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Hybridizing Heliconias

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(Editor's Note: This work was done in New Zealand where the photoperiods are opposite to those of the northern hemisphere. Most of the species used in this breeding program tend to be responsive to short day lengths for flower initiation.)

Introduction

It is well known that heliconias are difficult to hybridize due to different possible factors, such as poor pollen quality or inhibition of pollen growth in the stigma, to name two. As commercial heliconia flower growers we were producing both *H. stricta* 'Dwarf Jamaican' (DJ) and *H. wagneriana* (W). We started to wonder whether it was possible to hybridize these two. We valued the colouration of *H. wagneriana*, and the size and long flowering season of 'Dwarf Jamaican'. Both species set seed easily by natural self pollination. Our goal was to obtain DJ-like plants with a high flower production, but in different colours. In New Zealand we have no pollinating birds or insects so any cross pollinating was sure to be our own work.

Heliconia wagnereiana was a pollen parent

H. stricta 'Dwarf Jamaican' (L) was the female parent. The red F_1 progeny ® is from the cross of 'Dwarf Jamaican x *H. wagneriana.*

Growing Environment In New Zealand

Plants were grown in heated polyhouses with temperatures roughly between 16 and 30°C, but preferably between 19 and 26°C. The humidity at night is about 90% and during the day time preferably higher than 70%, but during sunny and windy days it can drop to 50%. Plants are grown in free volcanic soil with an underneath sprinkler system. Light intensity, which is extremely high in NZ, is reduced by 70% from September to April.

Method

Pollination was done in early mornings, preferably at first light. We chose September and October when the photoperiod is between 11 and 13 hours. No emasculations were done before the flower opened, to prevent damage to the stigmas. The opening flowers were prodded with a knife in such a way that the stigma and anthers popped out from between the sepals. The next step was to remove the anthers with scissors or a knife. By now the stigma was already covered with its own pollen. The pollen was removed by simply lightly rubbing it from the stigma with a knife. Once cleaned, a good quantity of donor pollen was placed on the stigma by sliding a donor anther over the stigma. No covering up was done. The next morning the process was repeated with the next open flowers.

Discussion

The whole process of cleaning the stigma after natural self pollination contamination had already occurred sounds quite messy, but it was done that way on purpose. Many have tried emasculation before the flowers opened (preventing pollen contamination) and have not been successful. What if, by allowing its own pollen to first interact with the stigma before removing it, the flower's own pollen starts a process that changes the stigma's receptiveness? Perhaps when its own pollen is removed from the stigma before it's able to finish the task of delivering, the stigma will still allow other donor pollen to slip in.

In nature hummingbirds bring in pollen from other plants to pollinate flowers. The question is, is it the fact that the pollen brought in is from a distant source that pollinates the flower? Or is it simply the rubbing of the birds beak that opens up the stigma? If that's the case, being a bit rough when cleaning the stigma might be beneficial.

These thoughts may or may not be the reasons for our results. In any case, the method we are using is working so we can live with the "messiness." It is noteworthy that after a hot day, it was not possible to find any good pollen, as it had all turned blackish. We also observed that plants not in the right nutritional status (e.g. high nitrogen) often fail to set seed.

Young Plants

After eight weeks fruits were harvested and directly planted, untreated, in a mix of peat and potting mix. The earliest seedlings came up after 3 months, but some took up to 9 months, at which point there is a 25% germination rate. Young plants take at least 9 months to flower (with the exception of one seedling which flowered after five months at only 20cm tall).

A pinkish *H. wagneriana* type produced by selfing the F_1

First Success

The first hybridization we tried was DJ × W. We selected one DJ inflorescence, which we pollinated over about 3 weeks using donor pollen from *H. wagneriana* until we had treated 20 flowers. From this lot we collected 5 fruits which produced 2 seedlings after 9 months. Very small beginnings! With the second leaf of one of the F_1 seedlings, it was already obvious that something special had happened.

The Purpose of HSI

The purpose of HSI is to increase the enjoyment and understanding of *Heliconia* (Heliconiaceae) and related plants (in the families Cannaceae, Costaceae, Lowiaceae, Marantaceae, Musaceae, Strelitziaceae, and Zingiberaceae) of the order Zingerberales through education, research and communication. Interest in Zingiberales and information on the cultivation and botany of these plants is rapidly increasing. HSI will centralize this information and distribute it to members.

