NOTA TÉCNICA

# Growth and Nutrients Accumulation in Frog Skin Melon

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## Summary

The objective of this work was to evaluate the growth and accumulation of plant nutrients in Ibérico hybrid melon (Syngenta Seeds). The experiment was carried out at the «Rafael Ferdandes» experimental farm of the Universidade Federal Rural Semi-Arido in Mossoró, Rio Grande do Norte, Brazil, from January to April 2013. We used a randomized block design with eleven treatments and four replications. The treatments consisted of the sampling periods: 0, 7, 14, 21, 28, 35, 42, 49, 56, 63 and 70 days after transplanting. This study assessed dry matter, nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), iron (Fe), manganese (Mn) and copper (Cu), the vegetative part (leaves and stems), fruits, and whole plant. The fruits were the preferred drain of the plant, corresponding to 73.7 % of the dry matter accumulated. The N, P, K, Fe, Mn, Zn and Cu were accumulated preferentially in fruits, while Ca, and Mg accumulated in the vegetative part. The highest accumulation of dry mass and nutrients occurred from 35 to 49 days after transplanting, with the exception of calcium, magnesium, copper and zinc that extended their accumulation until the end of the cycle. The decreasing order of nutrient accumulation for the Ibérico hybrid melon was: N > K > Ca > P > Mg > Fe > Zn > Mn > Cu.

**Keywords:** *Cucumis melo* L., dry matter, macronutrients, micronutrients, production

# Crecimiento y acumulación de nutrientes en melón piel del sapo

## Resumen

El objetivo de este estudio fue evaluar el crecimiento y acumulación de macro y micronutrientes en la planta del melón híbrido Ibérico (Syngenta Seeds). El experimento fue realizado entre enero y abril de 2013 en la hacienda experimental «Rafael Ferdandes» de la Universidade Federal Rural do Semi-Árido, ubicada en Mossoro, Río Grande do Norte, Brasil. El diseño experimental utilizado fue el de bloques al azar con once tratamientos y cuatro repeticiones. Los tratamentos consistieron en colectas a los 0, 7, 14, 21, 28, 35, 42, 49, 56, 63 y 70 días después del transplante. El estudio cuantificó las acumulaciones de materia seca, nitrógeno (N), fósforo (P), potássio (K), cálcio (Ca), magnésio (Mg), zinc (Zn), hierro (Fe), manganeso (Mn) y cobre (Cu) en la parte vegetativa (hojas y tallos), frutas y planta entera. Al final del ciclo los frutos acumularon mayor cantidad de materia seca, correspondiendo al 73,7 % del total. El N, P, K, Fe, Mn, Zn y Cu se acumularon preferencialmente en los frutos, mientras el Ca y Mg lo hicieron en la parte vegetativa. La mayor acumulación de masa seca y nutrientes ocurrió entre 35 y 49 días después del trasplante, con la excepción de calcio, magnesio, cobre y zinc que extendieron su acumulación hasta el final del ciclo. El orden decreciente de acumulación de nutrientes para el melón híbrido ibérico fue: N> K> Ca> P> Mg> Fe> Zn> Mn> Cu.

**Palabras clave:** C*ucumis melo,* materia seca, macronutrientes, micronutrientes, producción

## Introduction

Melon is a crop of relevant importance for the Brazilian Northeast, especially for the State Rio Grande Norte, where soil and climate conditions favor its development. Often, new melon hybrids are introduced in the producing regions, which make it necessary to carry out studies on the behavior of these materials, to improve the practices carried out during cultivation, and to enable producers to obtain high yield and quality.

Knowing the plant development in the phenological stage, it is possible to infer when plants absorb larger proportions of nutrients and at the same time, it is possible to provide these in the most favorable times and in readily assimilable form.

Although the accumulation of dry matter and nutrients is affected by climate, farming and cropping systems, generally nutrients are absorbed due to the cycle and translocation in the plant. Studies with muskmelon have dry matter accumulation curves in three well-defined stages, where the first one has slow accumulation, the second one is a period of rapid growth, also influenced by the growth of the fruit, and the third one, during the maturation of fruits, reducing the accumulation rate and senescence of the vegetative parts (Medeiros et al., 2007, 2008, 2011; Gurgel, Gheyi & Oliveira, 2010).

