A Summary of N and K Research with Muskmelon in Florida[1]

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Muskmelon—also called cantaloupe—and its cultural companions honeydew, casaba, and Persian melons are minor specialty crops in Florida. Crop losses to diseases and insects led to a reduction in the large production area that had once extended in the early 1900s from the Georgia and Alabama borders south through the Florida counties of Sumter and Marion; by 1936, only a small, insignificant area remained (Whitner et al. 1953). In the late 1980s and the 1990s, muskmelons were produced on small acreages in Southwest and North Central Florida (summer) and Southwest and West Central Florida (fall) (Fla. Dept. of Agric. and Consumer Services 1997; Hochmuth et al. 1988a). Some of the crops were grown as second crops after strawberry. Peak muskmelon harvests are in May and June, and most of the production is sold locally at markets and roadside stands or shipped out of the state with small loads of watermelon for roadside sale out of state. Today, the leading southeastern states are Georgia with 4,500 acres and South Carolina with 1,100 acres (USDA 2009). Florida acreage approaches 1,000 acres. The introduction of new cultivars with greater disease resistance and longer shelf life, together with the development of new fungicides, has helped maintain some small amount of muskmelon production in Florida.

This document is not meant to present new fertilization recommendations but rather to update the previously published research review by the same title, including new research conducted in the last decade. Current muskmelon fertilization recommendations are based on published field research, and a compilation of this literature contained in this document will assist with making valid fertilizer recommendations that are both commercially viable and that reduce risk of environmental consequences in adjacent water bodies. This publication documents the previous written literature, some of which now appears only in updated modern electronic format. All publications, including the reviewed older paper-format publications, will be placed in PDF on the website https://bmp.ifas.ufl.edu for future reference. This publication is an updated version of a previous research literature review by Hochmuth and Cordasco (2000; reviewed 2008) that covered fertilizer research through 1996. This new review document adds the research reports conducted since 1996 and expands on the role of irrigation in managing fertilizer for crop production efficiency and environmental protection. The audience for this publication includes Extension specialists and agents, commercial vegetable producers, consultants, and governmental agencies.

Fertilizer recommendations not only contain the recommended rate of fertilizer but also the management strategies for getting the most out of the fertilizer investment while protecting the environment. These principles for fertilization of vegetables are summarized by Hochmuth and Hanlon (2010a). Rate is only a part of the modern fertilizer recommendation. Sound fertilizer recommendations also consider fertilizer materials, irrigation, placement, and

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timing of application, among other aspects (Hochmuth and Hanlon 2010b).

Fertilizer is a major part of the crop production expenses for muskmelon but is critical for successful crop yields and high fruit quality. More than 40 years worth of muskmelon fertilization research has been conducted in Florida. During this time, many changes have occurred in muskmelon production practices including changes in cultivars and the introduction of new cultural systems, including polyethylene mulch and drip irrigation. The research reported in this publication includes research conducted on muskmelon production with polyethylene mulch. Muskmelon crop and fertilizer management recommendations, such as plant and row spacing, have changed with time in keeping with new developments in research (Hochmuth and Maynard 1996; Montelaro 1978; Hochmuth 1988a; b; 1996a: 1996b; Hochmuth and Hanlon 1989, 1995a; 1995b; 2000; Hochmuth and Smajstrla 1997; Kidder et al. 1989; Olson and Santos, 2010; Simonne and Hochmuth 2010). The most current recommendations for nutrient management in muskmelon production are presented in the *Commercial Vegetable Production Handbook for Florida* (Olson and Santos 2010) at https://edis.ifas.ufl.edu/entity/topic/vph. University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) recommends a target of 150 lb/acre N, 150 lb/acre P_2O_5, and 150 lb/acre K_2O only when soil concentrations of P or K are very low, based on results of M-1 soil testing (Hochmuth and Hanlon 1995a; 2000). More N can be applied to replace leached N or for extended harvesting seasons (Simonne and Hochmuth 2010). These recommendations have been in effect for the last decade, after being revised from 120-160-160 lb/acre N-P_2O_5-K_2O in 1974 (Montelaro 1978) to 120-150-150 lb/acre N-P_2O_5-K_2O in 1989 to 150-150-150 lb/acre N-P_2O_5-K_2O in 1997 (Hochmuth and Hanlon 1989; 1995b; Hochmuth and Cordasco 2000). Despite the recommendations, commercial growers often apply higher rates to reduce the risk of yield reductions when faced with unfavorable production conditions, typically excessive rainfall.

