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2020 Season Watermelon Yield, Leaf Tissue Nitrogen,

and Effect on Soil Nitrogen at Four Depths When Using

Soluble Versus Controlled Release Preplant Nitrogen

Under Two Different Irrigation Regimes

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**Background**

The Suwannee Valley region of North Florida is one of the largest watermelon production areas in the state with about 7,000 acres, approximately one-third of the state’s acreage. Soils in the Suwannee Valley area are well drained and perfect for watermelon production if water and nutrients are efficiently managed. Watermelon growers in this region have been leaders in the farming community for adopting best management practices (BMP) for the past 25 years. The research and extension programs of University of Florida/Institute of Food and Agricultural Sciences (UF/IFAS) have developed production systems that help area farmers conserve water and fertilizer. The recent development and adoption of statewide Best Management Practices in Florida and increased production costs have emphasized the need for improved irrigation and fertilizer management practices and a better understanding of water movement in the sandy soils common to the region. UF/IFAS county Extension agents and specialists have been working with Suwannee Valley’s watermelon growers for years to help them adopt plastic mulch and drip irrigation and to refine their management of this technology since it was introduced to the region in the late 1980s. The combination of these practices has reduced water use by more than 50% and has also reduced nitrogen fertilizer use by at least 25% in comparison to the practices used 25 years ago. In addition, watermelon farmers use at least 50% less fuel for low pressure drip irrigation pumping in comparison to the previously used overhead systems.

However, current watermelon production practices used in the Suwannee Valley and other parts of the state, have one distinct source of vulnerability to leaching fertilizers. That source, which can be improved is the source of pre-bed nitrogen fertilizer application. Granular fertilizers are typically used in the soil prior to bedding and before plastic mulch is applied. Granular fertilizers are less expensive than liquid sources later used via fertigation, and therefore, growers tend to use granular fertilizers in the bed for up to 50% or more of the seasonal nitrogen crop nutrient requirement. Soil moisture sensor technology is helping growers to not over irrigate early in the season. However, the early season is a vulnerable period to leaching because plant root systems are small and if cold temperatures are likely, growers tend to run longer irrigation events at night attempting to protect the crop from frost. If over-irrigation occurs early in the season (first 4 weeks), the risk of leaching is very high. The Suwannee Valley region watermelon growing area is now largely a Florida Department of Environmental Protection adopted Basin Management Action Plan area with the targeted reduction of nitrate-nitrogen load to groundwater at 4 million lbs in this region. This project addresses the need to identify new ways to adopt BMPs that will reduce nitrogen loading, thru fertilizer source and irrigation management. This report is for the second year of research on the use of controlled release nitrogen fertilizer in watermelon. The objective of this two-year project was to evaluate using a controlled release nitrogen source as an alternative to conventional, more soluble, sources of nitrogen in the bed fertilizers. Recent research at NFREC- Suwannee Valley with controlled release fertilizers (CRF), especially nitrogen, has shown great promise in watermelon, carrot, and corn production. Our objective in this study was to continue to work with industry suppliers of CRFs in Florida, such as Harrell’s Fertilizer, and evaluate a controlled release nitrogen fertilizer to be applied at the beginning of the season and provide nutrient needs for the early part of the growing season. This trial compared controlled release nitrogen to a conventional soluble nitrogen source for the preplant nitrogen applications. We measured the movement of nitrogen in the soil over time by taking multi-depth soil samples and analyzing for nitrate-N. CRFs offer the possibility of adopting new fertilizer coating technology (potentially an advanced BMP) to help reduce N losses in watermelon

**Materials and Methods**

The field trial was conducted at the University of Florida, North Florida Research and Education Center - Suwannee Valley in Live Oak, Florida. The site is characterized as having well-drained deep sandy soil typical of the soil used by watermelon growers in North Central Florida. Data were collected for watermelon fruit weight and count, leaf tissue nutrients, and soil nitrate N. The initiation of this trial in 2020 was delayed due to labor restrictions during the COVID-19 pandemic.

*Bed Preparation*

Bed spacing varies in the industry from 6 to 12 ft, but the industry standard bed spacing for watermelons grown in North Florida is 8 ft. In this trial, a wider, 10 ft spacing, was used to reduce vine crossing from one plot to the next, which helps to accommodate accurate leaf tissue samples collection. When a close row spacing is used in a watermelon research trial, it is very difficult to separate vines from one plot to another when taking leaf samples and harvesting fruit making sure the leaves or fruit are positively tracked back to a specific plot. However, fertilizer rates were calculated based on 8-ft row spacing.

