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Different nitrogen and boron levels influence the grain production and oil content of a sunflower cultivar

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ABSTRACT. Nitrogen is essential for plant growth and development and directly influences both grain production and oil content. Boron has been studied in sunflower cultivation due to high demand of this culture for this nutrient. This study aimed to evaluate the N and B differential supply effect on the grain and oil production of sunflower plants. The experiment was conducted in a greenhouse and used two sunflower hybrids: BRS 321 and Neon. N and B were applied via nutritive solution according to the following treatments: B + 50 N (2.49 kg ha^{-1} B and 10 kg ha^{-1} N at planting and 40 kg ha^{-1} B as additional fertilization); B + 10 N (2.49 kg ha^{-1} B and 10 kg ha^{-1} N at planting); 50 N (0 B and 10 kg ha^{-1} N at planting and 40 kg ha^{-1} N as additional fertilization) and 10 N (0 B and 10 kg ha^{-1} N at planting). Analyses of total N and B in all collected plant parts were performed, as well as measurements of grain production for each chapter and oil extraction at the end of the cycle. The association between B fertilization and a greater amount of N fertilization was essential to BRS 321 oil production. Regarding grain production at lower levels of N fertilization, Neon presented the best response to B application.

Keywords: *Helianthus annuus* L., oilseed, total N, oil extraction.

Diferentes níveis de Nitrogênio e Boro influenciam a produção de grãos e óleo em cultivares de girassol

RESUMO. O nitrogênio é essencial para o crescimento e desenvolvimento das plantas e tem influência direta na produção de grãos e conteúdo de óleo. O boro tem sido bastante estudado no cultivo de girassol, devido a alta exigência desta cultura por este nutriente. Este trabalho teve por objetivo avaliar o efeito de nitrogênio e boro na produção de grãos e óleo em plantas de girassol. O experimento foi conduzido em casa de vegetação utilizando-se dois híbridos: BRS 321 e Neon. N e B foram aplicados em solução nutritiva: B + 50 N (2,49 kg de B ha^{-1} e 10 kg de N ha^{-1} no plantio e 40 kg de N ha^{-1} suplementar); B + 10 N (2,49 kg de B ha^{-1} e 10 kg de N ha^{-1} no plantio); 50 N (sem B e 10 kg de N ha^{-1} no plantio e 40 kg de N ha^{-1} suplementar); 10 N (sem B e 10 kg de N ha^{-1} no plantio). Ao final do ciclo foi analisado os teores de N e B total em todas as partes das plantas, produção de grãos por capítulo e teor de óleo. A combinação entre o fornecimento de B com a maior adubação nitrogenada foi essencial para a produção de óleo pelo híbrido BRS 321. Em relação à produção de grãos com menor adubação nitrogenada Neon apresentou a melhor resposta à aplicação B.

Palavras-chave: *Helianthus annuus* L, oleaginosa, N-total, extração de óleo.

Introduction

Nitrogen (N) is one of the most essential elements for plants and is a limiting factor for their growth. Because crops are demanded in such large amounts, the agricultural sector relies greatly on N and often improperly uses it, which threatens air, water and soil quality (Xu, Fan, & Miller, 2012). The search for genotypes that efficiently use N by optimizing N fertilization has been the subject of several studies on important agronomical crops (Avice & Etienne, 2014).

N is essential for sunflower grain production and oil extraction (Rasool, Hassan, & Jahangir, 2013). Abdel-Motagally and Osman (2010) observed how increased soil N through fertilization influenced several growth parameters (plant height, stem diameter, head diameter, 100-seed weight, seed yield plant^{-1}, seed yield ha^{-1} and oil yield ha^{-1}), causing production increases. N fertilization affects many important agronomical parameters such as leaf area, capitulum diameter, achenes weight and yield (Ali & Noorka, 2013).

According to the dosage of N used, either decreases or increases in oil yield may be reported.