The early research focused largely on yield and fruit quality (size and shape) in response to fertilization. Since the early research was conducted, and since the first review of the literature in 1999, there has been increasingly strong interest in including environmental impacts (water quality) in the fertilizer research. The state (Fla. Dept. of Agr. and Cons. Serv. 2005; Simonne and Hochmuth 2010) has been formalizing Best Management Practices (BMPs) and encouraging growers to implement BMPs. A BMP should consider both economical and environmental components and should be based on the best available science.

This literature review includes all available published documentation concerning muskmelon yield and fertilizer use in Florida since the 1960s. We chose to present all the research without being selective, as that would introduce bias to the presentation. Inclusion of all Florida literature shows the development of the commercial production system with respect to fertilizer use. Commercial yields have been increasing, primarily due to the proper selection of new cultivars with traits that resist disease and pest pressures, and more intensive production practices such as plastic mulched beds. Since the basic plant has not changed, nutrient requirements have also been slow to change. In fact, nutrient use efficiency has increased while commercial fertilizer rates have not.

Since nutrient and water management are linked, fertilization research is summarized by irrigation method. Reviews, such as this document, may be used in the process of determining or revising recommendations. The fertilization recommendation addresses commercial yield and quality, the economics of crop production, and protection of the environment. Equally important is to have a mechanism available to the grower to adjust fertilization practices during the season due to leaching rains and extension of the growing season for additional harvests when market conditions are favorable. To address all of these concerns, UF/IFAS vegetable recommendations are given as a single target fertilizer rate that is projected to be sufficient for meeting the crop fertilizer needs for most growing seasons. This single target fertilizer rate is a recommended starting point and has been used historically in all vegetable fertilizer recommendations in Florida, as well as around the country. The target recommendation approach with footnotes was used by Montelaro (1978) and confirmed by Hochmuth and Hanlon (1995; 2000). The target value was derived from numerous fertilizer studies and represents a reasonable fertilizer rate that reflects the average maximum crop responses from all of the fertilizer research, not the extremes in responses. However the recommendation process recognizes some growing seasons are different, due to more leaching rains or increases in crop value than can lead to prolonged harvest windows. Hence the target fertilizer amount is accompanied by a series of footnotes that explain the addition of supplemental fertilizer during the growing season, which includes addressing leaching rains and additional harvests near the end of the season. It is logical to select a single target rate based on research that avoids excessive fertilizer applications that often reduce crop nutrient efficiency and increase the potential for environmental degradation.

Data Summary Method

Most authors chose to express rates on a per-acre basis, irrespective of variations in bed spacing among reports or experiments. Authors of a few reports chose to use the linear-bed-foot system to standardize fertilizer-rate expressions across experiments and planting patterns. In this report, we attempt to specify planting patterns and fertilizer rates for each experiment as far as we can determine. Current fertilizer recommendations for muskmelon are based on a 5-foot row spacing with one plant row per bed.

Evaluation of muskmelon yield responses to varying rates of applied fertilizer required a standardized method of summarizing statewide yields, which were expressed variably as kg/ha, Mg/ha, tons per acre, or cwt/acre. In addition, vegetable yields vary depending on season, cultivar, and location in the state. Relative yield (RY), a calculated percentage, was chosen as the unit to express muskmelon yield responses to fertilization. Relative yield is an accepted scientific method for summarizing and presenting data across wide sources and reports (Brown 1987).

In his book, C. Black (1992) summarized the advantages and disadvantages of the RY approach. There are valid statistical concerns about RY, but he concluded that, when applied properly and cautiously, the RY approach can be useful in displaying general relationships. Black demonstrates examples in his book where RY yield is helpful and where it was not. We chose the RY approach because we wanted to display the historical data without making biased decisions about what to include and what not to include in the presentation. Plotting absolute yield data in original units obviously would result in a scatter of data rendering any general interpretation impossible. Black (1992) points out that decisions can always be improved with further research, but the data on hand are the best we have at the time. The highest yield for each fertilizer experiment was assigned a 100% value, and other yields were expressed as a percentage of the highest yield. The actual yield corresponding to 100% RY was presented in the number of cwt/acre. The RYs were plotted against rates of nutrient to determine how muskmelon yields responded to fertilizer in Florida. The RY presentation allowed data from a variety of experiments to be included in the graphical summary of yield responses. For most studies, RYs of 90 to 100% were not significantly different.