The **HELICONIA SOCIETY INTERNATIONAL**, a nonprofit corporation, was formed in 1985 because of rapidly developing interest around the world in these plants and their close relatives. We are composed of dues-paying members. Our officers and all participants are volunteers. Everyone is welcome to join and participate. HSI conducts a Biennial Meeting and International Conference.

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The colouring of the midrib was a deep maroon, something we don't see with DJ before the 6th leaf. We still had to wait until flowering to determine whether it was more than just a random mutation within *H. stricta.* This F_1 inflorescence appeared to be a real mix between DJ (red bract colour, slightly white-tipped flowers) and W (inflorescence shape, number of flowers per bract). The other seedling turned out to be a normal DJ.

From a breeders point of view, not all F_1 hybrids are useful. The aim is to obtain a F_1 that is self pollinating and carries a wide range of genetic diversity in its genetics. The F_1 of the DJ×W is a real treasure because it can self pollinate, producing an F_2 generation with diversity in size and flower colouration. One of the F_2 progeny of this selfing we named 'Pacific Fire' and the other 'Pacific Rainbow.'

the 'Dwarf Jamaican' but a lot smaller than the Wagneriana and have a lot longer flowering season. When choosing the preferred varieties for commercial production we did not just look at the coloring but had to also keep into account which plant had the most productive flowering season.

Apart from our hybridization project, we have produced hundreds of seedlings of both *H. wagneriana* and 'Dwarf Jamaican' via self-pollination without any variation from the mother plant. Because DJ and W are both strong self pollinators in nature and produce homogeneous progeny, we are pretty confident that all F_1 hybrid plants produced from DJ×W will look the same as each other. For us there was no use to repeat this one, so we went to the next challenge.

A *H. wagneriana* pattern plant from the selfed F_1.

A *H. wagneriana* pattern plant from the selfed F_1 named 'Pacific Rainbow'

We self pollinated both the 'Pacific Fire' and the 'Pacific Rainbow.' The plants produced by 'Pacific Fire' were all very similar to the parent. The plants produced by 'Pacific Rainbow' all had the Wagneriana patterned inflorescences but had a range of colors, white/red, yellow/red, and white/ yellow/red; none of these we considered to be an improvement of the parent. Both varieties are bigger than

F_1 Hybrid production from crosses with 'Dwarf Jamaican'

For our next experiment we had to introduce plant material from Thailand to NZ, which was a slow and costly process. We now had to work with *H. stricta* plant material of new cultivars ('Dorado Gold,' 'Iris,' and 'Sharonii'),

Interspecific hybrids between *H. stricta* 'Dwarf Jamaican' and *H. wagneriana*

H. stricta 'Dwarf Jamaican' (P1) X *H. wagneriana* (P2)
AA (red) **aa** (typical *H. wagneriana pattern)*

Aa (F_1)
(red flower)

AA (F_2)
'Pacific Red'
(strong red)

Aa **Aa**
(----Red shades ----)

aa (F_2)
'Pacific Rainbow'
(*H. wagneriana* pattern)

AA X AA (F_3)
Self-pollinating 'Pacific Fire'
Only produces red flowers

aa X aa (F_3)
Self-pollinating 'Pacific Rainbow'
Only produces *H. wagneriana* pattern

and they didn't produce seed by self pollination. So we didn't know whether they were genetically hetero- or homogeneous.

We made the following cross pollinations using DJ as the mother:
DJ × 'Dorado Gold'. This cross produced 10 seedlings, 5 normal DJ and 5 identical hybrids.
DJ × 'Iris'. Produced 20 seedlings, 4 hybrids all with different characteristics. The rest were all DJ.
DJ × 'Sharonii'. Produced 4 seedlings, all hybrids with different phenotypes.
No further work has been done with the F_1s of DJ × 'Iris' and DJ × 'Sharonii' because more red heliconias weren't beneficial for us.

In the hybrids of DJ × W and DJ × 'Dorado Gold' (DG), the flower pattern of the pollen donor plants (W, DG) got lost in the F_1. In the F_2 the pattern comes back in roughly 25% of the plants, but can have different colours and shades. The remaining 75% of the F3 DJ × W gives red in different shades. The remaining 75% of DJ × DG gives shades of reds and orange.