In addition to N, Boron (B) is also an essential nutrient for plant growth. This micronutrient has been associated with various plant functions, such as water availability, sugar translocation, anion and cation uptake, N, phosphorus (P), carbohydrate and lipid metabolism (Al-Amery, Hamza, & Fuller, 2011). Sunflower is sensitive to nutrient shortages and can also be used as a tool for evaluating soil B availability (Oyinlola, 2007). Beneficial effects of major B doses used for sunflower productivity include: increases in achenes production (Lima et al., 2013), increases in oil extraction (Tahir, Ashraf, & Ibrahim, 2013), pollen viability (Krudnak, Wonprasaid, & Machikowa, 2013), and increases in photosynthetic activity and total fresh weight (Zahoor et al., 2011).

Taking into account the essentiality of N and B in sunflower, this study aimed to evaluate how differential supplies of nutrients might influence the grain and oil production of BRS 321 and Neon genotypes.

Material and methods

Experimental design

The experiment was carried out in a greenhouse at the Soil Sciences Department of Universidade Federal Rural do Rio de Janeiro from June to August 2013.

A completely randomized design in a factorial arrangement (2 genotypes x 2 N managements x 2 Boron levels) with eight replicates was used. Sunflower seeds from BRS 321 (EMBRAPA) and Neon (SEMBRAS) hybrids were used and were seeded on dried-air soil (DAS) trays from a sandy ULTISOL horizon surface collected at EMBRAPA – Agrobiologia. Nine days after germination in 20.7 dm^3 pots containing the same DAS, plantlets were transferred. Plants were fertilized with Hoagland solution containing urea as the N source (0.19 $g.pot^{-1}$ at planting and 0.36 $g.pot^{-1}$ as additional fertilization, corresponding to 10 kg ha^{-1} N and 40 kg ha^{-1} N, respectively) and boric acid as the B source (22.38 mg pot^{-1} B, corresponding to 2.49 kg ha^{-1} B) according to the following treatments: B + 50 N (2.49 kg ha^{-1} B and 10 kg ha^{-1} N at planting and 40 kg ha^{-1} N as additional fertilization); B + 10 N (2.49 kg ha^{-1} N and 10 kg ha^{-1} N at planting); 50 N (0 B and 10 kg ha^{-1} N at planting and 40 kg ha^{-1} N as additional fertilization); 10 N (0 B and 10 kg ha^{-1} N at planting).

Analysis of plant materials, grains and oil production

At the end of the cycle, 105 days (BRS 321) and 120 days (Neon) after germination, plants (one plant per pot) were collected and separated into capitulum, leaf blades, petiole, stem, roots and grains. Plant material was dried in a stove at 60ºC until reaching a constant weight, and the dry mass was then determined. Grains were counted, weighed and divided into void and filled grains. Total N (Tedesco et al., 1995) and total B (Malavolta, Vitti, & Oliveira, 1997) analyses of the dry material from each plant part as well as filled grains were conducted.

Oil extraction using hexane by Sohxlet extractor was performed for four hours (Yaniv et al., 1998).

Statistical analysis

Statistical analysis was performed using SISVAR software for Windows (Ferreira, 2011), and the averages were compared using Tukey's test at a 5% significance level.

Results and discussion

Dry mass

The Neon hybrid presented similar a capitulum mass and number of foliar blades upon treatment with 50 N and B + 10 N, showing a possible boron benefit in conditions of low nitrogen availability for this genotype. No significant difference between treatments for the BRS 321 hybrid was reported (Table 1). No grain dry mass differences for Neon were detected (Table 1). Treatment with 10 N resulted in lower grain mass for BR 321 when compared to that of the others, suggesting that BR 321 was more sensitive to low N supply associated with B (Table 1).

Contents and N and B amounts

Neon and BRS 321 grains presented the highest grain N content compared to the other plant compartments (Tables 2 and 3).

Neon and BRS 321 grains presented the highest grain N content (Table 2), indicating an apparent influence of B on increasing N remobilization efficacy, particularly for this genotype.

When only 50 kg ha^{-1} N (50 N) was applied, leaf blades from both genotypes presented higher N contents compared to other treatments (Table 2). Therefore, we propose that the N concentration of leaf blades is a sensitive parameter for evaluating a plant's N *status* once the petiole does not present a significant difference regarding total N content (Table 2). The fourth leaf from the apex to the plant base is currently being used as an index for nutritional status evaluation of several crops, including sunflower (Silva, Aquino, & Batista, 2011). The results from this survey corroborated the use of leaf blades as a parameter in sunflower crop as well.