Nondegradable white-on-black plastic mulch was applied to the beds forming a bed 24 inches across the top with 6-inch high sides. Drip tape was installed in the center of the bed under the plastic mulch in a shallow groove in the soil surface. The drip tape used was a T-Tape/Rivulis tape with 12 inch spacing and flow rate of 0.45 gallons per minute per 100 ft. Drip irrigation was used to irrigate and fertigate the crop in all plots.

This experimental design was a split plot design with four replications. Main plots were irrigation rates and subplots were preplant N source. All subplots were 35 ft in length.

*Irrigation Treatments*

There were two irrigation treatments in this study:

* BMP Irrigation (Simonne et al., 2019): followed Best Management Practices (BMP) by interpreting soil moisture sensor (SMS) data.
* BMP x 2.0 Irrigation: irrigation regime in which plants were irrigated 2.0 times longer than the BMP Irrigation program.

Soil moisture sensors were installed on April 6th to capture real time soil water content and allow for constant assessment of plant water needs and calculation of irrigation rates. Four 3.5-foot Sentek EnviroSCAN SMS were installed in the watermelon beds. Each sensor was purposefully placed in plots that were representative of the two irrigation treatments studied in this trial.

Drip irrigation was used to irrigate the crop under the irrigation treatments, BMP rate and 2.0 times the duration of the BMP rate, thru an injection table with two ports, each port was plumbed separately to only the plots for each irrigation treatment.

BMP irrigation events ranged from a 20-minute event once a day early in the season to two events a day of 45 minutes each when crop was developing fruit and temperatures were high (Table 1). Therefore, BMP x 2.0 irrigation events ranged from a 40-minute event once a day to two events per day of 90 minutes each at peak demand. The duration of these events includes the one minute that took the system to pressurize these relatively small irrigation zones. The start times of the irrigation events were set during mid-day daylight hours. When two events were used, the start times were set at 10:30 am and 3:00 pm.

*Nitrogen Fertilizer Treatments*

There were two preplant nitrogen fertilizer treatments, the uncoated or soluble N (ammonium nitrate) and the coated or controlled release N (coated urea) (Table 2). Plants in both treatments received equal rates of supplemental nitrogen by weekly fertigation applications later in the season once the petiole sap N concentrations indicated injections of N should start. The injected fertilizer solution was 7-0-7 (N- P2O5-K2O) and included a micronutrient mix. Besides the different sources of preplant N, the total amount of N supplied during the season was the same for both treatments, 150 lbs N per acre. All plants were supplied with the same amount of phosphorus, potassium and other macronutrients and micronutrients.

The total season target for both N and K2O was 150 pounds per acre. The seasonal total for nitrogen was selected because it is the current recommendation based on a summary of watermelon field research (Hochmuth and Hanlon, 2000). The total seasonal potassium rate was based on soil test recommendations. Fertilizer rates were calculated based on linear bed foot method using the standard 8-ft bed spacing (Hochmuth and Hanlon, 2018).

Preplant fertilizer applications were made to the flat prepared ground, prior to bedding and mulch application:

* 125 pounds per acre of 0N-0P2O5-60K2O, which is equivalent to 75 pounds of potash (K2O) per acre.
* 500 pounds per acre of a blended material with 0N-15P2O5-0K2O plus a micronutrient mix.
* Nitrogen fertilizer treatments were applied at a rate of 75 pounds of N per acre, as follows:
  + Soluble N: fertilizer source was ammonium nitrate 32N-0P2O5-0K2O.
  + Controlled release N: fertilizer source was coated urea material 44N-0P2O5-0K2O.

The remaining required 75 pounds per acre of N and K2O were applied equally to both N treatments by using a 7-0-7 (N- P2O5- K2O) solution injected weekly beginning the week of May 15th (Table 3). Injections were made using a peristaltic pump. Injection protocol was as follows: the irrigation system was pressurized with water only for 5 minutes; injection period was 20 minutes; and flushing with water only after the injection was 15 minutes. Fertilizer injections, or fertigation events, were independent of regular irrigation events. There was one fertigation event per week. The morning that a fertigation event was scheduled, the fertigation event replaced the morning irrigation event that would have happened otherwise. The N and K2O injections were based on published weekly injection rates at the physiological stage of growth as per IFAS recommendations (Simonne et al., 2019). The first injection target date was confirmed as appropriate based on petiole sap analysis. Six weekly nutrient injections were made starting on May 15th and ending on June 19. Identical fertilizer injections were made for both the soluble and controlled release fertilizer treatments (Table 2) during the growing season.