The amount and intensity of absorption of nutrients by plants are functions of the intrinsic characteristics of the organism, as well as the external factors that influence the process (Marschner, 2012). Fertilizer recommendations, in turn, are based on the response studies fertilization and nutritional requirements of the crop. Mainly due to the maximum absorption peaks, the requirement of crops for nutrients cannot be inferred only from the total extraction.

Several studies have been carried out on the growth and accumulation of nutrients in different cropping regions (Kano et al, 2010; Melo et al., 2013, Aguiar Neto et al., 2014; Mendoza-Cortez et al., 2014), and they have shown that cultivars have different nutritional requirements. In this context, it is important to evaluate the nutrient demand of different cultivars in their specific growing region, with the purpose of assisting the fertilization programs and identifying the most efficient cultivars in the absorption and use of nutrients.

A study conducted by Mendoza-Cortez et al. (2014) in Mossoro, Rio Grande do Norte, Brazil, with two melon cultivars (Olimpic express and Iracema), verified that growth was slow up to 28 days after transplanting (DAT) in both cultivars. The highest demand for nutrients occurred between 28 to 56 DAT and at the end of the cycle the accumulations of N, P, K, Ca, Mg and S were, for Olimpic express: 101.1, 13.5, 173.4, 110, 26.9 and 15.6 kg $ha^{-1}$; and for Iracema: 93.9, 9.5; 136.0, 84.1, 22.6 and 15.4 kg $ha^{-1}$, respectively.

In melon toad skin, hybrid Sancho, Silva Júnior et al. (2006) verified that more than 50 % of the extracted nutrients were accumulated in the vegetative part of the plant. Potassium, calcium, and nitrogen were the more demanded nutrients. The period of larger demand for nutrients happened between 43 and 54 days after sowing.

In this context, the aim of this work was setting the dry matter accumulation and nutrient uptake by the hybrid melon plant Ibérico.

## Material and Methods

The survey was conducted at the Experimental Farm Rafael Fernandes, belonging to the Federal Rural University of Semi-Arid, Mossoró (Latitude 5°03'37" S and longitude 37°23'50" W Gr, altitude of 72 m), State of Rio Grande do Norte, Brazil, on a soil classified as Ultisol (Soil Survey Staff, 1999) in the period January-April 2013. During the experimental period, the mean temperature and the average relative humidity were 26.7 °C and 56.8 %, respectively, and the rainfall was 60.1 mm.

The chemical soil analyses of the experimental area showed the following results: pH ($H_2O$) = 7.7; P (Mehlich) = 10.6 mg $dm^{-3}$; K = 107.7 mg $dm^{-3}$; Na = 23.0 mg $dm^{-3}$; Ca = 1.55 $cmol_c$ $dm^{-3}$; Mg = 0.12 $cmol_c$ $dm^{-3}$; Al = 0.00 $cmol_c$ $dm^{-3}$, H+Al = 0.00 $cmol_c$ $dm^{-3}$.

The design was a randomized complete block with eleven treatments and four replications. The treatments were the sampling periods (0, 7, 14, 21, 28, 35, 42, 49, 56, 63 and 70 days after transplanting - DAT). In each sampling, we used two plants per repetition.

Soil preparation consisted of plowing and harrowing, followed by plowing in rows, spaced 2.0 m with a depth of 0.30 m. The seeds were sown in polystyrene trays of 200 cells filled with commercial substrate, in which the plants remained in a greenhouse for 10 days. Transplantation was carried out when the seedlings had a definitive leaf.

The irrigation system used was dripping, consisting of a sideline row of plants with self-compensating drip type, and an average flow rate of 1.4 $Lh^{-1}$, spaced 0.40 m distance between rows of 2.0 m. The melon used was Ibérico

**Table 1.** Nutrients applied by fertigation along melon cycle, hybrid Ibérico.

| Períod | Amount applied (kg ha$^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| (DAT) | N | $P_2O_5$ | $K_2O$ | CaO | MgO | B | Zn |
| 0 – 7 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 8 – 14 | 4,4 | 9,6 | 5,6 | 0,0 | 0,8 | 0,0 | 0,0 |
| 15 – 21 | 11,6 | 21,0 | 12,6 | 0,0 | 1,3 | 0,1 | 0,7 |
| 22 – 28 | 28,4 | 21,0 | 12,6 | 5,5 | 0,7 | 0,7 | 0,7 |
| 29 – 35 | 9,9 | 9,0 | 0,0 | 5,5 | 0,3 | 0,3 | 0,0 |
| 36 – 42 | 11,0 | 15,0 | 15,0 | 5,5 | 1,4 | 0,5 | 0,0 |
| 43 – 49 | 19,5 | 0,0 | 28,6 | 6,0 | 0,8 | 0,0 | 0,0 |
| 50 – 56 | 17,0 | 0,0 | 29,8 | 6,0 | 0,0 | 0,0 | 0,0 |
| 57 – 63 | 10,0 | 0,0 | 32,2 | 0,0 | 0,0 | 0,0 | 0,0 |
| 64 - 70 | 2,0 | 0,0 | 32,2 | 0,0 | 0,0 | 0,0 | 0,0 |