The capitulum of both genotypes showed high N content in grains, as it is in this compartment that the grains are inserted, consequently accepting remobilized N for grain development from other plant parts. Braz and Rossetto (2010) also reported the highest N content in sunflower grains and capitulum at the end of the cycle.

The BRS 321 genotype presented higher shoot N content than the Neon genotype with B treatment (Figure 1B). Similarly, with B and 50 kg ha^{-1} N treatments, the highest N contents in the BRS 321 grains were observed (Figure 1A). These data suggest that there is a beneficial effect of B in terms of N content in the BRS 321 genotype.

Table 1. Sunflower plants dry mass (g plant^{-1}) of BRS 321 and Neon hybrids cultivated in a greenhouse at different N and B treatments: B + 50 N (2.49 kg ha^{-1} B and 50 kg ha^{-1}); B + 10 N (2.49 kg ha^{-1} B and 10 kg ha^{-1} N); 50 N (0 B and 50 kg ha^{-1} N) and 10 N (0 B and 10 kg ha^{-1} N).

Treatments	Grains	Capitulum	Leaf blades	Petiole	Stem
			Neon		
B + 50 N	29.30 a	15.67 ab	12.36 b	2.41 c	30.19 a
B + 10 N	52.20 a	17.27 a	17.66 a	3.31 ab	28.01 a
50 N	49.62 a	16.44 a	16.97 a	3.36 a	30.01 a
10 N	39.34 a	13.89 b	14.90 ab	2.84 bc	28.96 a
CV (%)	30.36	7.90	11.49	9.55	8.34
			BRS321		
B + 50 N	25.46 a	16.03 a	12.36 b	1.52 b	18.76 a
B + 10 N	20.80 a	12.29 a	17.66 a	1.78 ab	19.82 a
50 N	23.38 a	16.31 a	16.97 a	1.89 a	19.79 a
10 N	10.38 b	15.88 a	14.90 ab	1.46 b	15.61 b
CV (%)	16.23	16.01	11.49	11.58	8.74

Averages followed by the same letters in the columns for each genotype do not differ by Tukey's test at the 5% significance level.

Table 2. Total N grains, capitulum, leaf blades, petiole, stem, roots and soil contents of BRS 321 and Neon genotypes cultivated in a greenhouse at different N and B treatments.

Treatments	N-total (dry mass mg g^{-1} N)						
	Grains	Capitulum	Leaf blades	Petiole	Stem	Roots	Soil
					Neon		
B + 50 N	14.34 Ac	7.92 Bab	6.16 Bc	2.99 Ca	1.96 Ca	1.40 Cb	1.25 Ca
B + 10 N	16.07 Ab	6.43Bc	3.20 Cd	3.01 Ca	1.36 Da	1.60 Cb	1.16 Ca
50 N	17.78 Aa	8.36 Ba	9.18 Ba	3.61 Ca	1.37 Ca	2.82 CDa	1.09 Da
10 N	15.77 Ab	7.08 Bbc	7.82 Bb	3.45 Ca	2.27 Da	1.82 CDab	1.20 Da
					BRS321		
B + 50 N	36.66 Aa	6.99 ABb	9.84 Bab	4.03 CDa	3.39 CDa	4.17 CDa	1.09 Da
B + 10 N	30.27 Ab	9.86 Bb	7.92 BCb	3.47 CDa	2.42 Da	2.13 Da	1.32 Da
50 N	35.75 Aa	14.89 Ba	11.18 Ba	4.35 Ca	3.35 Ca	1.59 Ca	1.59 Ca
10 N	33.99 Aa	13.89 Ba	9.21 Cab	3.16 Da	2.86 Da	1.53 Da	1.54 Da

Averages followed by the same capital letters in lines and small letters in columns for each genotype do not differ by Tukey's test at the 5% significance level.

Table 3. Grains, capitulum, leaf blades, petiole and stem N contents of BRS 321 and Neon genotypes cultivated in a greenhouse at different N and B treatments.