Sometimes the argument is made that growers have expectations of greater yields than those obtained in research projects. Realistic, regularly obtainable yields are more reliable than expected yields or "yield goals." Research on this subject has documented that 20% of growers actually reached their yield goals, and only 50% reached 80% of their yield goals (Schepers et al. 1986). Therefore, growers rarely achieve their stated yield goals, which means fertilizer rates should not be set on unrealistic yield goals but rather on realistic goals based on research. This practice of using yield goals to set fertilizer rates is not recommended in Florida, so the effect of overfertilization has been avoided by grounding expectations in measurement of observed yields. In effect, the current Florida fertilizer recommendation includes a component that addresses yield expectation versus actual production capability concern expressed by growers. Scientists throughout the years have conducted many replicated demonstration studies in growers' fields, with true commercial production practices, and those studies are included in this review. Excessive fertilizer was justified in times past when fertilizer was viewed as inexpensive insurance against yield loss and before potential impacts to the environment were clearly understood. Research with numerous crops has shown that nutrient use efficiency declines as nutrient rate, especially N, increases. Even given the best of production systems, N use efficiency rarely exceeds 70% of the applied N. Concepts and practices for managing nutrients in vegetable production were summarized by Hochmuth (1992a, 1992b; 2000). Further, it has been suggested that the yields in older studies were much lower than yields obtained today. However there are research reports in the last two decades where yields were as high as yields achieved today. The highest yield for each fertilizer experiment was designated as 100%, and other yields were expressed as a percentage of the highest yield. The typical yield expression for muskmelon of cwt/acre was used with all data presented for the actual treatment corresponding to 100% RY. While fertilizer rate is reported in pounds per acre (lb/acre), the reader should keep in mind that the bed system used in each field may vary and require adjustments to the fertilizer rate. To address this issue, the linear bed foot concept can be used to convert among the various bed designs with and without spray rows or ditches (Hanlon and Hochmuth 1989; Hochmuth and Hanlon 2009). Additional cultural practices for commercial muskmelon production can be found in Chapter 2 of the *Vegetable Production Guide* (Simonne and Hochmuth 2010).

Keeping nutrients in the soil profile and available for muskmelon plant uptake requires proper irrigation management.

Because of the critical nature of irrigation and drainage management with respect to nutrient uptake by the plant and possible loss of nutrients to the environment, information is regularly updated (Simonne et al. 2010).

Another tool for measuring nutrients and thus contributing to appropriate management of fertilizer includes plant tissue and/or plant sap sampling. For interpretation of plant and petiole sap values, see Hochmuth (1994a, 1994b) and Hochmuth et al. (1991b; 2009).

Mixed Fertilizer Trials

Mixed N-P-K fertilizer studies were conducted in early muskmelon fertilization research. Yield results from these studies are presented (Figure 1) as responses to changes in nitrogen (N) fertilizer since N is often the most limiting nutrient in sandy soils.

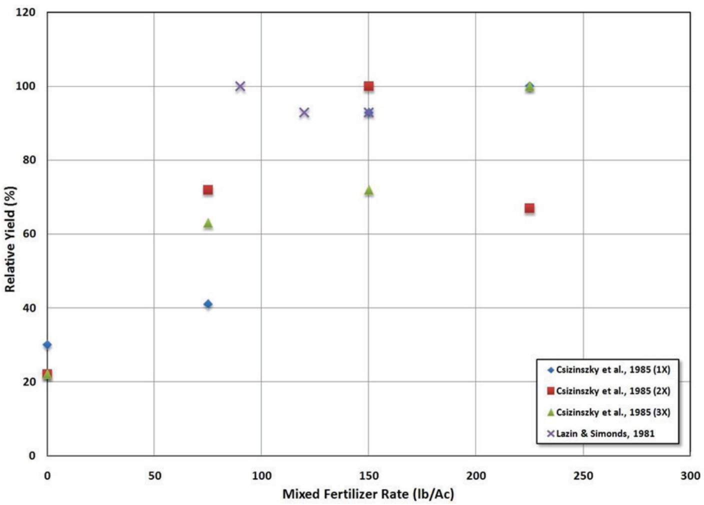

Figure 1. Relative yield of muskmelons for experiments as a function of single or multiple applications (#X) of added N (mixed fertilizer).