hybrid (Syngenta Seeds), frog skin type (*Cucumis melo* L. subsp. *melo* var. *inodorus* H. Jacq.). The adopted planting spacing was 2.0 x 0.4 m. Topdressing was done daily through irrigation water, beginning right after transplanting, and the total following amounts 113.8; 75.5; 168.6; 28.5; 5.3; 1.6 and 1.4 kg ha$^{-1}$ of N, $P_2O_5$, $K_2O$, CaO, MgO, B, and Zn were applied, respectively (Table 1). The fertilizers used were urea, potassium nitrate, potassium chloride, calcium nitrate, magnesium sulfate, boric acid, and zinc sulfate.

The plants were harvested without roots (cut at the base of the stem), fractionated into leaves, stem + branches and fruits + flowers (when present). They were washed with water; then with water + neutral detergent; then again with water, and finally with deionized water. The samples were dried in a forced-air circulation oven at 65 ºC, for 72 hours. The chemical analyzes were carried out in the extracts obtained by sulfuric (N), and by nitric-perchloric (P, K, Ca, Mg, Cu, Fe, Mn and Zn) digestion. Nitrogen was quantified by the Kjeldahl semi micro method, phosphorus by the phosphomolybdic complex method in reducing medium, potassium by flame emission photometry, and other nutrients by atomic absorption spectrophotometry (EMBRAPA, 2009).

In order to determine the amount of these accumulates on each plant fraction, the concentration was multiplied by the dry mass of the referred fraction, and the total plant accumulation was determined by the sum of the accumulation of the fractions for each nutrient.

All the determined characteristics were subjected to analysis of variance and regression analysis using the Tablecurve software (Jandel Scientific, 1991).

## Results and Discussion

### Dry Matter

The emergences of the male and female flowers occured, respectively, at 23 and 27 days after transplanting, and fruiting began 35 days. The marketable yield was 41 t ha$^{-1}$ (population of 12,500 plants per hectare), averaging 1.2 fruits plant$^{-1}$ and 2.7 kg fruit$^{-1}$.

The accumulation of dry matter in the vegetative part of the plant (leaves and branches) was slow to 21 DAT, stepping up then with a maximum observed in the period of 35-42 DAT (8.81 g plant$^{-1}$ day$^{-1}$). From then on there was a reduction of the same, and a strong increase in the dry matter accumulation rate of the fruit, which reached 11.03 g plant$^{-1}$day$^{-1}$ (Figure 1A). The fruits accumulated more dry matter than the other organs of the plant, with an estimated maximum of 379.02 g plant$^{-1}$, at harvest time.

As for the vegetative part, the accumulation of total dry matter was slow up to 21 days after transplanting (DAT), stepping up from this. The maximum increase in dry matter occurred in the period from 35-49 DAT, with a rate of 19.5 g plant$^{-1}$ day$^{-1,}$ while remaining high in the following period (50-56 DAT) averaging 11.44 g plant$^{-1}$ day$^{-1}$.

The dry matter accumulation estimated at the end of the cycle (70 DAT) was 491.38 g plant$^{-1}$ (Figure 1A, Table 2), higher than the accumulation observed by Silva Júnior et al. (2006), possibly due to the hybrid, and / or management of cultivation.

The partition of assimilates in the plant changed due to the evaluation period. When the work on the determination of the dry matter of the fruit began, at 42 DAT, the leaves and branches accounted for 75 % of the total accumulated by the plant; since then there was a reduction in the share of the vegetative part of the total. At 56 DAT, the vegetative part and the fruit accounted, respectively, for 43 and 57 % of total dry matter. Since the emergence, the fruits became the preferred drain assimilated, and there was greater translocation of carbohydrates and other compounds from the leaves to the fruit, increasing its share in the total of dry matter in relation to the vegetative part.