Treatments	N content (mg plant^{-1} N)					
	Grains	Capitulum	Leaf blades	Petiole	Stem	Roots
			Neon			
B + 50 N	475.81 Ac	118.69 Ba	81.11 BCab	12.54 Ca	62.29 BCa	*
B + 10 N	659.21 Ab	107.61 Ba	67.58 BCb	8.84 Ca	32.34 BCa	*
50 N	923.97 Aa	138.09 Ca	168.82 Ba	11.04 Da	59.89 CDa	*
10 N	675.81 Ab	110.98 Ba	118.08 Bab	7.04 Ca	61.44 CBa	*
			BRS321			
B + 50 N	741.73 Aa	133.49 Ba	161.59 Ba	7.38 Ca	55.16 Bca	*
B + 10 N	662.24 Aab	158.82 Ba	93.41 BCa	6.67 Ca	46.55 Ca	*
50 N	727.97 Aa	223.23 Ba	94.87 Ca	8.77 Ca	73.39 Ca	*
10 N	607.86 Ab	131.14 Ba	87.16 BCa	5.75 Ca	58.17 Bca	*

*Root N content analyses were not performed. Averages followed by the same capital letters in lines and small letters in columns for each genotype do not differ by Tukey's test at the 5% significance level.

The Neon genotype presented the highest grain N content when 50 kg ha^{-1} N, but no Boron, was applied (Figure 1A); on the other hand, shoot N content did present the same result (Figure 1B), indicating that this genotype displays promising performance regarding grain and oil production. In conditions of high N availability, the Neon genotype does not accumulate Nitrogen in the shoot, directly transmitting N uptake by grains; this results in high grain production as well as higher oil yield (Table 7).

In both genotypes, the leaf blades presented the highest B contents (Table 4). Boron is responsible for increases in efficiency of photosynthesis light energy utilization (Broadley et al., 2012). The highest B content was observed in the 151.38 mg kg^{-1} B + 50 N (Neon) and 126.14 mg kg^{-1}(BRS 321) treatments (Table 4). With no B treatment, independently of N performance, leaf blades presented medium N contents (from 48.86 to 57.98 mg kg^{-1} B). These concentrations were lower than those reported by Aquino, Silva, and Berger (2013) in their study of hybrids and sunflower varieties. They observed medium leaf blade B contents ranging from 119.25 to 140.35 mg kg^{-1} in hybrids and sunflower varieties, respectively, once plants did not receive B fertilization and were only absorbing soil nutrients.

The capitulum also presented substantial B content. Leaf blades and capitulum presented the highest B contents when plants were fertilized by these nutrients (B + 50 N and B + 10 N treatments) (Table 4).

In general, Neon presented higher B contents than those of BRS 321, even showing less responsiveness to the nutrient. The Neon genotype presented the highest leaf blade B content with B + 50 N and B + 10 N treatments (Table 5).

The capitulum also presented significant B contents in both genotypes (Table 5). This might be explained by the nutritional demand for Boron in pollen tube growth; Boron is an important nutrient for reproductive structures (Broadley et al., 2012). Small amounts of B on the pollen tube were observed when BRS 321 axillary inflorescence analysis was performed.

The genotypes presented different traits regarding B exportation to the grains. The BRS 321 and Neon genotypes grains presented similar B contents, independently of the treatment (Table 5). Lobo, Grassi Filho, and Brito (2011) reported minor micronutrient exportation with the lowest N content, including exportation of B, but did not observe any interactions between N and B doses.

Grain and oil production

The Neon genotype presented the highest oil content of grains with the 50 N treatment (Table 6). N application in a large amount (50 N) and a small N amount associated with B (B + 10 N) resulted in higher grain production for this genotype, leading to high oil content under these N and B availabilities (Table 7). In the B + 10 N treatment, filled grains production was similar to that presented with the 50 N treatment (Tables 6 and 7). This result suggests that B favors the production of filled grains, an agronomically significant trait, and might also reduce the need for N fertilizers.