*Seeding and Transplanting*

A commonly used standard seeded watermelon cultivar, ‘Estrella’, was selected for the trial. A seeded cultivar was chosen to accommodate leaf tissue sampling in comparison to a seedless and pollinator type being used. The combination of two plant types in the same plot when growing a seedless/pollinator system makes it more difficult to select the treatment plants only, so a seeded cultivar was chosen.

Transplants were seeded March 6, 2020 in Speedling (Sun City, FL) 128-cell transplant trays. Transplants were planted in single rows into the beds at a 3-ft spacing on April 3, 2020 (Figure 1). Each main plot (irrigation rate) was 70 ft in length and subplots (N source) were 35 ft in length.

The crop was managed for weeds, insects and diseases in accordance with recommended management strategies and no unusual or impactful problems were encountered.

*Sample Collection*

Soil sample collection was based on approximately a 14-day schedule and stage of growth. The frequency was set to capture movement of N through the soil profile. Soil samples were taken with a soil auger at depths of 0-6, 6-12, 12-24 and 24-36 inches in each plot. Soil samples were taken on six dates beginning April 16, 2020 and approximately every two weeks thereafter. The final soil sample was taken on July 3, approximately one week after the final harvest. Leaf samples were taken three times (May 15, May 29, and June 8) for nutrient analysis during the growing season. Watermelon fruit were harvested on June 12, 19, and 26. Individual mature watermelon fruit were counted, and weights were recorded for all watermelons harvested. Fruit at harvest were identified as marketable or nonmarketable. The majority of the few culls were due to fruit shape deformities or fruit splitting.

*Data Analysis*

Data were analyzed using the Generalized Linear Mixed Model Procedure of SAS (SAS Version 9.4; SAS Inst. Inc.). A two-way analysis of variance was performed to determine significance of main effects. Means separation was used to examine differences between treatments. We analyzed the effect of each treatment, irrigation and N fertilizer, separately and also the effect on their interaction.

**Results and Discussion**

Total marketable yield in this trial was good at approximately 50,000 lbs per acre across all treatments for the total season of all harvests with no significant differences for yield among any of the four treatment interactions of irrigation and N source (Figure 2, Table 4). There were significant effects of irrigation treatment at the first and second harvest (Table 5). At the first harvest, the BMP x2 irrigation regime yielded more marketable fruit, in fruit count and weight. At the second harvest, the BMP irrigation regime yielded more marketable fruit, in pounds per acre. There were significant effects of fertilizer treatment at the second harvest, 78 DAP. Significant differences were found in marketable fruit weight and count. For both variables, plants treated with CRN yielded more fruits and more pounds per acre than plants fertilized with soluble AN (Table 6). However, no significant differences were found in season total yield for fertilizer treatments or irrigation treatments.

Figure 3 shows the soil moisture levels at five depths during the season and associated rainfall at this field site, both for the duration of the season. Figure 3 also depicts the graph of soil moisture for the BMP irrigation schedule and for the BMP x2 schedule during the season. There were a few events worth noting during this season. For the first half of May, plants were depending solely on irrigation events and were pulling a high amount of water in response to rapid plant growth and fruit development. Later in the season, an 8-inch rainfall event was also captured by the soil moisture sensors. Overall, both irrigation regimes provided enough water for the plants, however, the beds under the BMP x2 irrigation schedule had a greater impact from the 8-inch rainfall in June, since beds were already more wet than the BMP schedule prior to the rain. This is important to note as it could add to the potential of nutrient leaching. In this specific case, the 8-inch rainfall on June 7 and the accumulated 3-inch rainfall in June 11 and 12, reached depth of 20 inches, but the fact that they happened towards the end of the season implicates a smaller risk of nutrient leaching as plants and roots are more developed and there is less fertilizer available. The soil moisture sensor readings were used daily to assess soil moisture and to adjust the number and duration of irrigation events during the season (Dukes et al., 2018). Overirrigation during the early part of the season typically results in the highest risk of leaching soluble fertilizer below the root zone.

Figure 4 also shows the soil moisture levels focused on the first month of the season after transplanting. Accumulated rainfall from April 13, 14, and 15 was 3.6 inches. This series of events can be considered a leaching rain event (period) due to the activity seen at 20 inches depth. In addition, we consider how early in the season this happened, when roots were not yet well developed, and more fertilizer was susceptible to leaching when compared to later on in the season.

Soil nitrate nitrogen levels were measured six times during the season and the results are shown in Figure 5.