We also had a try with *H. orthotricha* 'She'. DJ × 'She'. Produced 3 hybrids, all with the same phenotype. The F_1 of DJ × 'She' proved to be a good flower producer with 'She'-like flowers without the hairs and smaller plant size than the original 'She' variety.

Pollinations that failed to produce any hybrids were DJ × *H. caribaea* 'Gold' and DJ × *H. champneiana* 'Splash'.

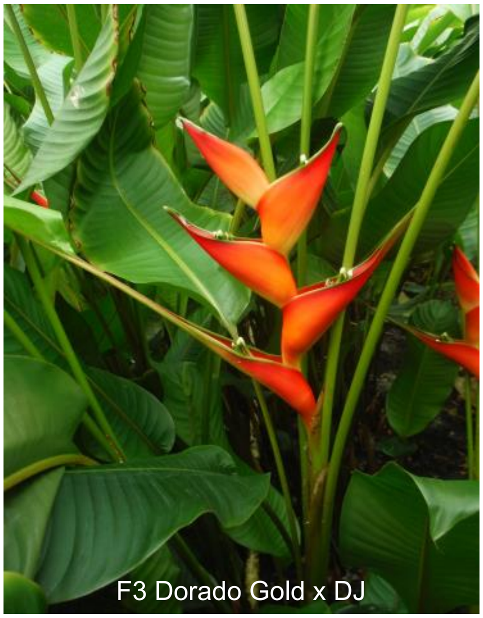
Multi-species hybrid production
'Pacific Fire' (DJ × W) ×' She'. Produced 8 hybrids, all with red shades and a dark band on the upper edge of the bracts. There is some pubescence on the flower but barely detectable.

A 'Dwarf Jamaican' type plant from the selfed F_1 named 'Pacific Fire'


DJ x *H. orthotricha*


Dorado Gold x DJ


F2 Dorado Gold x DJ


F3 Dorado Gold x DJ


F4 Dorado Gold x DJ


F4 Dorado Gold x DJ


F4 Dorado Gold x DJ


F4 Dorado Gold x DJ


F4 Dorado Gold x DJ

Striking Gold
DJ × 'Dorado Gold' produced a plant with a DG shaped inflorescence, mainly orange cheeks with a yellow keel. This F_1 hybrid didn't self pollinate so in the next season we made the self-pollination by hand. This cost us a full season delay to discover what the F_2 looked like. The colour range in F_2 is wide and stunning. But most of the plants were still too big or had a short flower season. The most gold-coloured one was used to create a F_3 by back-crossing with DJ. The inflorescence of the F_3 looked quite similar to the F_1 but the plant and flower size are much more DJ-like. This F_3 produced a F_4 generation, again with a wide range of colour but also with the right plant size and long flowering season. From this F_4 group we will try to select new varieties suitable for cut flower production.

Future Goals
Our future goal is to hybridize heliconias, creating additional dwarf varieties more suitable for the cut flower and pot plant industry, and for gardeners.

In our hybridization work we have had to destroy many different plants because of lack of space and money. Also, there is a risk that by some disaster (e.g. heater failure during a severe frost) all our plants could be lost, and so many years of waiting and work are undone.

We want to continue and expand our work, but we need one or more collaborators to make the project viable. We invite any interested heliconia enthusiasts, research institutes or businesses to contact us and get involved in advancing this project.

Rare three species hybrid
(*H.stricta* 'DJ' x *H. wagneriana*) x *H. orthotricha*

2015 Travels in Ever-Surprising Colombia

Bruce Dunstan

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This August saw me back in Colombia with good friends Carla Black and Angel Rodriguez, once again looking for heliconias in habitat. Our previous trips were focused on the Cordillera Occidental or Western Range, crossing to the wet Pacific slope via four roads north of Cali. But now we were running out of new options for accessing the biodiversity gold mine of the western-most Andean slopes.

So we tried to get into Las Orquideas National Park, outside of Urrao, but as in 2012, when my guide called it the "homeland of the FARC," the parks authority limits access for security reasons. This was our first and last encounter with security issues on the whole trip – things really are better than just four years ago.