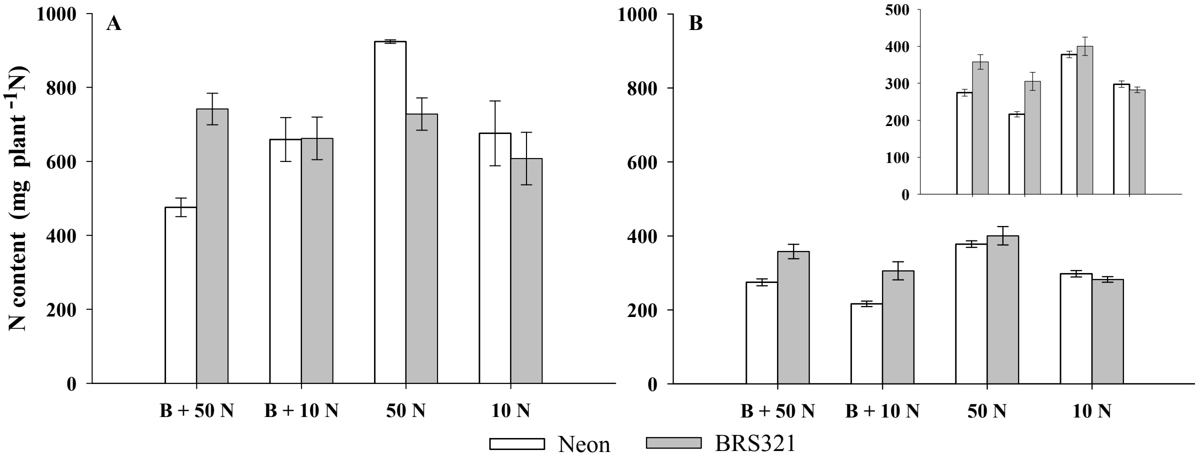

Figure 1. Grains (A) and aerial part (B) contents of BRS 321 and Neon genotypes cultivated in a greenhouse at different N and B treatments. Bars represent eight replicates, medium ± standard error.

Table 4. Grains, capitulum, leaf blades, petiole, stem, roots, axillary inflorescence and soil B contents (mg.kg^{-1}) of BRS 321 and Neon genotypes cultivated in a greenhouse at different N and B treatments.

	B content (mg kg^{-1})						
Treatments	Grain	Capitulum	Leaf blades	Petiole	Stem	Roots	Axillary inflores-cence
				Neon			
B + 50 N	0.08 Da	77.77 Ba	151.38 Aa	42.10 Ca	0.13 Da	20.43 CDab	*
B + 10 N	0.07 Ca	82.09 Aa	82.25 Ab	42.09 Ba	0.14 Ca	24.25 BCa	*
50 N	0.11 Ba	57.33 Ab	48.86 Ac	42.13 Aa	0.19 Ba	8.03 Bb	*
10 N	0.10 Ca	51.96 Ab	56.57 Ac	42.09 Aba	0.15 Ca	11.27 BCab	*
				BRS321			
B + 50 N	0.07 Da	80.35 Ba	126.14 Aa	42.14 Ca	0.15 Da	24.33 CDa	0.10 Da
B + 10 N	0.08 Ba	67.10 Bb	103.36 Ab	41.63 Bca	0.15 Da	23.59 CDab	0.30 Da
50 N	0.08 Da	48.16 Ac	52.17 Ac	42.10 Aa	0.17 Ba	14.35 Bb	0.14 Ba
10 N	0.08 Ca	53.34 Ac	57.98 Ac	42.12 Aba	0.17 Ca	16.55 BCab	0.17 Ca

*Neon genotype did not present axillary inflorescence. Averages followed by the same capital letters in lines and small letters in columns for each genotype do not differ by Tukey's test at the 5% significance level.

Table 5. Grains, capitulum, leaf blades, petiole, stem and inflorescence B contents (mg.plant^{-1}) of BRS 321 and Neon genotypes cultivated in a greenhouse at different N and B treatments.