At the beginning of May (sampling #2), the effect of fertilizer treatment and the effect of irrigation treatment were significant. Samples from the CRN treatment had a significantly higher amount of nitrate-N than the soluble N. Samples treated with BMP irrigation regime showed a significantly higher amount of nitrate-N than the BMP x2 regime. In practical terms, more N is available for plant uptake when the levels of nitrate-N are higher in the soil.

The result of higher N in the CRN plots in the shallow soil samples could be related to the soil sample analysis methodology. When the soil samples were ground in the initial processing step, the N in a CRN polymer would have been released and contributed to the N amount found in that sample. Any N found in the top 6 inches of soil in the CRF plots would have been due to N both in the polymer and N released to the soil from the polymer prior to soil sampling. The total N requirement in the CRF plots was applied preplant and therefore the soil analysis shows the total seasonal N in the bed. Each time a soil sample was taken, it was taken near the previous sampling site, so new CRF materials would be included. To assess the movement of N through the soil profile, the 12-24 and 24-36-inch deep samples would only show any soluble nitrate-N in both fertilizer treatments. These deeper samples are better indicators of potential N leaching. In future research trials, it is possible to only capture the released nitrate-N outside of the polymer coated granules, by changing the soil sample processing to include a filtration step to capture the polymers before assessing the nitrate-N amount.

At mid-May, irrigation had a significant effect in nitrate N in the soil. Plots that received the BMP regime showed higher levels pf nitrate N in the soil, especially in the shallower layers of the soil, from 0 to 12 inches.

Nitrate N found in the soil at the mid-June sampling (sampling #5), show potential effects of the 8-inch rain from June 7 on the two irrigation schedules, at the depth 0 to 6 inches. Where plants had been irrigated with the BMP regime, nitrogen levels went up despite the leaching rain event. However, samples from where plants where irrigated with the BMP x2 irrigation regime, did not show an increase. An increase in N in deeper layers of the soil was not detected, leading up to the hypothesis that N could have leached passed 24 inches depth in plots irrigated with BMP x2 regime. At sampling #5, in mid-June, irrigation had a statistically significant effect in nitrate-N in the soil. Higher N was found when plants were irrigated with BMP regime, when compared to the BMP x2 regime. At the end of the season, nitrate nitrogen levels were low at all depths indicating most of the applied nitrogen had been used by the crop and very little was left to be leached from the soil below 24 to 36 inches (Figure 5).

Plant tissue samples were taken three times during the season and that data (Table 7) were compared to the published adequate ranges as reported by Hochmuth et al. (2018), as shown on Table 8. The treatments in this study were focused on two nitrogen sources and therefore, our comparisons of nitrogen levels in the leaf tissue will be primarily discussed. However, we present all the nutrient data to show levels of all nutrients were maintained in the adequate range or above. At the first leaf tissue sampling, the irrigation treatment had an effect in N. Plants irrigated with the BMP Irrigation Rate had higher levels of N when compared to the ones irrigated with BMP x2 Irrigation Rate.

At the second sampling, both fertilizer and irrigation treatments had an effect in N levels, but there was no significant interaction between those treatments:

* Plants irrigated with the BMP Irrigation Rate had higher levels of N when compared to the ones irrigated with BMP x2 Irrigation Rate.
* Plants fertilized with the soluble AN had higher levels of N when compared to those fertilized with CRN.

No significant differences were found at the third sampling.

Nitrogen was found well above adequate levels for all treatment interactions, at all three samplings. P and K were in adequate levels for all treatment interactions and sampling dates. Ca, B, Zn, Mn, Fe, and Cu were found above adequate levels for almost all treatments and sampling dates.

**Conclusions**

Overall, this research trial shows that higher than recommended irrigation rates (two times the BMP regime), can have an impact on soluble nitrogen movement in the soil as evidenced by the 20-inch depth soil moisture sensor data during the month of June. During the month of June, both fertilizer treatments were receiving the same soluble N via fertigations and therefore, all N was soluble and susceptible to leaching during the excessive rainfall event of 8-inches in early June.

Higher early yields attained in this trial with the BMP 2X irrigation rate was likely due to the BMP irrigation rate being less than optimum from May 4th to May 13th. There was one high rainfall period (April 13-15) in this trial during the first few weeks. The soil moisture sensor data show there was a possibility of N leaching at the lower depths during this period to move water past the 20-inch depth in April for both irrigation rates.

It is difficult to draw many final conclusions from this year’s trial due to the very excessive rainfall events that overwhelmed the ability to compare irrigation rates in the study. Although, we do conclude the higher irrigation rate was much more likely to result in leaching events that the BMP irrigation rate based on the soil moisture sensor data.