So instead, we chose a route a bit farther north that crosses the range and gets into the lowlands of the Rio Atrato basin. This area was recommended by a bromeliad associate who had visited recently, with the caveat that the forest was being chopped and was pretty patchy. But that was good enough, so onwards we drove, heading northwest to the town of Frontino. As we made our way along the rather busy road that joins Medellín to the Caribbean port of Turbo we spied a big red pendent growing at high elevation. Our first thought was either *H. griggsiana* or *H. combinata.*

Heliconia hybrid *H. griggsiana* and maybe *H fernadezii* growing along the main road from Medellin to Turbo

We examined what may be another hybrid of these two species although it looks quite different to what we saw in other locations in 2012 and 2014. Maybe there was *H. fernandezii* in its genetic make-up, as the type locality of that species is not far away. To find something so different, and so early in the trip, was very encouraging.

The route towards Frontino goes through lots of cleared areas, but we saw heliconias in the patches of forest along the creeks. We found a very attractive form of *H. trichocarpa* with bright red glabrous bracts. A little further up the

H. huilensis growing between Frontino and Nutibara, Antioquia (Knife length is 17 cm)

I thought I was looking at a mummified inflorescence that had stopped maturing, but closer inspection showed open flowers on an even older inflorescence. Excitedly we cut the inflos and took them out onto the road for a closer look at this strange new discovery. Flippantly I said to Carla, "It's just another *H. huilensis.* " That's our running joke in Colombia - *H. huilensis* has a very wide range, and I have seen variations from glabrous in the northern slope of the central range, to black hairs in the central western range, to brown arachnoid indument on the western slope of the central range. Around the dinner table that evening, a closer comparison of images of the flowers and staminodes showed that we were very likely looking at another variation within *H huilensis* ! I'll document these variations in a future article.

After these discoveries we made our way into the small town of Nutibara for a well-deserved meal in the only restaurant serving lunch. Once satisfied and comfortable, we asked about accommodation and news of the road to the lowlands and the town of Murri. Nutibara is well off the beaten track for tourists so the fact we were in town and wanting to stay was a bit of a novelty for the locals. After some group discussion, accommodation was found for $3 a night including wifi and breakfast.

Full of hope and bravado we set off in the afternoon to see what the road was like and whether our little 2WD car could manage. But just half an hour along we came face to face with a pickup truck loaded in lulo (*Solanum quitoense*) that had part of its front suspension sheared off, resulting in the truck occupying the entire narrow road and going nowhere for the foreseeable future. Leaving our car squeezed to one side, we walked up the road for a couple of kilometres admiring the view. But the route had long been cleared and was being farmed. We also found that our street car was not going to negotiate the ruts and rocks in the road.

So, back to town for more planning and logistics. The entire hostel family plus all the people coming and going for meals got in on the transportation discussion – and took advantage to grill the tourists on the minutiae of life outside of Nutibara. I might add I am the tall silent type as my Spanish is limited to that of a mute, although I can get the bare minimum of food and basics when pressed into action. Thankfully Angel and Carla happily chatted away with our local friends, who in the end suggested we use the services of Don Darío, a local driver of note with a very well-used 2-door Lada 4WD from the early 80s. Don Darío was summonsed and negotiations began on how much it would cost, how long it would take, how much petrol was required and whether he would go back to Frontino to fuel up so we could avoid paying the high price in Nutibara where there was no petrol station. We made it abundantly clear how we would need to stop regularly to run into the forest. It turned out that this last bit was something the Don struggled with.

Cresting the range between Frontino and Murri we entered the cloud forest

The next morning we set off, albeit a little late, not quite an hour after our agreed departure, as Don Darío may have had a big night the night before? I noticed a fevered sweat on his brow that was wiped away regularly with the traditional lightweight poncho sported by all real rural Colombian gentlemen. As we made our way up to the ridge the moisture in the air increased to the point we were driving through clouds and seeing nice diversity in bromeliads and other cloud forest plants. The first heliconia we saw stopped the Lada very quickly. It was beautiful, with velvety dark green leaf tops and royal purple reverse. We speculated about ID until thankfully we found a *H. burleana* bud. Slightly further down the hill was the common high elevation species *H. combinata.* Next stop was just as quick: a very attractive red and yellow variant of *Heliconia pogonantha*. This plant was quite different to the four currently described varieties and highlights the polymorphism in some *Heliconia* species.