At the end of the cycle, it was found that the participation of the vegetative part was 26.3 %, and 73.7 % fruits accumulated the total of dry matter (Figure 1A).

Growth patterns similar to the ones observed in this study were also reported in other studies. Working with melon, Santos et al. (2014) observed the fruits behaving as the preferred drain of the plant, accounting for 72.25 % of the dry matter accumulation. Evaluating the growth of Mickylee watermelon plants, Braga et al. (2011) verified that at the end of the cycle, the vegetative part (leaves and stems) and the fruits contributed respectively with 36.1% and 63.9% of the dry mass accumulated by the plant.

### Macronutrients

The accumulation of nutrients followed the pattern of the dry matter accumulation curve by the plants, being slow in the first 21 DAT, stepping up then until the end of the cycle.

Nitrogen accumulation grew until the end of the cycle, and by harvest time the accumulated amount was 16.2 g plant $^{-1}$ (202.5 kg ha $^{-1}$). The highest demand period was 35-49 DAT, with a rate of accumulation in the period of 0.67 g plant $^{-1}$ day $^{-1}$ average (Figure 1B, Table 2). Subsequently, there was a reduction in the absorption rate, to only 0.23 g plant $^{-1}$ day $^{-1}$ in the period 63-70 DAT.

In the vegetative part, the accumulation of N was small in the early stages, from 0.06 g plant $^{-1}$ at 7 DAT to 7.83 g plant $^{-1}$ to 53 DAT. The 28-42 DAT period was the most demanding for this nutrient, with an estimated accumulation of 4.42 g plant $^{-1}$, about 60 % of the total accumulated by the plant in the period. In the following period, the increase in the amount of N accumulated in the vegetative part of the plant was lower (1.3 g plant $^{-1}$), possibly due to the translocation of this nutrient to the fruit. The accumulation in the fruit continued until harvest with a maximum estimated of 12.2 g plant $^{-1}$ (Figure 1B).

The greater accumulation of N, coinciding with the maximum dry matter accumulation, is also reported by other authors in studies with melon (Aguiar Neto et al., 2014) and other cucurbits such as pumpkin (Vidigal, Pacheco & Facion, 2007) and watermelon (Serafim et al., 2015).

The accumulation of phosphorus in the plant reached an estimated maximum value of 2.1 g plant $^{-1}$ (26.2 kg ha $^{-1}$ P) 70 DAT. The greatest demand was observed in the 35-49 DAT period, whose average yield was 0.07 g plant $^{-1}$ day $^{-1}$ (Figure 1C, Table 2).

In the vegetative part, the accumulation of P increased to 49 DAT (0.90 g plant $^{-1}$), and from then decreased, reaching 0.44 g plant $^{-1}$ (Figure 1C). On the other hand, the accumulation of P in the fruits increased with the estimated maximum of 1.49 g plant $^{-1}$ at 70 DAT, representing 71 % of the total accumulated by the plant. The reduction in the vegetative part due to great demand phosphorus by the fruits resulted in a redistribution of the nutrient. Other authors also observed a greater redistribution of P from the vegetative parts to the fruits in watermelon (Vidigal et al., 2009) and melon (Aguiar Neto et al., 2014)

The amounts of phosphorus extracted from the ground by the vegetables are usually low, especially when compared to nitrogen and potassium. However, despite its seemingly low demand, this nutrient levels the soil solution, and the speed of its recovery from it, are not sufficient to meet the needs of the crops and, as a result, phosphorus is the nutrient that must be provided in higher proportions.

Potassium was the second nutrient accumulated, with a maximum of 11.4 g plant $^{-1}$ (142.5 kg ha $^{-1}$), 70 DAT, and the greater demand occurred in the period 35-49 DAT (Figure 1D, Table 2). The vegetative part and the fruit represented, respectively, 21.7 and 78.3 % of the K accumulated by the plant. From 52 DAT, the average accumulation of potassium in the vegetative part of the plant showed a slight reduction. On the other hand, the fruits presented a strong increase in K accumulation (Figure 1D), indicating the high demand of the fruits by this nutrient. Other authors also reported the highest accumulation of K by watermelon fruits. (Grangeiro & Cecílio Filho, 2004; Serafim et al., 2015) and for melon (Aguiar Neto et al., 2014).