**References**

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**Figures and Tables**

**Figure 1.** Trial set up two days after planting.

A train traveling down a dirt road

Description automatically generated

**Figure 2.** Total marketable fruit weight per treatment interaction per harvest date and standard error bars.

A picture containing screenshot

Description automatically generated

**Figure 3.** Daily rainfall and soil moisture content for the SMS installed in the BMP Irrigation treatment and for the sensor installed in the BMPx2 Irrigation treatment during the growing season of April to June 2020.z

A close up of a piece of paper

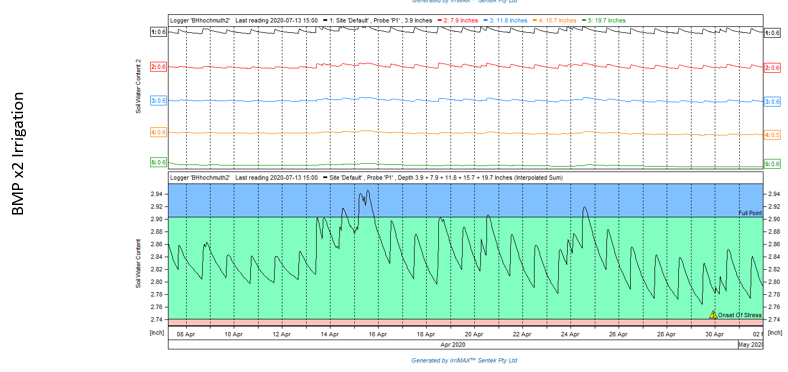
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zThe top graph shows rainfall in inches. The graph in the center shows soil moisture content readings for each soil moisture sensor placed at different depths beneath the soil surface: 4” (black line), 8” (red line), 12” (blue line), 16” (orange line), and 20” (green line). The bottom graph shows soil moisture content as the sum of all sensors and are shown within a blue zone indicating soil moisture saturation, a green zone indicating optimum soil moisture, and a red zone indicating low soil moisture and potential crop stress. Soil moisture readings provided by 3.5-foot Sentek EnviroSCAN.

**Figure 4.** Daily rainfall and soil moisture content for the SMS installed in the BMP Irrigation treatment and for the sensor installed in the BMPx2 Irrigation treatment during the first four weeks of the trial, April 3 to May 1, 2020.z

A screenshot of a cell phone

Description automatically generated



zThe top graph shows rainfall in inches. The graphs in the center show soil moisture content readings for each soil moisture sensor placed at different depths beneath the soil surface: 4” (black line), 8” (red line), 12” (blue line), 16” (orange line), and 20” (green line). The bottom graph shows soil moisture content as the sum of all sensors and are shown within a blue zone indicating soil moisture saturation, a green zone indicating optimum soil moisture, and a red zone indicating low soil moisture and potential crop stress. Soil moisture readings provided by 3.5-foot Sentek EnviroSCAN.

**Figure 5.** Nitrate N found in soil samples collected at four different depths during the growing season.z

A close up of a map

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z Note the photo shows the typical soil profile in North Florida, in this case, the profile is under a corn crop (Barrett, 2019).

**Table 1.** Summary of growing conditions (temperature and rainfall) during the growing season.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  | 2020 Growing Season | | |
|  |  | April | May | June |
|  |  |  |  |  |
| Temperature  at 7' (F) | Min. | 46.54 | 46.80 | 62.96 |
| Max. | 91.09 | 94.19 | 95.47 |
|  |  |  |  |  |
| Total Accumulated Rainfall (inches) |  | 6.22 | 1.35 | 15.05 |
|  |
|  |  |  |  |  |

Source: Florida Automated Weather Network (FAWN), Report Generator for Live Oak, Florida.

**Table 2**. Summary of the two nitrogen fertilizer treatments studied in this 2020 trial.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Nitrogen Fertilizer Treatment** | **Season Total N (lbs/A)** |  | **N Preplant**  **Fertilizer Application** | |  | **Fertilizer Application via Drip Irrigationz** | |
|  |  |
|  |  |
|  | **Analysis** | **Pounds of N per Acre** |  | **Analysis** | **Pounds of N per Acre** |
| Soluble N | 150 |  | 32-0-0 | 75 |  | 7-0-7 | 75 |
| Controlled Release N | 150 |  | 44-0-0 | 75 |  | 7-0-7 | 75 |
|  |  |  |  |  |  |  |  |
| zRefer to Table 3 for the complete fertilizer injection schedule. | | | | | |  |  |

