese	16.7 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal
18	Agroliquid + Foliar (Fase3)	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese + Fase3	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal +1.5 gal applied 10 prior to harvest
19 thru 30	Agroliquid (Open for Product development)	High Nrg-N + Pro-germ + Micro 500 + Boron + Manganese	12 gal + 5 gal + 5 gal + 0.5 gal + 0.125 gal + 0.125 gal

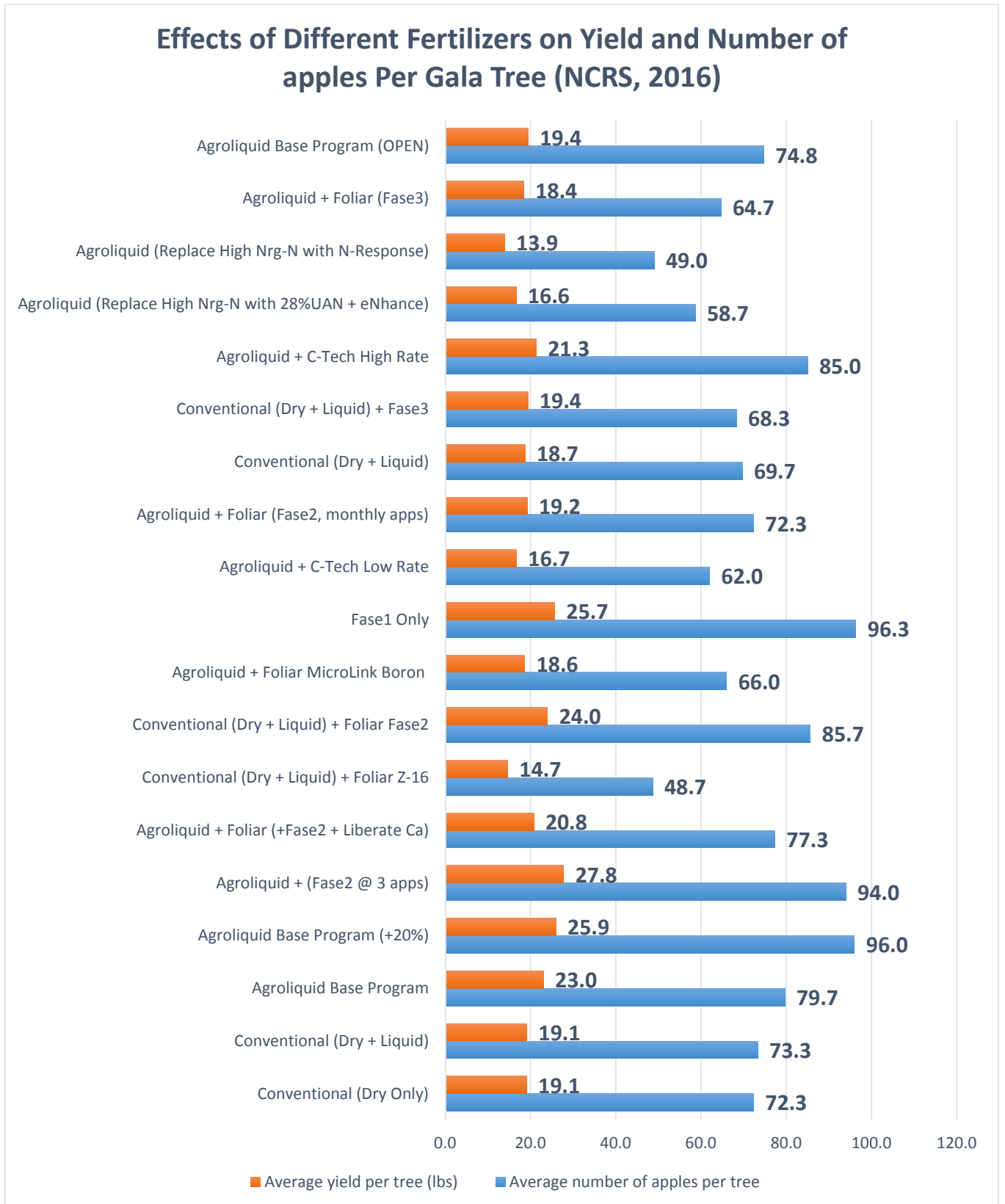
Harvest Procedures:

At the time of harvest, three representative trees were chosen to be used as a subpopulation for data collection of the plot. From these trees all of the fruit was removed by hand with all of the pieces of fruit being counted and weighted. After this process was completed, several apples from each data tree were collected and placed into a plastic sample bag. The sample consisted of between 20 to 25 apples per plot. These samples were then placed into a cold storage facility (kept at 40 °F) for a minimum of 45 days before being evaluated for fruit chemistry parameters.

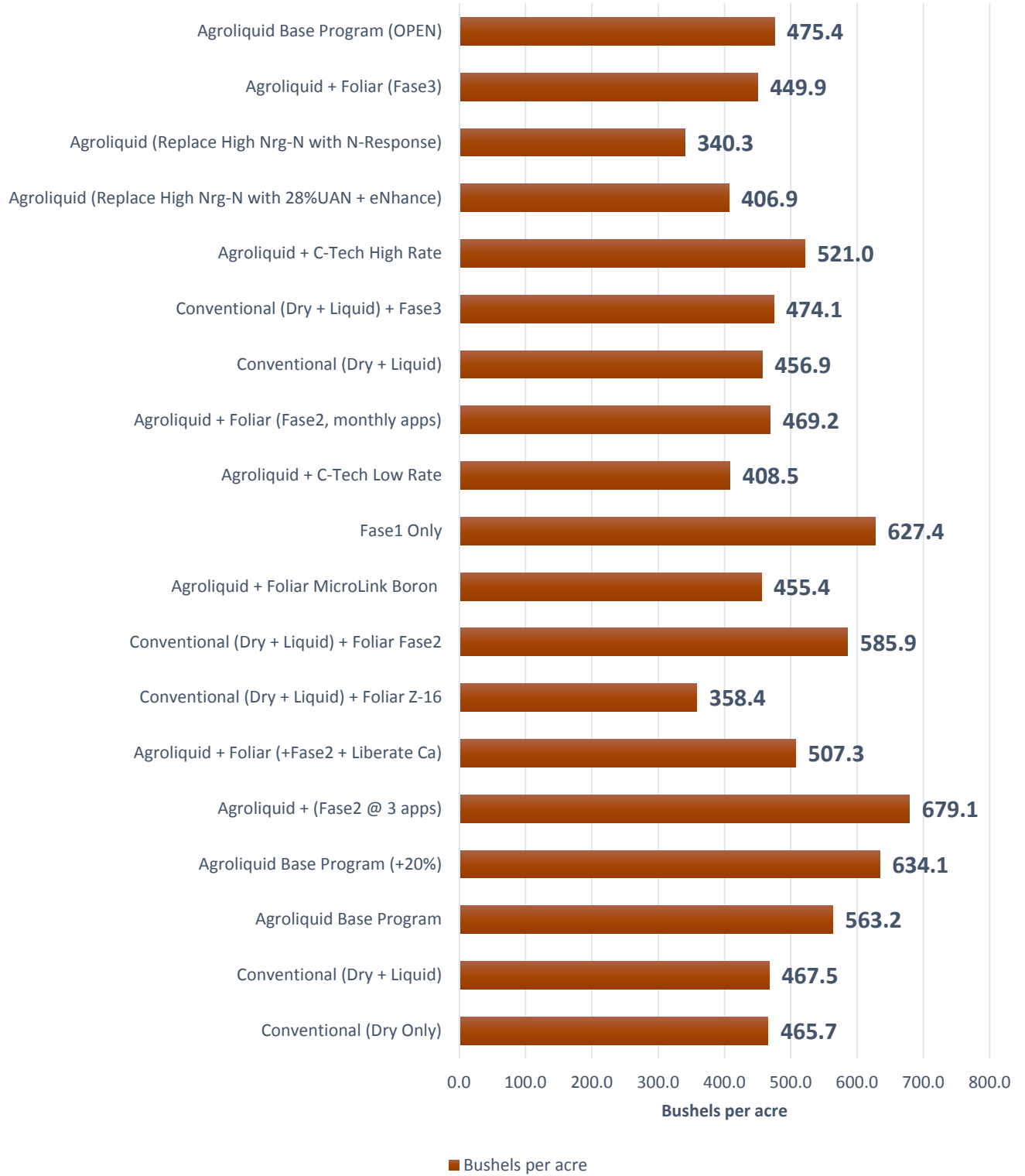
Chemical Analysis Procedures:

Total soluble sugars, internal fruit pressure, starch index, amount of fruit containing rot, and color of fruit was collected after the samples were brought out of storage. In order to collect this data all of the apples in the sample bags were placed on a white surface and had a picture of the fruit taken from above. This photo was used to visually grade the fruit for color and rot but to also serve as a digital record of the fruit produced from the various plots. After the photo was taken five randomly chosen apples from the sample bag were selected for chemical analysis. In order to check internal fruit pressure on an apple, three thin slices of skin were removed from opposite sides of the apple. A penetrometer using an 11.1mm tip was then pushed into the flesh of the fruit until reaching the predetermined mark for depth on the penetrometer. This value was recorded. The left over slices of skin and flesh were used for determining the soluble sugars of the fruit. These small pieces were squeezed above a refractometer and the value seen on the device was recorded. The last test performed on each apple was to cut the apple in half and applying the apple halves to 0.1N iodine solution. The iodine was allowed to react for several seconds before being graded on a scale of 1 to 6. This starch scale for apples has been published by Cornell University and the same scale was used in all apple evaluations. This entire process was repeated for every apple in all samples.

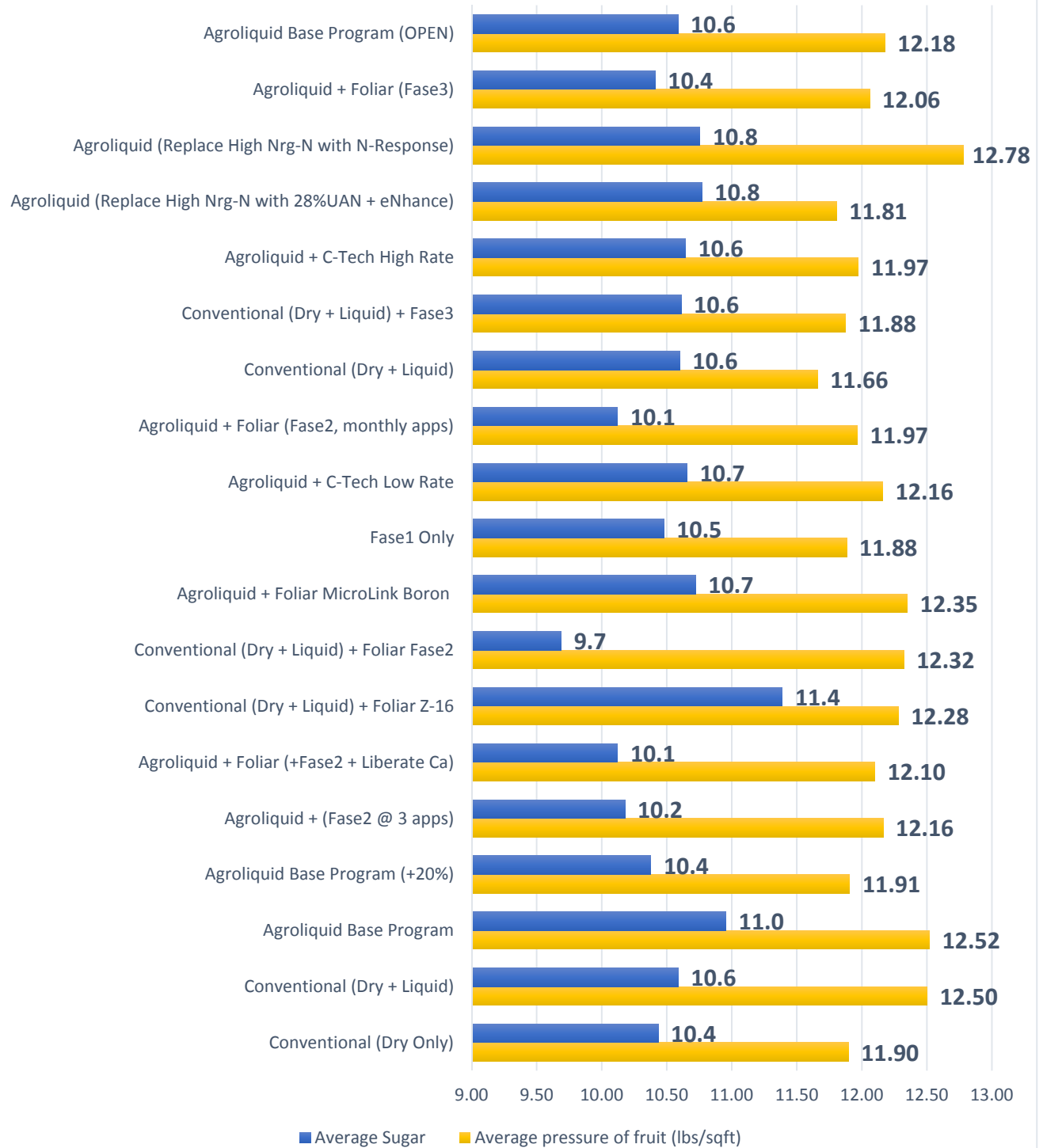
Results:



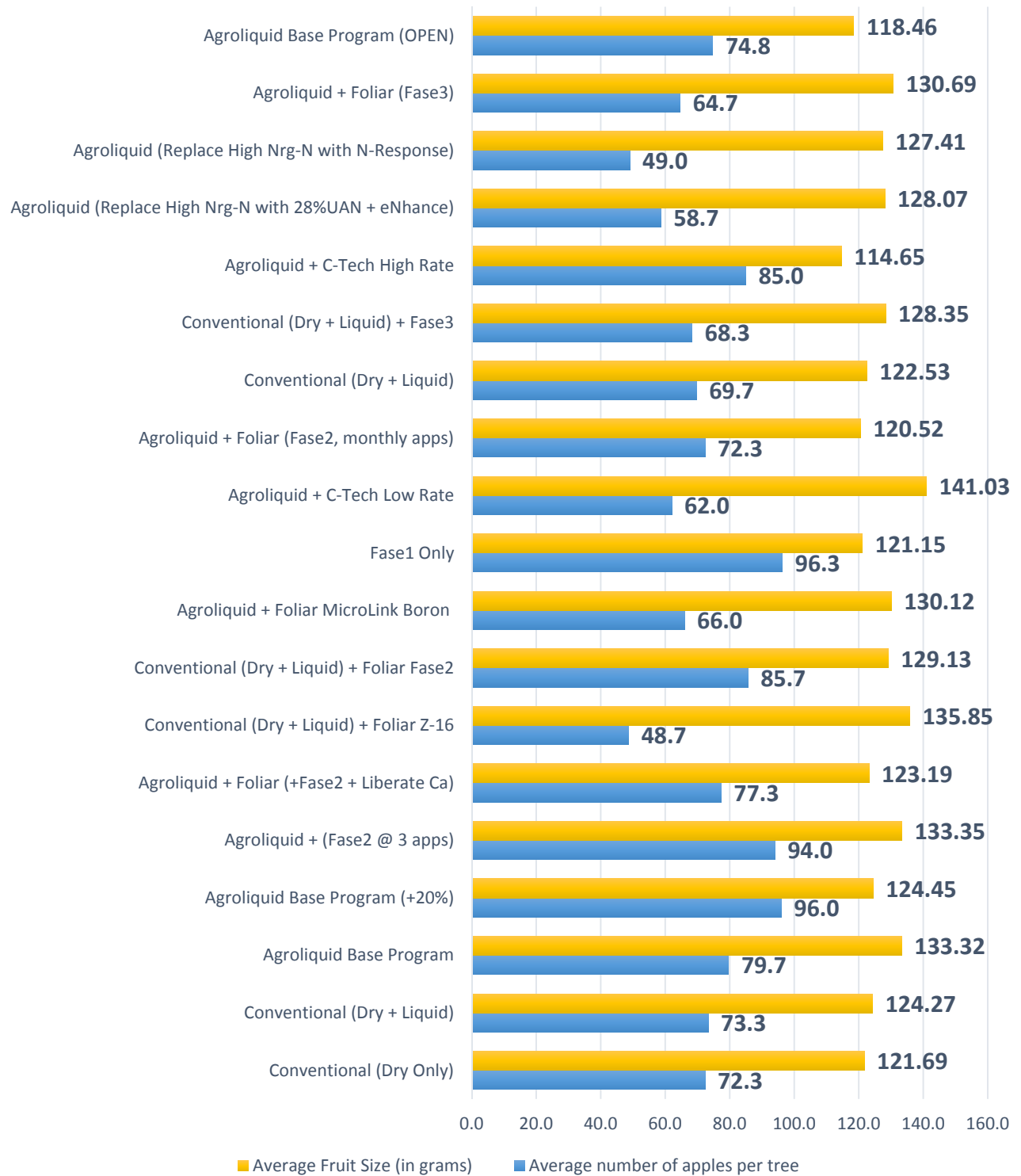
Effects of Different Fertilizers on Yield on Buckeye Gala (NCRS, 2016)



Effects of Different Fertilizers on Fruit Quality on Buckeye Gala (NCRS, 2016)



Effects of Different Fertilizers on Fruit Size and Number of Fruit on Buckeye Gala (NCRS, 2016)



Conclusions:

- In 2016 was the first fruiting year for the trees and the yields at the time of harvest for these Buckeye Gala plots reflect this. The objective of fertilizing for 1500 bushels per acre was setup before the experiments were started. The goal is achieve this goal once the orchard becomes into mature bearing years.
- First year impressions show differences of both the fruit chemistry but also in the yield of the fruit in the first season between these various fertilizer programs. It is hard to describe which program is the most effective to producing the best apple. From the various data collect we can point out several trends. The use of foliar applications of Fase2 increases yields and average fruit size compared to plots that were not treated with product. The C-Tech product is showing promise in increasing fruit size while not sacrificing the amount of fruit on a tree. The use of Agroliquid products out preforms conventional fertilizer in all parameters collected in 2016. The use of Fase3 seems to have effect of helping with both color produced but also with help in storage and maintain proper internal fruit pressures.
- Out of the 18 different treatments all of the Agroliquid treatments out yielded the conventional fertilizer. Including an Agroliquid product in addition to a conventional fertilizer program helped improve yield in all cases compared to the conventional fertilize only programs.