Nitrogen rates of 210 and 315 lb/acre were evaluated in a spring 1965 experiment at the North Florida Experiment Station in Quincy (Bryan 1966). Blended fertilizers were 211-159-251 and 315-289-374 lb/acre N-P_2O_5-K_2O, but fertilizer sources were not indicated. Fertilizers were applied in bands 8 inches to each side of the bed center before mulching with black, clear, or white/black (smoke) polyethylene. The unmulched, check treatment received a basic initial fertilization followed by later sidedress fertilizations. Single-row beds of Ruston fine sand soil (plots 50 x 6 feet) were planted with 'Florida No. 1' muskmelons. The type of irrigation used in this study was not specified.

The best yield, averaged using mulched and unmulched treatments, occurred with 210 lb/acre N for 85 cwt/acre (100% RY). Yield with 315 lb/acre N was 34 cwt/acre (Bryan 1966). Yields were evaluated for mulched and unmulched plants this season and in the previous season (1964) where only the recommended N rate was applied to mulched and unmulched beds of 'Florisun' muskmelons. Mulched muskmelon plants yielded more than unmulched plants in both spring seasons with 100% RYs with clear polyethylene mulched muskmelon in 1965 (68 cwt/acre) and with black polyethylene in 1964 (190 cwt/acre). Lower yields occurred with aluminum-painted black polyethylene mulch, 82% RY (1965), and with white/black (smoke) polyethylene mulch, 74% RY (1964). Lower soil temperatures were cited as the yield-reducing factor with these mulches. Relative yields from unmulched plants were 54% and 63% of the high mulched yields in each respective season. Early yield (19 June harvest, 1964) was increased for cantaloupes mulched with black polyethylene, 46 cwt/acre, and clear polyethylene, 43 cwt/acre, compared with unmulched plants, 14 cwt/acre. Cost of the black polyethylene that season ($100/acre), combined with high yield, increased the net return after sale of fruits from plants mulched with this product compared to those mulched with clear ($120/acre) or white/black polyethylene ($200/acre).

'Earli-dew' and 'TAM-Dew' honeydew melons were direct seeded or transplanted with three rates of a mixed (6N-6P_2O_5-8K_2O) fertilizer at 1500, 2000, or 2500 lbs/acre (Lazin and Simonds 1981). Greatest early yields were with 'Earli-dew' and transplants, and greatest season yields were with 'TAM-Dew' and direct-seeding. Fertilizer rates had no effect on yields, but the percentage of cull fruits was reduced with the highest fertilizer rate, equal to 150 lbs/acre N.

Reuse of polyethylene mulched beds for a second season muskmelon crop was the subject of an experiment in Bradenton, UF/IFAS Gulf Coast Research and Education Center (GCREC), spring 1984 (Csizinszky et al. 1985). The subsurface-irrigated, EauGallie fine sand beds were planted the previous fall with tomato. Single-row beds were spaced on 4.5-foot centers in groups of beds separated by irrigation/drainage ditches. Fertilizer calculations and yields were based on 7,500 linear bed feet of crop per acre. Fertilizer treatments were a zero fertilizer check and multiples of one, two, and three times a base fertilization rate of 75-30-75 lb/acre N-P_2O_5-K_2O from a liquid 6-1.1-5 N-P-K analysis. Fertilizer was applied 100% preplant, 50:50 preplant and midgrowth, or 33% each at preplant, at midgrowth, and at fruit set. All fertilizer applications were made using a liquid fertilizer injection wheel.

Fertilizer rate and number of applications interacted in their effects on total marketable yield (significant at 1% probability) (Csizinszky et al. 1985). Yield responses for each fertilizer rate applied on a single, double, or triple application schedule were plotted in Figure 1. Yield was optimized with 150 lb/acre N applied in two equal applications (599 cwt/7,500 linear bed feet/acre). Two equal fertilizer applications, averaged using all application rates, likewise increased individual fruit weight to 3.22 lb/fruit at the third week compared to 2.5 and 3.1 lb/fruit with a single preplant fertilization or three equal fertilizer applications, respectively. Yields were low and fruit considered unmarketable due to low soluble solids content from plants grown on the unfertilized check plots. Fruits from all fertilized plants resulted in acceptable marketable quality fruit. Use of the fertilizer injection wheel facilitated split fertilizer applications on mulched beds and provided sufficient fertilizer for muskmelon yields greater than estimated state yields of 80 cwt/7,500 linear bed feet/acre.

Results of work on the economics of muskmelon production conducted at Live Oak in spring 1987 (Meline and Hochmuth 1988) showed that enhanced early yields and resulting higher preseason prices provided cost justification for polyethylene-mulch and transplant-established muskmelons. Cost comparisons were made for direct-seeded or transplanted muskmelon grown with or without polyethylene mulch. Net return was greatest with the mulch/transplant cultural method ($403/acre), followed by mulch/direct seed ($62/acre), no mulch/transplant ($51), and no mulch/direct seed ($3/acre).