H. pogonantha, between Frontino and Murii, Antioquia

The next species we came across was quite a surprise. Another red pendent that appears to be *Heliconia fredberryana* , described from way south in Ecuador but it does get a mention in the Colombian heliconia book as being endemic to the area bordering with Ecuador. We also found a philodendron, *P. fibrosum* , known only from much farther south, which just goes to prove that more people out looking are helping to extend some species' known ranges. Also growing in this elevation was *H. signa-hispanica* happily blooming, and a pink-flowered form of *H. cordata.* As we descended the slope I was captivated by the range of

H. cf. f*redberryana* growing between Frontino and Murii, Antioquia

anthuriums including what I thought was *A. warocqueanum* and *A. veitchii*. I have since been told I was mistaken on that first one. Oh well, with more than 1000 *Anthurium* species, and more added regularly, there is no chance of me keeping track of all of them. I'll just stick to taking photographs.

We eventually made it to Murri for our pre-packed lunch wrapped in *Calathea lutea* leaves: a cheap, eco-friendly way to package take-away lunches. Mine was still warm from sitting on the Lada's transmission case throughout the trip.

The town of Murri was full of people as the health department were in town running workshops on neo natal health, so we saw plenty of young babies and young mothers all wearing practical, yet fashionable, rubber boots. We made a half-hearted attempt to walk to a patch of lowland forest but the heat of the lowlands and the big lunch made it too much of a task. My bromeliad friend had walked three hours to get to primary forest, he tells me. That hike was not for us, especially after all the amazing things we had seen on the way down the slope. Besides, we had to get back to Nutibara before dark.

After our abbreviated post-lunch walk it was back into the Lada to have another look as we travelled back up the hill.

Anthurium sp. aff. *warocqueanum* growing between Frontino and Murri, Antioquia

A. veitchii growing between Frontino and Murri, Antioquia

It's amazing what a different viewpoint can show: what I quickly ID'd on the way down as 'Geraldesii' (a red necrotic pendent with fine hairs) actually turned out to be another necrotic red pendent but actually with glabrous bracts – a species I've never seen in images or in real life. Another Colombian red pendent heliconia to add to the list of possible new species!

I spotted additional bromeliads on the way up, including *Guzmania triangularis* and a new *Mezobromelia* , as well as the black-flowered *Anthurium atramentarium* , well-known to the towns-people, who made sure we looked for it along the route. So once again we found the diversity of the Cordillera Occidental awe-inspiring. Don Dario's Lada began to behave badly on the long steep hill, and eventually we were convinced the clutch was overheating and going out. We suggested we would walk while he let it cool down, but 15 minutes later the Don was back behind us smiling and saying he had solved a carburettor fuel problem. Thankfully it rattled its way back up and over the hill into Nutibara in the late afternoon.

Our trip was off to a very good start. But this was all we could do in the Cordillera Occidental. It was time to head east to Santander. To be continued...

Red pendent species with necrotic bract margins between Frontino and Murri, Antioquia

Macronutrient Deficiencies in *Heliconia psittacorum* x *Heliconia spathocircinata* 'Golden Torch'

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Introduction

Nutritional deficiency affects heliconia cut flower production and the success of its commercialization. Relative to other floricultural crops, heliconia in cultivation generally requires high rates of macro-elements, particularly N. There is a great variation in heliconia management in farm production, mainly concerning fertilization.

Appropriate fertilization programs must be used in commercial cut flower production, in order to guarantee productivity, quality and post-harvest durability of the floral stem. The scarcity of a nutrient can cause visible abnormalities, which are characteristic to each element. Nevertheless, many times growth and production can be already affected before visual deficiency symptoms apppear.

The objective of this study was to characterize nutritional deficiencies in plants of *Heliconia psittacorum* x *H. spathocircinata* 'Golden Torch', through growth indicators, symptomatology and macronutrient contents in leaves and underground plant parts.

Material and Methods

Rhizomes from *Heliconia psittacorum* x *H. spathocircinata* 'Golden Torch' were used, selected with 30cm long and approximately 120g of fresh mass. Previously, the macronutrient contents were determined in 10 rhizomes possessing fresh mass, size and source similar to the used in the experiment. The rhizomes presented the following average macronutrient concentrations (g·Kg –1 fresh mass): N (18.22), P (2.66), K (23.76), Ca (3.70), Mg (1.09) and S (9.96). A completely randomized experimental design was used, with 10 replications, being 5 replications randomly collected for the analyzed development stage (reproductive), and the experimental unit was one rhizome per pot.