	B content (mg plant^{-1})					
Treatments	Grain	Capitulum	Leaf blades	Petiole	Stem	Axillary inflores-cence
				Neon		
B + 50 N	3.51 Ca	1479.13 Ba	1702.58 Aa	109.62 Ca	4.69 Ca	*
B + 10 N	3.74 Ca	1456.74 Aa	1254.10 Ba	140.48 Ca	4.60 Ca	*
50 N	3.92 Ca	852.37 Ab	571.84 Bc	94.48 Ca	4.44 Ca	*
10 N	3.95 Ba	724.50 Ab	568.70 Ac	95.04 Ba	4.54 Ba	*
				BRS321		
B + 50 N	2.66 Ca	994.89 Ba	1484.39 Aa	72.54 Ca	3.66 Ca	0.44 Ca
B + 10 N	1.52 Ca	904.21 Bab	1202.53 Ab	84.78 Ca	2.77 Ca	0.40 Ca
50 N	2.06 Ca	875.26 Ab	464.79 Bc	75.87 Ca	3.14 Ca	0.64 Ca
10 N	0.80 Ca	751.97 Ac	563.29 Bc	59.28 Ca	3.54 Ca	0.60 Ca

*Neon genotype did not present axillary inflorescence. Averages followed by the same capital letters in lines and small letters in columns for each genotype do not differ by Tukey's test at the 5% significance level.

In contrast to Neon, B fertilization in the BRS 321 genotype was a determinant for the production of filled grains as 10 kg ha^{-1} N as 50 kg ha^{-1} N fertilization (Table 6). The BRS 321 genotype presented the highest oil yield with B + 50 N treatment; in other words, B fertilization might influence BRS 321 oil yield (Table 6). By testing increasing B doses (0, 0.25, 0.5 and 2 mg dm^{-3} B), Castro et al. (2006) observed the influence of B application on grain production and oil yield, mainly at 0.5 mg dm^{-3} doses and independently of water conditions.

BRS 321 genotype plants presented higher production of empty grains when they were restricted to B fertilization (Table 6). This fact might be explained by the higher demand for this nutrient in the reproductive stage; plants can present a deformed capitulum with large numbers of empty grains (Lima et al., 2013). Tahir et al. (2013) reported grain production and oil yield increases by applying B as boric acid in differentiated doses on Hysun-33 hybrid sunflower plants.

BRS 321 genotype presented the highest oil content, mainly on 50 kg ha^{-1} N and B (68.75%), apart from 50 N treatment when received the highest N doses (Table 6). According to Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA, 2011) BRS 321 medium oil contents ranged from 40 to 44%, however, this survey reported 68.75%, as previously mentioned above. Probably due to a characteristic of this genotype, which proved to be responsive to B and N, especially for oil production. However, it is important confirmation of those results in a field experiment in these same conditions of N and B fertilization. Zahoor et al. (2011) also observed the highest oil contents (48%) on sunflower plants fertilized on 2 kg ha^{-1} B. According to these same authors the highest oil content might be related to greater N uptake by seed, which might subsequently be incorporated into the protein molecule. Neon genotype also presented significative oil content values, although less than BRS 321 one.

Neon genotype presented filled grains production with medium oil contents (61.54%) on 50 kg ha^{-1} N. Abdel-Motagally and Osman (2010) studying two Giza Sahka-102 and 53 genotypes obtained the highest oil yield at higher N doses, however, when analyzing seed oil percentage values observed decrease with N fertilization increase.

Table 6. Filled and void grains number (number plant^{-1}) and oil yield (percentage) of BRS 321 and Neon genotypes cultivated in greenhouse at different N and B treatments.

	Filled grains (number plant^{-1})		Void grains (number plant^{-1})		Oil yield (%)	
Treatments	Neon	BRS321	Neon	BRS321	Neon	BRS321
B + 50 N	536 Ab	235 Ba	310 Ab	271 Ab	50.65 Bb	68.75 Aa
B + 10 N	760 Aa	264 Ba	443 Aa	311 Bb	47.88 Ab	51.92 Ab
50 N	858 Aa	54 Bb	437 Aa	471 Aa	61.54 Aa	53.91 Bb
10 N	608 Ab	81 Bb	372 Aab	448 Aa	42.02 Bb	49.58 Ab
CV (%)	11.29	41.45	17.51	15.18	10.09	9.11

Averages followed by the same capital letters on line and small letters on column for each genotype do not differ by Tukey test at 5% significance level.

Significative positive correlation between plant filled grains and oil percentage on both genotypes was observed (Figure 2A and B). Curiously, BRS 321 genotype produced smaller filled grains amount than Neon one, and even so, higher or similar oil percentage when compared to Neon (Figure 2) possibly due to Neon grains dilution effect.