Nitrogen

Polyethylene-mulch and raised beds have become standard cultural practices for muskmelon production in the state (Hochmuth et al. 1991a). The N rate recommendation for muskmelon grown on irrigated, mineral soils (subsurface and overhead irrigation) was 120 lb/acre N (Montelaro 1978) and remained unchanged in 1989 for mulched or unmulched muskmelon (Kidder et al. 1989). In experiments with mixed fertilizer, muskmelon yield was optimized with 150 lb/acre N applied equally at preplant and midgrowth (Csizinszky et al. 1985). Additional experimentation with muskmelon fertilization was conducted in Gainesville (1986) with overhead irrigation, in Osteen (1986) with subsurface irrigation, and in Live Oak (1988 and 1989) with drip irrigation to further document muskmelon N requirements on sandy Florida soils (Hochmuth et al. 1991a).

Mulched beds in Gainesville experiments (sprinkler irrigation) were fertilized with 0, 50, 100, or 150 lb/acre N (NH_4NO_3) and 120 lb/acre K_2O, broadcast and incorporated before application of black polyethylene mulch (Hochmuth et al. 1991a). Unmulched beds received the same N rates applied in three equal applications: at bedding, at the 5-leaf stage, and at initiation of vining. Muskmelons were direct seeded. Nitrogen and mulch interacted in their effects on total season yield. Mulched plants produced nearly twice the yield of unmulched plants and ten times the early fruit yield with no increased yield of mulched plants due to increased N. A high soil organic matter content, 2.3%, may have decreased the response to added N for 99% RY (301 cwt/acre) with zero lb/acre N. Yields from unmulched plants responded quadratically to increased N fertilizer leveling off at rates greater than 50 lb/acre N (184 cwt/acre, 100% RY). Yields from the mulched plants only were presented with results from other mulched experiments in Figure 2.

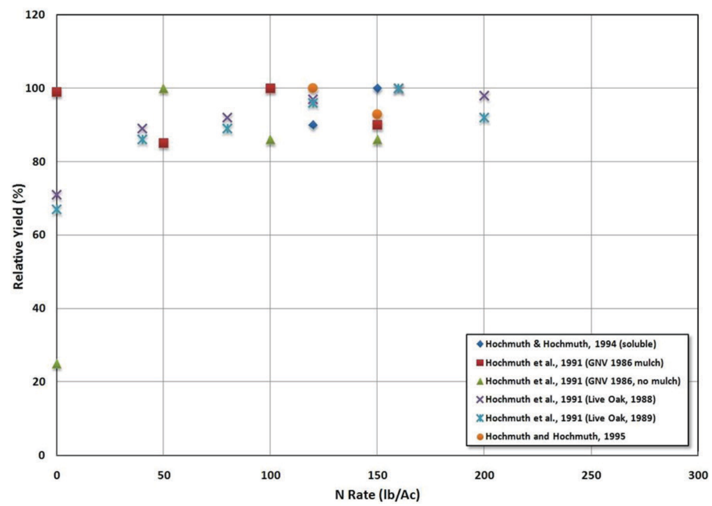

Figure 2. Relative yield of mulched muskmelons for experiments, years, and seasons as a function of added N.

Subsurface irrigation, in a 1986 experiment, was established with a perched water table maintained at 20 inches below the bed surface (Hochmuth et al. 1991a). Muskmelons were transplanted into beds mulched with black polyethylene and fertilized with 0, 60, 120, 180, or 240 lb/acre NH_4NO_3-N and 150 lb/acre each of P_2O_5 and K_2O. Fertilizers, N and K, were applied in bands to each side of the row and in grooves on the bed surface. Phosphorus was broadcast in the bed and incorporated. Yields responded quadratically to increased N with a peak response at 120 lb/acre N (211 cwt/acre, 100% RY). Yields were reduced with 240 lb/acre N to 47% RY. Leaf tissue N concentrations of 4.8%, from most recently matured leaves taken at first fruit, were associated with high yield.