**Table 3.** Fertigation schedule for the injection of nitrogen and potassium during the 2020 watermelon growing season.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fertilizer**  **Injection**  **Date** | **Days**  **after Transplanting** | **Week Number** |  | **N Injection** | |  | **K2O Injection** | |
|  | **UF/IFAS**  **Daily rate recommendation** (pounds per acre per day) | **Total N Injected** (pounds per acre  per week) |  | **UF/IFAS**  **Daily rate recommendation** (pounds per acre per day)z | **Total K2O Injected** (pounds per acre per week) |
| 3-Apr-20 | 0 | 0 |  | 0 | 0 |  | 0 | 0 |
| 10-Apr-20 | 7 | 1 |  | 0 | 0 |  | 0 | 0 |
| 17-Apr-20 | 14 | 2 |  | 0 | 0 |  | 0 | 0 |
| 24-Apr-20 | 21 | 3 |  | 0 | 0 |  | 0 | 0 |
| 1-May-20 | 28 | 4 |  | 0 | 0 |  | 0 | 0 |
| 8-May-20 | 35 | 5 |  | 0 | 0 |  | 0 | 0 |
| 15-May-20 | 42 | 6 |  | 1.35 | 9.5 |  | 1.35 | 9.5 |
| 22-May-20 | 49 | 7 |  | 2 | 14 |  | 2 | 14 |
| 29-May-20 | 56 | 8 |  | 2 | 14 |  | 2 | 14 |
| 5-June-20 | 63 | 9 |  | 2 | 14 |  | 2 | 14 |
| 12-Jun-20 | 70 | 10 |  | 2 | 14 |  | 2 | 14 |
| 19-Jun-20 | 77 | 11 |  | 1.35 | 9.5 |  | 1.35 | 9.5 |

zThe recommended rate of K2O was calculated based on soil test results.

**Table 4.** Means for the effects of the interactions between irrigation and N fertilizer treatments on fruit weight and number of fruits.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
| **Harvest Date (Days after transplanting)** | **Irrigation and**  **Nitrogen Fertilizer**  **Treatment**  **Interaction** |  | **Average Fruit Weightz** | | |  | **Fruit Numberz** | |
|  | (pounds per fruit) | (pound per acre) | |  | (number of fruit  per acre) | |
| **Individual Marketable Fruit** | **Marketable Fruit** | **Culls** | **Marketable Fruit** | **Culls** |
| 6/12/2020 (71) | BMP Irrigation & Soluble N |  | 21.82 | 32,067 | 1,711 |  | 1,478 | 78 |
| BMP Irrigation & CRN |  | 22.95 | 28,606 | 0 |  | 1,245 | 0 |
| BMP x2 Irrigation & Soluble N |  | 22.04 | 39,379 | 953 |  | 1,789 | 78 |
| BMP x2 Irrigation & CRN |  | 23.55 | 39,185 | 0 |  | 1,672 | 0 |
| 6/19/2020 (78) | BMP Irrigation & Soluble N |  | 16.38 | 9,062 | 389 |  | 545 | 39 |
| BMP Irrigation & CRN |  | 16.63 | 18,085 | 525 |  | 1,089 | 39 |
| BMP x2 Irrigation & Soluble N |  | 17.28 | 5,231 | 1,497 |  | 389 | 117 |
| BMP x2 Irrigation & CRN |  | 12.64 | 7,973 | 2,159 |  | 583 | 156 |
| 6/26/2020 (85) | BMP Irrigation & Soluble N |  | 17.61 | 8,790 | 369 |  | 506 | 39 |
| BMP Irrigation & CRN |  | 19.29 | 6,087 | 0 |  | 311 | 0 |
| BMP x2 Irrigation & Soluble N |  | 12.86 | 8,070 | 0 |  | 506 | 0 |
| BMP x2 Irrigation & CRN |  | 14.63 | 6,826 | 0 |  | 389 | 0 |
| **Season**  **Totaly** | BMP Irrigation & Soluble N |  | 18.60 | 49,919 | 2,470 |  | 2,528 | 156 |
| BMP Irrigation & CRN |  | 19.62 | 52,778 | 525 |  | 2,645 | 39 |
| BMP x2 Irrigation & Soluble N |  | 17.39 | 52,680 | 2,450 |  | 2,684 | 194 |
| BMP x2 Irrigation & CRN |  | 16.94 | 53,983 | 2,159 |  | 2,645 | 156 |
|  |  |  |  |  |  |  |  |  |
| zNo significant interactions were found for any of the variables shown on this table. | | | | | | | | |
| ySeasonal data was obtained by lumping the three harvests data together. | | | | | | | | |