Additional Information:

Row Labels	Fertilizer Program Code	Average number of apples per tree	Average yield per tree (lbs)	Average fruit size (lbs)	Average Fruit Size (in grams)	Average pressure of fruit (lbs/sqft)	Average Sugar	Average Starch Index	Average of Days in storage	Bushels per acre
1	Conventional (Dry Only)	72.3	19.1	0.27	121.69	11.90	10.4	5.2	48	465.7
2	Conventional (Dry + Liquid)	73.3	19.1	0.27	124.27	12.50	10.6	5.5	49	467.5
3	Agroliquid Base Program	79.7	23.0	0.29	133.32	12.52	11.0	4.8	48	563.2
4	Agroliquid Base Program (+20%)	96.0	25.9	0.27	124.45	11.91	10.4	5.3	49	634.1
5	Agroliquid + (Fase2 @ 3 apps)	94.0	27.8	0.29	133.35	12.16	10.2	5.3	48	679.1
6	Agroliquid + Foliar (+Fase2 + Liberate Ca)	77.3	20.8	0.27	123.19	12.10	10.1	5.5	50	507.3
7	Conventional (Dry + Liquid) + Foliar Z-16	48.7	14.7	0.30	135.85	12.28	11.4	5.2	48	358.4
8	Conventional (Dry + Liquid) + Foliar Fase2	85.7	24.0	0.28	129.13	12.32	9.7	5.5	48	585.9
9	Agroliquid + Foliar MicroLink Boron	66.0	18.6	0.29	130.12	12.35	10.7	4.9	48	455.4
10	Fase1 Only	96.3	25.7	0.27	121.15	11.88	10.5	5.4	49	627.4
11	Agroliquid + C-Tech Low Rate	62.0	16.7	0.31	141.03	12.16	10.7	4.7	46	408.5
12	Agroliquid + Foliar (Fase2, monthly apps)	72.3	19.2	0.27	120.52	11.97	10.1	5.3	48	469.2
13	Conventional (Dry + Liquid)	69.7	18.7	0.27	122.53	11.66	10.6	5.6	50	456.9
14	Conventional (Dry + Liquid) + Fase3	68.3	19.4	0.28	128.35	11.88	10.6	5.3	48	474.1
15	Agroliquid + C-Tech High Rate	85.0	21.3	0.25	114.65	11.97	10.6	5.7	50	521.0
16	Agroliquid (Replace High Nrg-N with 28%UAN + eNhanse)	58.7	16.6	0.28	128.07	11.81	10.8	5.7	50	406.9
19	Agroliquid Base Program (OPEN) with N-Response	49.0	19.9	0.28	129.46	11.98	10.8	5.7	50	348.3
20	Agroliquid Base Program (OPEN)	69.3	18.8	0.29	129.69	12.06	10.4	5.1	48	489.0
19-20	Agroliquid Base Program (OPEN)	83.0	23.0	0.28	128.96	12.38	10.8	5.4	48	835.6
22	Agroliquid Base Program (OPEN)	65.0	16.9	0.26	115.90	12.15	10.2	5.3	49	412.6
23	Agroliquid Base Program (OPEN)	78.0	20.7	0.27	121.29	12.33	10.3	5.8	47	507.0
24	Agroliquid Base Program (OPEN)	54.7	13.9	0.24	110.24	12.13	10.8	5.1	49	339.5
25	Agroliquid Base Program (OPEN)	85.5	21.8	0.25	114.56	12.06	10.4	5.2	46	532.3
26	Agroliquid Base Program (OPEN)	70.3	18.8	0.27	124.53	12.72	10.8	5.7	50	460.7
27	Agroliquid Base Program (OPEN)	58.0	15.8	0.27	121.89	11.45	10.7	5.7	50	385.2
28	Agroliquid Base Program (OPEN)	72.7	19.1	0.26	119.65	12.21	10.7	5.2	48	467.9
29	Agroliquid Base Program (OPEN)	81.7	19.6	0.24	107.57	12.55	10.9	5.4	48	479.3
30	Agroliquid Base Program (OPEN)	107.7	25.5	0.24	108.96	12.10	10.3	5.8	49	622.7
	AVERAGE OF OPEN PLOTS	74.8	19.4	0.3	118.46	12.2	10.6	5.4	48.3	475.4

Complied data from the specific plots used to generate tables and graphs.