Drip irrigation was applied to maintain soil moisture at -10 centibars, as measured by tensiometer to a 12-inch depth, in Live Oak experiments in 1988 and 1989 (Hochmuth et al. 1991a). Muskmelons were transplanted into Klej (Lakeland) fine-sand soil beds fertilized with 0, 40, 80, 120, 160, or 200 lb/acre NH_4NO_3-N. Fertilizers, including 50 lb/acre P_2O_5 and 150 lb/acre K_2O, were incorporated in the bed area, and beds were mulched with black polyethylene. Total marketable yield (1988) increased linearly with added N, although model fit was poor, and there was negligible increase in yield from rates greater than 120 lb/acre N (221 cwt/acre, 97% RY). Yields of cull fruit, No. 1 large and No. 2 medium-sized fruit, also increased linearly in response to N. Total, marketable grade fruit yield, in the 1989 experiment season increased quadratically with 96% RY with 120 lb/acre N and 100% RY (359 cwt/acre) with 160 lb/acre N. Using the quadratic equation, maximum yield was calculated to occur with 143 lb/acre N (352 cwt/acre), $r^2 = 0.54$. Leaf-tissue N concentrations of 4.0% at early fruit set were associated with high yields with N rates of 120 and 160 lb/acre N.

Experimentation with controlled-release (CR) fertilizer on drip-irrigated beds was conducted at the Suwannee Valley Agricultural Research and Education Center at Live Oak, in the spring of 1993 (Hochmuth and Hochmuth 1994). Lakeland fine sand soils were fertilized with a factorial set of CR-KNO_3 treatments and two N-rate treatments. Nitrogen treatments were 120 lb/acre soluble-N (NH_4NO_3 and KNO_3); or they were 150 lb/acre applied as soluble–N or as 50/50 CR (urea and KNO_3) and soluble-N. Treatments to evaluate yield response to N also included 100 lb/acre K_2O. Nitrogen and K fertilizers were broadcast in a 36-inch wide swath and incorporated preplant. No P was applied since soils tested high for P. Beds were prepared on standard 5-foot centers, drip irrigated to maintain soil moisture at -8 to -12 centibars as measured by tensiometer (8-inch soil depth), and mulched with black polyethylene. 'Hymark' muskmelons were direct seeded through the mulch. Yields were not affected by N rate or N source, averaging 338 cwt/acre with 150 lb/acre of soluble or blended soluble and CR-N (100% RY) and 90% RY with 120 lb/acre soluble-N fertilizer.

Experimentation with CR-N and K fertilizers continued at Live Oak (SVREC) in the spring of 1994 (Hochmuth and Hochmuth 1995). Fertilizer treatments were formulated and applied on Lakeland fine sand soil as in the previous 1993 experiment. Beds were prepared as before on 5-foot centers with drip irrigation applied to maintain soil moisture at -8 to -12 centibars. In 1994, 'Hymark' muskmelon transplants were used instead of direct seeding. Total marketable yields again were similar with fertilization at 120 or 150 lb/acre N. Yields were 219 cwt/acre with 120 lb/acre N (100% RY) and averaged 204 cwt/acre with 150 lb/acre N (from soluble or blended soluble and CR-N sources). Leaf-tissue N concentrations also were not different with increased N averaging 5.8% at first flower and 3.0% one week before first harvest.

Summary Nitrogen

Early experiments with mixed fertilizers resulted in optimum muskmelon yield responses with 150 lb/acre N applied half preplant and half at midgrowth. Midgrowth fertilizer applications were applied through polyethylene mulch using a liquid-fertilizer injection wheel. Individual fruit weight was increased by two fertilizer applications as opposed to one or three fertilizer applications. Yields from muskmelon mulched in clear or black polyethylene in the spring resulted in yields nearly twice those of unmulched muskmelon. Early muskmelon harvest was three times greater with mulched than with unmulched muskmelon, offsetting the higher cost of this production method.

Studies designed to isolate yield responses to N were generally conducted with mulched muskmelon. Muskmelon yields were either optimized with 120 lb/acre N, leveled off at rates greater than 120 lb/acre N, or did not respond to N rates between 120 and 150 lb/acre. A quadratic yield response to N rates occurred in one experiment resulting in a calculated (quadratic equation) optimum yield with 143 lb/acre (352 cwt/acre). Nitrogen fertilization to 240 lb/acre resulted in a severe yield reduction to 47% RY from an optimum yield with 120 lb/acre N in one experiment. The N rate recommendation was increased to 150 lb/acre from 120 lb/acre in 1995 (Hochmuth and Hanlon 1995a; b). Muskmelon yields did not differ where N was derived from soluble or soluble plus CR-N sources.