**Table 5.** Means for the effects of irrigation treatments on fruit weight and number of fruits.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |
| **Harvest Date (Days**  **after transplanting)** | **Irrigation Treatment** |  | **Average Fruit Weightz** | | | |  | **Fruit Number**z  (number of fruit  per acre) | | |
|  | (pounds per fruit) | (pounds  per acre) | | |  |
|  | **Individual Marketable Fruit** | **Marketable Fruit** | | **Culls** |  | **Marketable Fruit** | | **Culls** |
|  |  |  |  |  |  |  |  |  |  |  |
| 6/12/2020 (71) | BMP |  | 22.38 | 30,336 | b | 856 |  | 1,361 | b | 39 |
| BMP x2 |  | 22.79 | 39,282 | a | 476 |  | 1,731 | a | 39 |
|  |  |  |  |  |  |  |  |  |  |  |
| 6/19/2020 (78) | BMP |  | 16.50 | 13,574 | a | 457 |  | 817 |  | 39 |
| BMP x2 |  | 14.96 | 6,602 | b | 1,828 |  | 486 |  | 136 |
|  |  |  |  |  |  |  |  |  |  |  |
| 6/26/2020 (85) | BMP |  | 18.45 | 7,438 |  | 185 |  | 408 |  | 19 |
| BMP x2 |  | 13.74 | 7,448 |  | 0 |  | 447 |  | 0 |
|  |  |  |  |  |  |  |  |  |  |  |
| **Season**  **Totaly** | BMP |  | 19.11 | 51,348 |  | 1,497 |  | 2,586 |  | 97 |
| BMP x2 |  | 17.17 | 53,332 |  | 2,304 |  | 2,664 |  | 175 |
|  |  |  |  |  |  |  |  |  |  |  |
| zMeans followed by the same letter in a column are not significantly different. Mean separation by Tukey-Kramer test at 5% level (Alpha=0.05). If no letters are shown, no significant differences were found within the data shown on a given column. | | | | | | | | | | |
| ySeasonal data was obtained by lumping the three harvests data together. | | | | | | | | | | |

**Table 6.** Means for the effects of N fertilizer treatments on fruit weight and number of fruits.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |
| **Harvest Date (Days**  **after transplanting)** | **Fertilizer Treatment** |  | **Average Fruit Weightz** | | | |  | **Fruit Number**z  (number of fruit  per acre) | | |
|  | (pounds  per fruit) | (pounds  per acre) | | |  |
|  | **Individual Marketable Fruit** | **Marketable Fruit** | | **Culls** |  | **Marketable Fruit** | | **Culls** |
|  |  |  |  |  |  |  |  |  |  |  |
| 6/12/2020 (71) | Soluble (AN) |  | 21.93 | 35,723 |  | 1,332 |  | 1,634 |  | 78 |
| CRN |  | 23.25 | 33,895 |  | 0 |  | 1,458 |  | 0 |
|  |  |  |  |  |  |  |  |  |  |  |
| 6/19/2020 (78) | Soluble (AN) |  | 16.83 | 7,147 | b | 943 |  | 467 | b | 78 |
| CRN |  | 14.64 | 13,029 | a | 1,342 |  | 836 | a | 97 |
|  |  |  |  |  |  |  |  |  |  |  |
| 6/26/2020 (85) | Soluble (AN) |  | 15.23 | 8,430 |  | 185 |  | 506 |  | 19 |
| CRN |  | 16.96 | 6,456 |  | 0 |  | 350 |  | 0 |
|  |  |  |  |  |  |  |  |  |  |  |
| **Season Totaly** | Soluble (AN) |  | 18 | 51,300 |  | 2,460 |  | 2,606 |  | 175 |
| CRN |  | 18.28 | 53,380 |  | 1,342 |  | 2,645 |  | 97 |
|  |  |  |  |  |  |  |  |  |  |  |
| zMeans followed by the same letter in a column are not significantly different. Mean separation by Tukey-Kramer test at 5% level (Alpha=0.05). If no letters are shown, no significant differences were found within the data shown on a given column. | | | | | | | | | | |
| ySeasonal data was obtained by lumping the three harvests data together. | | | | | | | | | | |