Results and Discussion

The visible symptoms of different macronutrients were essentially similar to those available in the literature. In the experimental conditions of this work, visual nutrient deficiency symptoms (Figure 1) appeared in the following occurrence order: N, Mg, K, P and S. More drastic nutritional deficiency symptoms are do to a longer time growing under nutrient omission conditions.

Figure 1. Leaves of *Heliconia psittacorum* x *Heliconia spathocircinata* 'Golden Torch' plants cultivated under complete nutrition solution, with omission of N, P, K, Ca, Mg or S and macronutrients absent (water), at 150 days.

The growth indicators were different between treatments (Table 1), and the plants cultivated in solution with omission of at least one macronutrient presented distinct concentration from those cultivated in complete nutrition solution. Surprisingly, dry matter yields and nutrient concentrations in plants were not decreased significantly in all treatments (Table 2).

Table 1. Average shoot number, dry mass production of leaves and underground plant part (g/plant), leaf total number and leaf area (cm-^{2}) of *Heliconia psittacorum* x *H. spathocircinata* Golden Torch, cultivated in complete solution, with N, P, K, Ca or Mg omission and macronutrients absence (water).

Treatment	Nº of shoots	Leaves dry mass (g)	Underground part dry mass (g)	Nº of leaves	Foliar area (cm^2)
Complete	9.40 a	83.62 ab	64.51 ab	31.60 d	299.10 d
- N	3.80 b	28.72 cd	31.92 bc	20.60 e	217.50 g
- P	4.00 b	33.18 bcd	51.55 abc	20.20 e	256.20 e
- K	10.60 a	77.79 abc	81.85 a	36.00 c	244.30 f
- Ca	8.60 a	107.46 a	66.22 ab	39.20 b	310.10 c
- Mg	9.40 a	85.62 ab	58.43 abc	37.40 bc	388.20 a
- S	10.80 a	113.46 a	69.65 ab	44.00 a	323.30 b
Water	2.20 b	8.06 d	19.73 c	9.20 f	115.50 h
CV%	27.12	32.26	35.00	26.42	14.68

* Means followed by the same capital letter in the column and small letter in the line did not differ by Tukey Test (P<0,05).

Table 2. Mean values for each nutrient extracted from heliconias, in g Kg-^{1} of dry mass, in the flowering phases, for each part of the plant (leaf and underground part), cultivated in complete solution, with N, P, K, Ca, Mg or S omission and macronutrients absence (water).

Nutrient	N	P	K	Ca	Mg	S
			leaf			
Complete	24.4 a	1.3 ab	12.9 bc	5.2 cd	1.0 c	4.6 cd
- N	5.2 c	3.6 a	22.0 a	4.8 d	2.4 bc	4.2 d
- P	20.3 b	0.5 cd	15.2 abc	7.1 bc	1.6 c	6.9 ab
- K	25.6 a	1.5 bc	3.6 d	11.7 a	5.3 a	3.9 d
- Ca	26.1 a	1.4 bcd	15.0 abc	0.8 e	1.2 c	7.7 a
- Mg	25.0 a	1.3 bcd	16.6 ab	7.3 b	0.6 c	5.9 bc
- S	24.1 a	2.0 b	8.5 bcd	9.8 a	4.7 ab	1.0 e
Water	7.4 c	0.3 d	7.7 cd	5.9 cd	2.6 bc	2.1 e
			underground part			
Complete	14.6 a	5.2 ab	83.6 a	3.5 bc	3.7 bc	3.6 b
- N	4.7 c	5.8 a	80.1 a	3.0 cd	3.1 bc	2.3 bc
- P	10.5 b	1.5 d	55.0 c	5.5 ab	2.9 bc	1.7 cd
- K	15.1 a	3.4 c	0.8 f	5.5 ab	13.4 a	2.7 bc
- Ca	12.3 b	5.0 ab	64.5 b	1.3 d	1.2 c	7.0 a
- Mg	11.9 b	3.2 c	77.9 a	5.7 a	1.5 c	3.4 b
- S	11.7 b	4.5 b	41.6 d	4.7 abc	12.1 a	0.7 d
Water	3.7 c	2.4 cd	12.0 e	3.3 cd	5.3 b	1.4 cd

* Means followed by the same letter in the column and small letter in the line did not differ by Tukey Test (P<0,05).