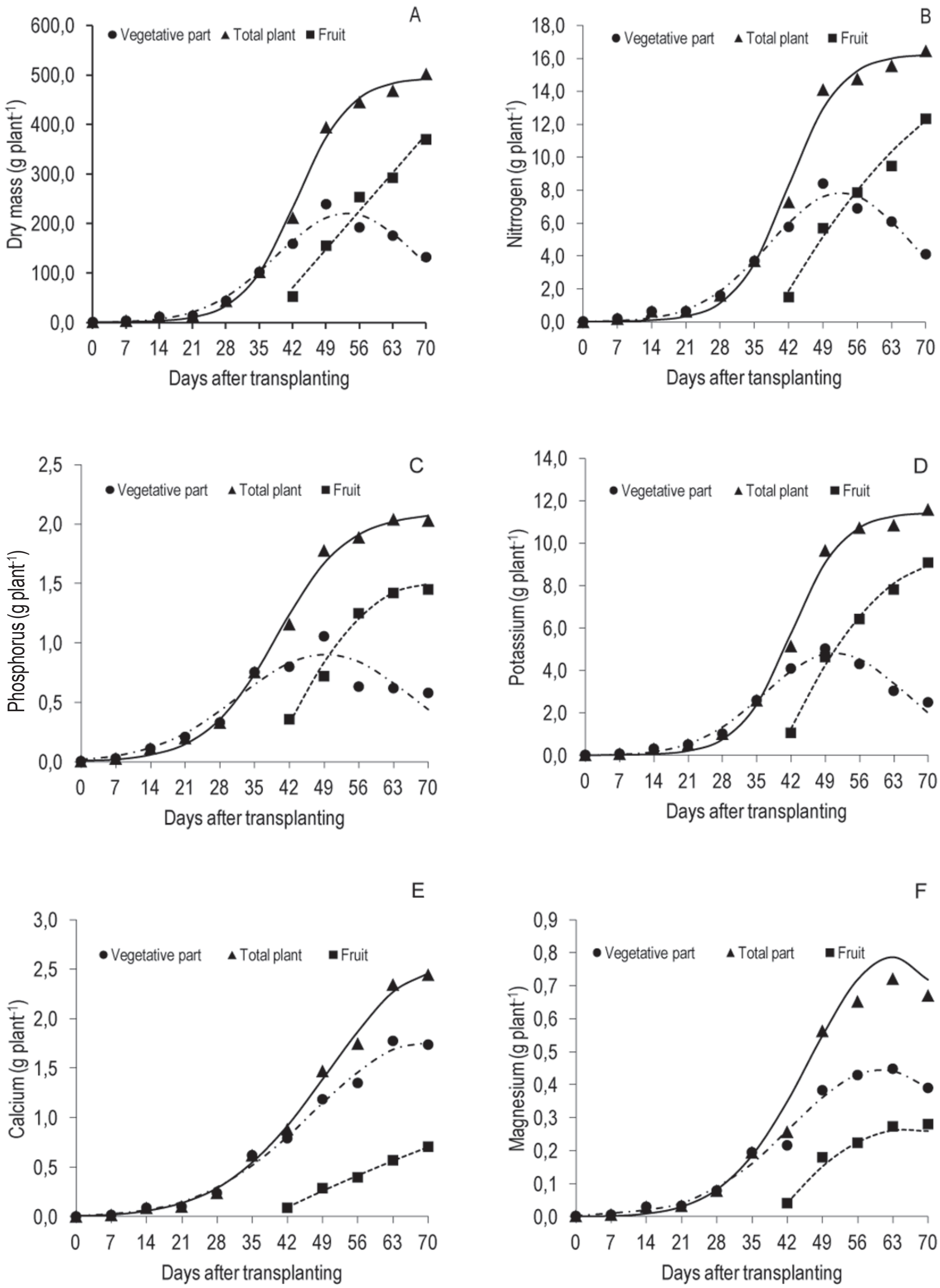


**Figure 1.** Accumulation of dry matter (A), nitrogen (B), phosphorus (C), potassium (D), calcium (E) and magnesium (F) in melon, hybrid Ibérico, a function of days after transplanting (DAT).