**Table 7**. Interaction means for the effects of irrigation and N fertilizer treatments on leaf tissue nutrient analysis for the three sampling dates. Lab results from Waters Agricultural Laboratories (Camilla, GA).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sampling Date (DAT) Stage of Growth** | **Irrigation and Nitrogen Fertilizer Treatment Interaction** |  | **Leaf Tissue Nutrients** | | | | | | | | | | |
|  | **N** | **P** | **K** | **Mg** | **Ca** | **S** | **B** | **Zn** | **Mn** | **Fe** | **Cu** |
|  | ------------------------ % ------------------------- | | | | | | ------------------ ppm ----------------- | | | | |
| 5/15/2020 (43) First flower | BMP Irrigation & Soluble N |  | 5.06 | 0.41 | 2.99 | 0.43 | 1.61 | 0.32 | 56 | 48 | 147 | 177 | 25 |
| BMP x2 Irrigation & Soluble N |  | 4.82 | 0.42 | 3.36 | 0.43 | 1.52 | 0.31 | 57 | 47 | 136 | 158 | 24 |
| BMP Irrigation & CRN |  | 5.07 | 0.43 | 3.36 | 0.46 | 1.61 | 0.32 | 61 | 52 | 168 | 167 | 25 |
| BMP x2 Irrigation & CRN |  | 4.93 | 0.44 | 3.04 | 0.42 | 1.44 | 0.32 | 55 | 48 | 157 | 180 | 26 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5/29/2020 (57) First fruit | BMP Irrigation & Soluble N |  | 5.12 | 0.48 | 3.04 | 0.43 | 2.02 | 0.39 | 44 | 49 | 203 | 208 | 25 |
| BMP x2 Irrigation & Soluble N |  | 4.60 | 0.45 | 2.93 | 0.42 | 2.22 | 0.37 | 44 | 44 | 183 | 197 | 23 |
| BMP Irrigation & CRN |  | 4.69 | 0.44 | 2.70 | 0.46 | 2.34 | 0.37 | 48 | 49 | 226 | 240 | 24 |
| BMP x2 Irrigation & CRN |  | 4.41 | 0.42 | 2.79 | 0.43 | 2.34 | 0.35 | 45 | 46 | 209 | 243 | 23 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6/8/2020 (67) Harvest | BMP Irrigation & Soluble N |  | 4.85 | 0.52 | 2.72 | 0.39 | 1.91 | 0.35 | 50 | 38 | 80 | 128 | 12 |
| BMP x2 Irrigation & Soluble N |  | 4.84 | 0.48 | 2.66 | 0.41 | 2.33 | 0.35 | 56 | 40 | 98 | 128 | 14 |
| BMP Irrigation & CRN |  | 4.74 | 0.48 | 2.57 | 0.42 | 2.17 | 0.35 | 56 | 39 | 109 | 153 | 13 |
| BMP x2 Irrigation & CRN |  | 4.57 | 0.45 | 2.42 | 0.39 | 2.16 | 0.32 | 54 | 36 | 103 | 164 | 13 |

**Table 8**. UF/IFAS adequate ranges for macronutrients and micronutrients in leaf tissue for Florida grown watermelons.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | |  | Leaf Tissue Nutrients | | | | | | | | | | |
| Stage of Growth | | N | | | P | K | Mg | Ca | S | B | Zn | Mn | Fe | Cu |
| ------------------------------- % -------------------------------- | | | | | | | | ----------------------- ppm ----------------------- | | | | |
| Vines 12 to 18 inches in length | | 3.0-4.0 | | | 0.3-0.5 | 3.0-4.0 | 0.25-0.5 | 1.0-2.0 | 0.2-0.4 | 20-40 | 20-40 | 20-100 | 30-100 | 5-10 |
| First Flower | | 2.5-3.5 | | | 0.3-0.5 | 2.7-3.5 | 0.25-0.5 | 1.0-2.0 | 0.2-0.4 | 20-40 | 20-40 | 20-100 | 30-100 | 5-10 |
| First Fruit | | 2.0-3.0 | | | 0.3-0.5 | 2.3-3.5 | 0.25-0.5 | 1.0-2.0 | 0.2-0.4 | 20-40 | 20-40 | 20-100 | 30-100 | 5-10 |
| Harvest Period | | 2.0-3.0 | | | 0.3-0.5 | 2.0-3.0 | 0.25-0.5 | 1.0-2.0 | 0.2-0.4 | 20-40 | 20-40 | 20-100 | 30-100 | 3-10 |

Source: Plant Tissue Analysis and Interpretation for Vegetable Crops in Florida. G. Hochmuth, D. Maynard, C. Vavrina, E. Hanlon, and E. Simonne.