Plants with N-deficiency presented generalized chlorosis, starting in the older leaves, which gradually had changed color from green to pale-green (Figure 1). Chlorosis is associated to a reduction on chlorophyll contents and Rubisco activity, that causes low photosynthesis rates (Hermans et al., 2006). When supply is insufficient, the N of old leaves is translocated to new leaves, due to its high mobility in the phloem (Marschner, 2012).

Nitrogen was the nutrient that most limited plant growth. N-deficiency generally inhibits plant growth; causes chlorosis in leaves, especially in older leaves; reduces leaf and shoot production; decreases leaf area (Lawlor, 2002); and, consequently, the leaf surface for light absorption for photosynthesis (Hermans et al., 2006). Reduction of nearly 60% in the number of emitted shoots, 66% in the average leaf dry mass production, 50% in the underground dry mass, 35% in leaf number and 27% in leaf area were observed, when compared to similar growth indicators of the complete treatment (Table 1).

In plants with P-deficiency, visual symptoms were not well defined, chlorosis being observed (Figure 1). It's important to note that visual symptoms are not always present. Besides that, under P-omission conditions reductions were found on shooting, leaf number and leaf area, when compared to plants treated with complete solution (Table 1). The inhibition of leaf expansion and shooting reduction is a direct effect of P-deficiency by the restriction on cell expansion and decreased root elongation (POTTERS et al., 2007).

Plants with K deficiency presented dark-green color in all the leaves with apical necrosis in the older and leaves with more evident leaf veins, resembling a chartaceous texture. Decreases in shooting and dry mass production of leaves and underground plant part were not observed. An increase in leaf number occurred, when compared to plants treated with complete solution, but this is not necessarily beneficial to plant once a reduction in leaf area occurred (Table 1). Plants cultivated under K omission conditions presented increased Mg and Ca contents in leaves, in the reproductive phase, when compared to the complete treatment. In the underground plant part, only Mg increase occurred, in both phenological phases (Table 2).

Plants cultivated under Ca omission conditions did not present visible symptoms (Figure 1). The omission of this nutrient in some plants does not initially reveal any visible nutritional deficiency symptom in the plant (Castro et al., 2007). The low Ca concentration in the plant tissues can not cause symptoms until that certain phase or physiological condition starts metabolic processes that expresses the deficiency. In plants cultivated with Ca omission, no significant decrease occurred neither in shoot production, nor in dry mass production of leaves and underground parts, when compared to plants treated with complete solution (Table 1). Leaf number and leaf area were higher when compared to the treatment with complete solution. Lack of Ca affects growth points in plants, according to Maschner (2012), but the requirement for Ca for growth is lower in monocotyledons than in dicotyledons species.

The treatment with Ca omission caused decreases in N and K and increase in S contents, in leaves, in both analyzed phases. In the underground plant part, decrease in N, P and Mg and increase in S occurred, in the vegetative phase. In the reproductive phase, reduction in N and K and increase in S occurred (Table 2).

Under Mg omission in the nutrient solution, plants presented marginal chlorosis in the older leaves and necrosis in the leaf blade borders and in the leaf apex (Figure 1). These symptoms are identical to the reported by Broschat (1992), who described deficiency symptomatology in species from Zingiberales order, including heliconias. Although plants with Mg deficiency showed very evident visual symptoms, there were no significant differences in shooting and dry mass production of leaves and underground plant parts, in regard to plants treated with complete solution. Leaf number and leaf area were higher than the plants treated with complete solution (Table 1).

The Mg content in plants under complete treatment did not present differences when compared to treatments with Mg omission (Table 2). This fact suggests that rhizomes export sufficient Mg to supply plant until the beginning of flowering. Besides the Mg contained in rhizomes is enough to supply plants until the beginning of the reproductive phase. In the treatment with Mg absent, the Ca content increased in leaves and in underground parts, characterizing the competitive inhibition effect. Plants from Mg omission treatment also presented increased N and K contents in leaves in the vegetative phase. In the underground plant part, a decrease in P content occurred in the vegetative phase. In the reproductive phase, decrease in N and P occurred (Table 2).