The third nutrient most absorbed by the plant, calcium, reached the maximum accumulation of 2.5 g $plant^{-1}$ (31.2 kg $ha^{-1}$) at 70 DAT, and the increased demand occurred in the period 42-56 DAT (Figure 1E, Table 2). Unlike it what was observed for the nutrients mentioned above, the vegetative part of the Ibérico hybrid accumulated a higher amount of calcium, accounting for 71.3 %, while fruits accounted for only 28.7 % of the cumulative total. The distribution pattern of calcium, preferably in the vegetative part, is a consequence of the same being translocated almost exclusively by the xylem and driven primarily by the transpiration stream. This pattern of Ca distribution is very common in fruit vegetables, in which it is observed a high concentration of Ca in the shoot, mainly in the leaves, which transpire much more than the fruits, such as tomatoes (Lucena et al., 2013) and watermelon (Serafim et al., 2015).

The magnesium (Mg) accumulation occurred by the end of the cycle, with a maximum estimated at 0.78 g $plant^{-1}$ (9.7 kg $ha^{-1}$) at 63 DAT. The period of greatest Mg accumulation was 35-56 DAT, that presented a rate of 0.02 g $plant^{-1}day^{-1}$, corresponding to 60.0% of the cumulative total (Figure 1F, Table 2). Similar to Ca, albeit in smaller quantities, Mg accumulated in greater amount in the vegetative parts of the plant (58 %) in detriment of fruits (42%). This is possibly due to the fact that Mg is part of the chlorophyll molecule. Depending on the Mg status of the plant, 6 to 25 % of magnesium is connected to the chlorophyll molecule, and 5 to 10 % is firmly connected to pectates, the cell wall or the vacuole as a soluble salt (Marschner, 2012).

#### Micronutrients

Iron was the micronutrient accumulated in greater quantity by the Ibérico hybrid, with an estimated total of 35.0 mg $plant^{-1}$, obtained at 70 DAT. This is equivalent to a detention 437.5 g $ha^{-1}$ of Fe. The vegetative part contributed 44.0 % and fruits 56.0 % of the cumulative total. The Fe accumulation rate was low in the first 28 DAT stepping

**Table 2.** Regression equations for the accumulations of dry mass and macronutrients in the vegetative part (PV), fruit (F) and in the total plant (TP), in melon, Ibérico hybrid.

| Characteristic | Equation | | $R^2$ | Maximum accumulation in the plant (g $plant^{-1}$) |
|---|---|---|---|---|
| Dyr mass | PV | $Y = 220.48exp\{-0.5[(X - 53.46)/14.90]^2\}$ | 0.96** | |
| | F | $Y = -392.87 + 11.03X$ | 0.97** | 491.38 |
| | TP | $Y = 495.26/\{1 + exp[- (X - 42.79)/5.62]\}$ | 0.99** | |
| Nitrogen | PV | $Y = 7.83exp\{-0.5[(X - 52.68)/14.52]^2\}$ | 0.97** | |
| | F | $Y = -27.10 + 0.88X - 0.0046X^2$ | 0.98** | 16.20 |
| | TP | $Y = 16.27/\{1 + exp[- (X - 41.88)/5.33]\}$ | 0.98** | |
| Phosphorus | PV | $Y = 0.90exp\{-0.5[(X - 49.24)/17.37]^2\}$ | 0.96** | |
| | F | $Y = -5.81 + 0.2087X - 0.00149X^2$ | 0.98** | 2.10 |
| | TP | $Y = 2.09/\{1 + exp[- (X - 39.29)/7.14]\}$ | 0.99** | |
| Potassium | PV | $Y = 4.82exp\{-0.5[(X – 51.02)/14.36]^2\}$ | 0.99** | |
| | F | $Y = -31.68 + 1.0892X – 0.00727X^2$ | 0.99** | 11.40 |
| | TP | $Y = 11.47/\{1 + exp[- (X – 42.01)/5.26]\}$ | 0.98** | |
| Calcium | PV | $Y = 1.76exp\{-0.5[(X – 69.26)/21.87]^2\}$ | 0.98** | |
| | F | $Y = -1.06 + 0.0312X – 0.0000857X^2$ | 0.99** | 2.50 |
| | TP | $Y = 2.47/\{1 + exp[- (X – 71.78)/21.19]\}$ | 0.98** | |
| Magnesium | PV | $Y = 0.45exp\{-0.5[(X – 60.83)/18.07]^2\}$ | 0.99** | |
| | F | $Y = -1.40 + 0.0503X – 0.00038X^2$ | 0.99** | 0.78 |
| | TP | $Y = 0.79/\{1 + exp[- (X – 62.99)/16.46]\}$ | 0.97** | |