Potassium

Soil Testing

M-1 extractant indices (expressed as ppm soil-extracted nutrient) are classified as very low, low, medium, high, and very high, and a crop specific fertilizer recommendation is made from that classification (Hochmuth and Hanlon 1995a). The M-1 solution became the standard extractant in 1979 at UF. Before adoption of the M-1 extractant, ammonium acetate and water extractants were used. Indices recorded from these methods cannot be directly equated with M-1 indices or fertilizer recommendation rates. Water management practices, fertilizer sources, and application methods will also be summarized in this review.

Potassium

Two studies were conducted on potassium (K) fertilization of muskmelon, both at Live Oak (SVREC) on Lakeland fine sand beds spaced on 5-foot bed centers (fertilizer rates calculated on 5-foot centers) (Hochmuth and Hochmuth 1994; 1995). Factorial fertilizer treatments in each experiment were grouped by percent CR-K present in their formulation, 0, 25%, or 50%, with K rates of 0, 50, 100, or 150 lb/acre K_2O. Due to an interaction between K rate and percent CR-K in the spring 1993, yield responses to K rate were presented graphically by percent CR-K (Figure 3). A zero K check treatment was also included. Percent K and K rate did not interact in the spring 1994 experiment season. Soluble (KNO_3) and CR-K fertilizer sources (polymer-coated KNO_3) were the same each year. Soluble and CR-N sources (NH_4NO_3 and polymer-coated urea) were applied at 150 lb/acre N each season with all fertilizers broadcast in a 36-inch swath (1993) and 30-inch swath (1994), tilled, pressed into beds, and covered with black polyethylene mulch. 'Hymark' muskmelon was direct seeded through the mulch in 1993 and transplanted in 1994. Drip irrigation was applied both seasons to maintain soil moisture between -8 and -12 centibars.

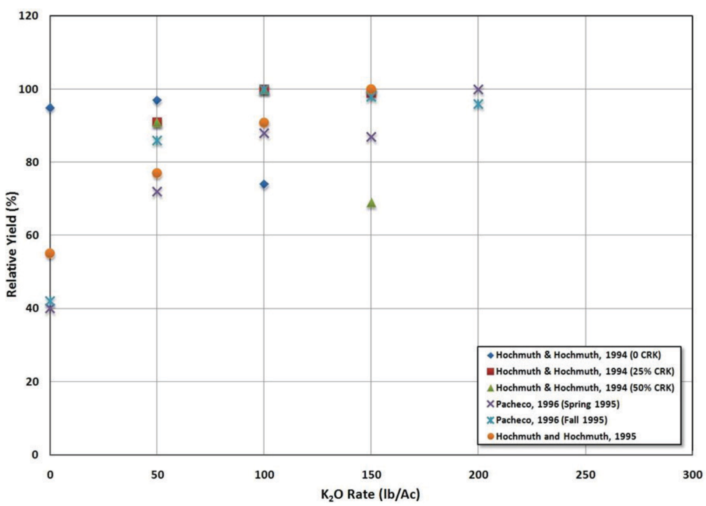

Figure 3. Relative yield of mulched muskmelons for experiments as a function of added K_2O (0 to 50% controlled-release K).

Soil K concentrations (M-1) tested low (35 ppm) in spring 1993, and 130 lb/acre K_2O was recommended (Kidder et al. 1989). Yields did not differ with 50 lb/acre K_2O formulated with no CR-K, 25%, or 50% CR-K. With 100 lb/acre K_2O, however, yields increased from 280 cwt/acre (no CR-K) to the highest overall yield of 409 cwt/acre (25% CR-K). A similarly high yield (377 cwt/acre) required 150 lb/acre K_2O when no CR-K was included in the K fertilizer. Researchers cited improved K efficiency with the 25% CR-K treatment or reduced soluble salt injury potential with CR-K. Yields with the 150 lb/acre K_2O rate were also best with 25% CR-K (403 cwt/acre). Linear increases in leaf-tissue K concentrations resulted from added K fertilizer at both sample dates with K concentrations less than the sufficiency range at the 18-inch runner stage with all K treatments and within the sufficiency range (except with 50 lb/acre K_2O) at the full-size fruit stage. The proportion of CR-K in the K fertilizer had no effect on leaf K concentrations.

Low M-1 soil test K concentrations (28 ppm) also resulted in the second season, spring 1994, and 130 lb/acre K_2O was again recommended. The proportion of CR-K did not, however, interact with K rates this season. Muskmelon yields responded linearly (5% probability) to K fertilizer rates, presented as main effects using all CR-K treatment percentages, with 100% RY produced with 150 lb/acre K_2O (222 cwt/acre). The main effects of CR-K treatments, averaged using all K rates, were also described by a linear function (5% probability). Muskmelon treated with 25% to 50% CR-K responded with 100% and 95% RY, respectively, compared to 69% RY where no CR-K was included in the fertilizer treatment.