The production of filled grains of the BRS 321 genotype was the highest with N treatment and B application, and consequently the oil yield was also the highest (Table 7). Rasool, Hassan, and Jahangir (2013) observed that as N doses increased, grains production and oil yield also increased; additionally, grains oil content decreased when high N doses were applied.

The production of capitulum filled grains in the Neon genotype was higher with lower N doses and N supplementation, as well as with N treatment once these treatments presented the highest capitulum oil yield (Table 7). Both genotypes presented beneficial effects of B, mainly for the Neon genotype, apart from the lower N doses applied with B. This resulted in the production of filled grains and oil yield similar to that of the BRS 321 genotype. Foloni et al. (2010) also demonstrated the beneficial effects of B in sunflower crop. These authors reported that B doses applied only on the planting furrow, regardless of leaf B, provided the highest aerial part total phytomass production; this positively influenced capitulum grains total mass. Leaf application increased the total number of grains only on plots receiving no B in the soil (Foloni et al., 2010).

When the BRS 321 genotype received lower N doses with no B application, it led to the lower production of filled grains compared to that of other treatments. The beneficial effect of B was also demonstrated in this study (Table 7).

It can be concluded from results of this analysis that both the Neon and BRS 321 genotypes presented different traits regarding nutritional demand, as well as in the production of grains and oil yield

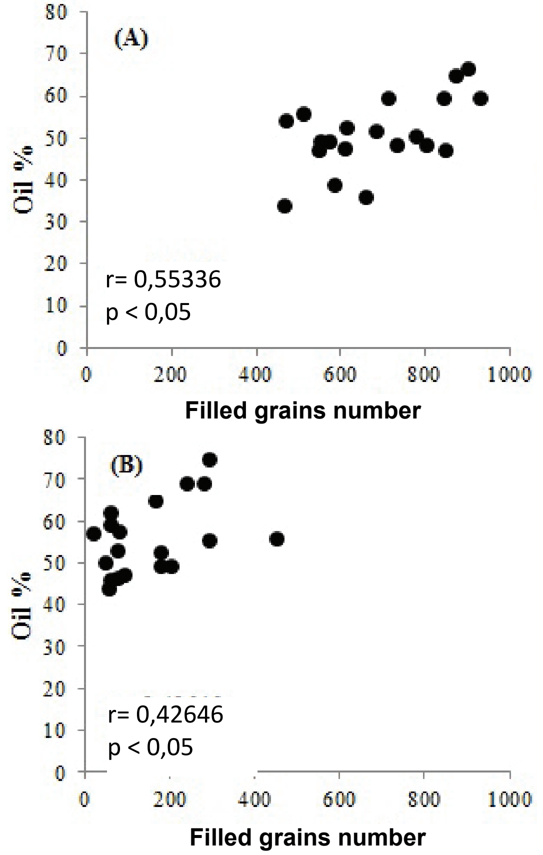

Figure 2. Correlation between the number of filled grains (number plant^{-1}) and oil yield of Neon (A) and BRS 321 (B) genotypes.

Table 7. Production of filled grains (g capitulum^{-1}) and oil yield (g capitulum^{-1}) of BRS 321 and Neon genotypes cultivated in a greenhouse at different N and B treatments.

Treatments	Filled grain production (g capitulum^{-1})		Oil yield (g capitulum^{-1})	
	Neon	BRS321	Neon	BRS321
B + 50 N	28.23 Ac	21.03 Ba	14.28 Ab	13.07 Aa
B + 10 N	50.21 Aa	18.32 Ba	24.06 Aa	9.63 Bab
50 N	47.35 Aab	17.42 Bab	29.21 Aa	9.54 Bab
10 N	38.37 Ab	8.58 Bb	16.18 Ab	4.24 Bb
CV (%)	19.13		22.85	

Averages followed by the same capital letters in lines and small letters in columns for each genotype do not differ by Tukey's test at the 5% significance level.

Conclusion

Sunflower hybrids presented different traits regarding B fertilization. The combination of a larger supply of N associated with B is essential for BRS 321 grain production and oil yield. The Neon genotype is more responsive in terms of grain production, exhibiting less input when associated with B fertilization. Results indicate leaf blades as the most sensitive part for evaluating sunflower plant N *status*.

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