Plants cultivated under S omission presented a uniform chlorosis in younger leaves (Figure 1). This is due to the fact that S is not easily carried from the older to the younger leaves. However, shoot production and leaf and root dry mass production were no different from plants treated with complete solution. On the other hand, these plants presented higher leaf numbers and leaf areas than plants treated with complete solution (Table 1).

In this experiment the heliconias had the benefit of nutrient inputs from the starting rhizomes. Heliconias are plants that grow very rapidly and have in their rhizomes a great amount of carbohydrates and transfer a great percentage of biomass from the underground parts into the leaves (Castro et al., 2011).

Plants cultivated under S omission presented increases in N and decreases in K contents, in leaves in the vegetative phase, while in the reproductive phase increases in Ca and

Mg contents occurred. In the underground plant parts, reduction in P and K and increase in Mg contents occurred in the vegetative phase. In the reproductive phase, N and K decrease and Mg increase were observed (Table 2).

Heliconias submitted to nutritional stress may present growth indicators, macronutrient concentrations and initial production of flowers similar to a plant with proper nutrition, but decrease productivity throughout the development and impair the postharvest longevity of inflorescences (Castro et al., 2007).

Conclusions

1. Macronutrient omission, except Ca, causes changes that are translated as visible symptoms of nutritional deficiency to each nutrient.
2. Among the macronutrients, N and P deficiencies affect more intensely shoot number, leaf dry mass production, total leaf number and leaf area.
3. More evident symptoms of nutritional deficiency require a longer time growing under nutrient omission conditions because of the amount of nutrients from rhizome.

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Report from 20th Brazilian Congress of Floriculture and Ornamental Plants

Dr. Vivian Loges vloges@yahoo.com

The 20th Brazilian Floricultural and Ornamental Plants Congress (20º CBFPO) was organized by Dr. Carlos Eduardo Ferreira de Castro and Dr. Charleston Gonçalves (Figure 1), under the auspices of the Instituto Agronomico de Campinas (IAC) and the Brazilian Society of Floriculture and Ornamental Plants (SBFPO). It was held in the Escola Superior Luiz de Queiroz (ESLQ) September 7-11, 2015 in Piracicaba, São Paulo state, simultaneously with the 7th Brazilian Plant Tissue Culture Congress (7º CBCTP).

Dr. Charleston Gonçalves and Dr. Carlos Eduardo Ferreira de Castro

The symposium was attended by more than 520 participants from all the Brazilian states, with 24 oral reports and 470 poster presentations. Lectures were delivered by leading Brazilian scientists working on the methodology of ornamental plant breeding and production, focused mainly native plants. The improvement of Brazilian floriculture by graduate and post graduate students, professors, universities, governmental administration and research institutions was discussed.

Carla with the 2016 conference committee

Norberto Maciel and Carla Black

Carla Black and Norberto Maciel (Figure 2), from the Heliconia Society International were invited to present their work with tropical plants from the Zingiberales order. New cultivars of *Etlingera elatior* 'Prumirim', 'Itamambuca', 'Camburi' and 'Cacheffo' and *Zingiber spectabile* 'Suanno' were introduced to the public (Figure 3). More than 20 research projects with Zingiberales species were presented during the meeting: *H. psittacorum x H. spathocircinata* productivity in different levels of shade and nutrient contents; *Etlingera elatior* planting space and levels of shade; temperatures, harvest points, use of hormones and carnauba wax (*Copernicia prunifera*) in post-harvest treatments of *Etlingera elatior, Zingiber spectabile* and *Z. zerumbet* inflorescences; use of hormones in *Cheilocostus speciosus* propagation; and different substrates and nutritional solutions in *Zingiber spectabile, Etlingera elatior* and *Heliconia bihai* rhizome propagation.

Complete oral reports and posters can be seen at http://www.cbfpo.net.br/cd/resumos-por-area.html. You can also enjoy the journal Advances in Ornamental Horticulture and Landscaping from our Brazilian Society of Floriculture and Ornamental Plants (http://www.sbfpo.com.br/site/)

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