Two cultivars of muskmelon were used in spring and fall experiments evaluating crop response to K on soils testing very low in K (Pacheco 1996). The spring experiment was on a sandy soil testing 14 ppm M-1 K (very low), and the fall experiment was conducted on a sandy soil testing 17 ppm in K (very low). Muskmelons were planted on beds spaced on 5-foot centers and were drip irrigated. In the spring, there was a quadratic response to K with total marketable yield leveling at rates greater than 90 lb/acre K_2O (linear-plateau model). The quadratic model predicted a maximum yield with 170 lb/acre K_2O. In the fall, yield was maximized with 60 lb/acre K_2O (linear-plateau), and the quadratic maximum K rate was 145 lb /acre K_2O.

'Athena' muskmelon was grown in Gainesville in 1999 with several sources of K (Hochmuth and Gal 2001). Raised plastic-mulched beds with drip irrigation were used, and the K rate was 160 lbs/acre K_2O. K was applied 100% preplant incorporated or in 12 equal weekly injections (fertigation). Early yield was not affected by K source. Total-season yield averaged 470 cwt/acre and was not affected by K source. Early fruit yield was not affected by K application method, but total-season yield was greater with fertigation.

Summary Potassium

Muskmelon yields responded to less than the recommended K rate (150 lbs per acre K_2O) in a spring 1993 experiment and to more than the recommended rate in a spring 1994 experiment. In both seasons, increased fertilizer efficiency resulted when fertilizer contained 25% to 50% of a CR-K source. Optimum yield the first season occurred with 100 lb/acre K_2O compared to 150 lb/acre when the fertilizer contained no CR-K. Research in Gainesville with two muskmelon cultivars documented a requirement for more K (170 lb/acre K_2O) in spring than in fall (145 lb/acre K_2O). Source of K fertilizer did not influence muskmelon fruit yield, but weekly fertigation led to greater yields than 100% preplant application. Additional experiments with K fertilization of muskmelon are needed for all key production areas (the southwest, north central, and west central areas of the state) in addition to research utilizing current production practices—drip irrigation, mulch, CR-K fertilizer, and fertigation—to assess muskmelon response and adjust recommendations as needed.

Irrigation and Nutrient Management

Irrigation and nutrient management are tied closely together for keeping nutrients and water in the root zone. Several irrigation systems are used in Florida for irrigating vegetables (Smajstrla and Haman 1998). Irrigation recommendations for muskmelon production are presented by Dukes et al. (2010). Muskmelon production has moved almost entirely to mulched, covered raised beds. With plastic mulch and drip irrigation, growers can inject fertilizers into the irrigation system, improving nutrient management efficiency (Hartz and Hochmuth 1996; Hochmuth and Hartz 1996).

Overall Summary

High yields for Florida-grown muskmelon have ranged from 200 to 600 cwt/acre in research with N and K fertilization since 1965. Significant yield increases resulted with the use of polyethylene mulch (clear or black in the spring) to ten times those of unmulched muskmelon. Results summarized in Figure 2 show that muskmelon yield was maximized in most studies with 150 lb/acre N. Muskmelon grown as a second crop on previously mulched beds proved a viable production alternative facilitated by use of a fertilizer injection wheel. Split fertilizer application, once at preplant and again at midgrowth, significantly increased yields with this cultural method. Experimentation with CR fertilizers resulted in no yield effect with CR-N sources but had significant yield effects when applied as 25% to 50% of the K fertilizer source (polymer-coated KNO_3). Nearly 80% of the research presented in this summary was conducted in North Florida, and additional research is needed in key production areas in Southwest and West Central Florida for a comprehensive study of Florida muskmelon fertilization.

List of General Summaries and Conclusions:

- In most studies, muskmelon responded to N fertilization at 150 lb/acre for a crop on 5-foot beds, center-to-center, in the early research, mostly conducted with seepage irrigation.
- In newer studies with plastic mulch and fertigation, the responses were to 120 to 150 lb/ acre.
- Controlled-release fertilizers, especially K, can be used with muskmelon at 25 to 50% of the total K needs.
- Studies with K showed responses to 150 lbs/acre K_2O or slightly more.
- Muskmelons grown with polyethylene mulch resulted in greater fruit yields and reduced N leaching.

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