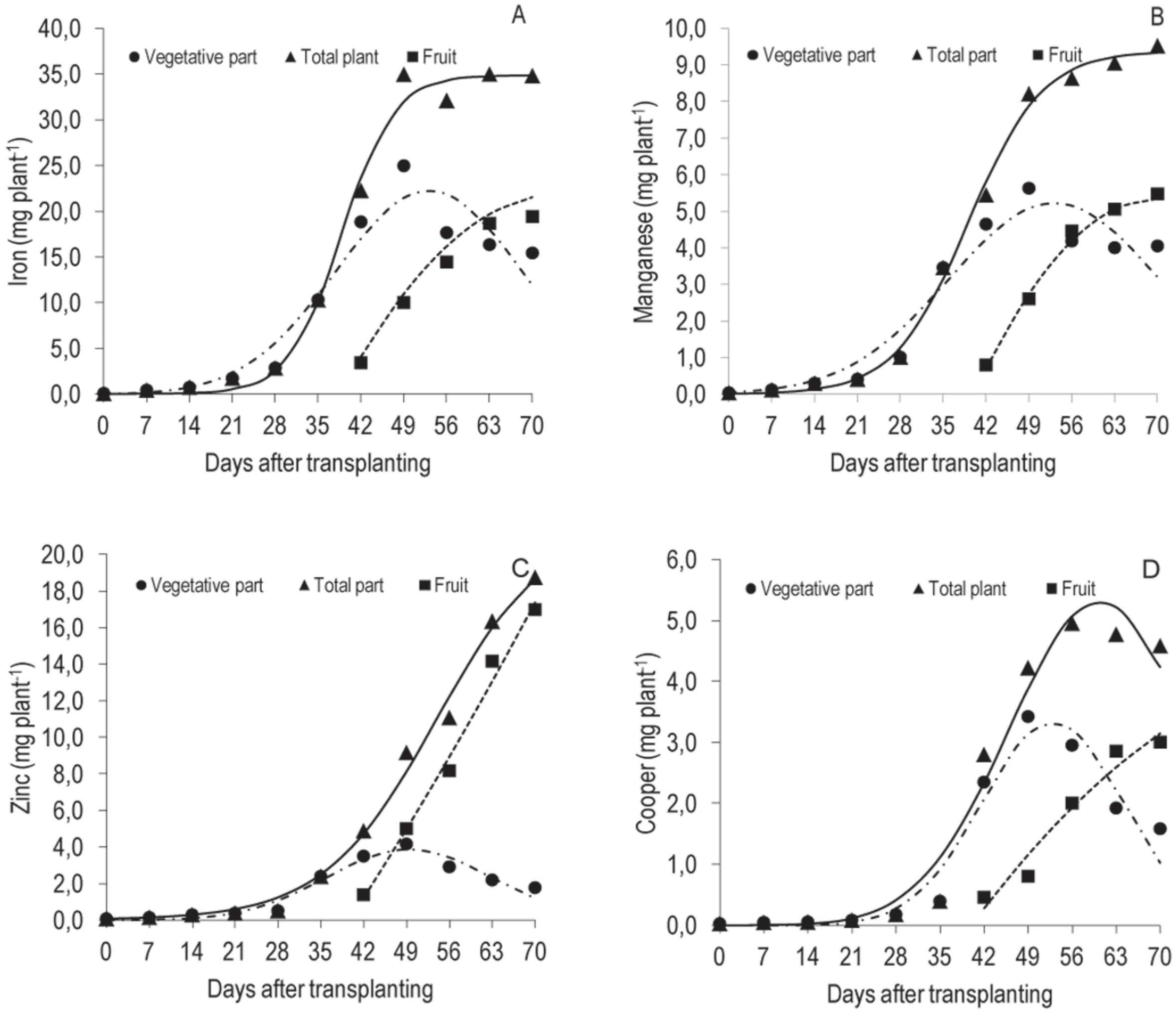


**Figure 2.** Accrual iron (A), manganese (B), zinc (C) and copper (D) in melon, Ibérico hybrid, a function of days after transplanting (DAT).

up then, peaking in the period from 35-42 DAT, when it was 1.93 mg plant $^{-1}$ day$^{-1}$ (Figure 2A, Table 3).

Manganese was the third most accumulated micronutrient for plants with a maximum obtained at 70 DAT (9.33 mg plant $^{-1}$), which is equivalent to a detention 116.62 g ha $^{-1}$ Mn. The total accumulated in the plant, 42.6 %, was allocated by the vegetative part, and 57.4 % for the fruits. The accumulation was growing until the end of the cycle, but the increased demand occurred in the period of 28-49 DAT when the accumulation rate was 0.31 mg plant $^{-1}$ day $^{-1}$ (Figure 2B, Table 3).

Zinc accumulation also increased by the end of the cycle, with a maximum of 18.7 mg plant $^{-1,}$ at 70 DAT, which is equivalent to a detention 233.7 g ha $^{-1}$ Zn. The total accumulated in the plant, 10.0 %, corresponded to the vegetative part, and 90.0 % to the fruits. The maximum accumulation rate was 0.54 mg plant $^{-1}$ day $^{-1}$ obtained in the period 42-63 DAT (Figure 2C, Table 3).

The maximum accumulation of copper was 5.30 mg plant $^{-1}$ (66.2 g ha $^{-1}$). The greatest demand was in the period of 35-56 DAT, whose average yield was 0.19 mg plant $^{-1}$ day $^{-1}$. The maximum copper accumulation was 5.30 mg plant -1 (66.2 g ha $^{-1}$). The highest demand was in the period of 35-56 DAT, whose average accumulation was 0.19 mg plant$^{-1}$ day$^{-1}$. At the end of the cycle, the vegetative part and the fruits contributed, respectively, 34.5 and 65.5% of the Cu accumulated by the plant (Figure 2D, Table 3).

**Table 3.** Regression equations for the accumulations of micronutrients in the vegetative part (PV), fruit (F) and in the total plant (TP) in melon, Ibérico hybrid.

| Characteristic | Equation | | $R^2$ | Maximum accumulation in the plant (mg plant$^{-1}$) |
|---|---|---|---|---|
| Iron | PV | $Y = 22.30exp\{-0.5[(X – 53.16)/15.13]^2\}$ | 0.96** | |
| | F | $Y = -72.16 + 2.5287X – 0.017X^2$ | 0.98** | 35.00 |
| | TP | $Y = 34.89/\{1 + exp[- (X – 38.86)/4.26]\}$ | 0.97** | |
| Manganese | PV | $Y = 5.24exp\{-0.5[(X – 53.20)/17.02]^2\}$ | 0.97** | |
| | F | $Y = -23.61 + 0.8266X – 0.0059X^2$ | 0.99** | 9.33 |
| | TP | $Y = 9.38/\{1 + exp[- (X – 39.16)/6.00]\}$ | 0.98** | |
| Zinc | PV | $Y = 3.87exp\{-0.5[(X – 49.41)/13.43]^2\}$ | 0.98** | |
| | F | $Y = -17.62 + 53.86X – 0.00181X^2$ | 0.99** | 18.70 |
| | TP | $Y = 21.90/\{1 + exp[- (X – 53.86)/9.18]\}$ | 0.98** | |
| Cooper | PV | $Y = 3.34exp\{-0.5[(X – 52.92)/11.16]^2\}$ | 0.97** | |
| | F | $Y = -7.20 + 0.2238X – 0.0010887X^2$ | 0.98** | 5.30 |
| | TP | $Y = 5.31/\{1 + exp[- (X – 60.37)/14.37]\}$ | 0.97** | |

At the end of the cycle, the quantities exported to the fruits were 152.87 kg ha $^{-1}$ of N; 18.62 kg ha $^{-1}$ of P; 111.75 kg ha $^{-1}$ K; 8.75 kg ha $^{-1}$ of Ca and 3.25 kg ha $^{-1}$ of Mg; 269.37 g ha $^{-1}$ of Fe; 216.87 g ha $^{-1}$ Zn; 66.75 g ha $^{-1}$ Mn and 39.37 g ha $^{-1}$ of Cu.

## Conclusions

The fruits were the preferred drain of the plant, corresponding to 73.7 % of the dry matter accumulated. The nitrogen, phosphorus, potassium, iron, manganese, zinc, and copper were accumulated preferentially in the fruit, while calcium and magnesium were accumulated mostly in the vegetative tissue.

The highest accumulation of dry mass and nutrients occurred from 35 to 49 days after transplanting, with the exception of calcium, magnesium, copper, and zinc that extended their accumulation until the cycle end.

The decreasing order of nutrient accumulation for the Ibérico hybrid melon was: N > K > Ca > P > Mg > Fe > Zn > Mn > Cu.

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