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INSECT INCIDENCE AND AGRONOMIC PERFORMANCE OF COMMON BEAN GENOTYPES IN THREE GROWING SEASONS UNDER ORGANIC SYSTEM

INCIDÊNCIA DE INSETOS E DESEMPENHO AGRONÔMICO DE GENÓTIPOS DE FEIJÃO COMUM EM TRÊS ÉPOCAS DE CULTIVO SOB SISTEMA ORGÂNICO

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Abstract

The objective of this work was to observe the performance of creole genotypes of common bean and the limiting phytosanitary factors in three growing seasons in the organic system. Three trials were carried out, with plantations in October 2017, January 2018 and May 2018. A random experimental block design was used, consisting of 4 replicates and 10 treatments (commercial: BRS Esplendor (preto) and BRS Estilo (carioca), and the creoles: Amarelinho, Bolinha Vermelho, Cavalo Bolinha, Mouro, Paquinho, Palhacinho, Preto Jacaré and Roxão). The number of chrysomelidae damaged plants, whitefly nymph incidence, incidence of Bean golden mosaic virus (BGMV), thrips and heteropteran incidence were quantified. Besides, the grain mass and quality of grains (yield, normal grains, spotted grains and chocho grains) were measured. The first season of growing had the highest heteropteran incidence; BGMV was observed only on second season. Third season of sowing produced highest yield and lower insect incidence. Insect incidence varied between the genotypes at all data of sowing, with minor differences between the creoles and commercial materials. BGMV in second season prevented bean production in all genotypes.

Resumo

O objetivo deste trabalho foi observar o desempenho de genótipos crioulos de feijão e os fatores fitossanitários limitantes em três épocas de cultivo sob sistema de cultivo orgânico. Foram realizados três ensaios, com plantios em outubro de 2017, janeiro de 2018 e maio de 2018. Foi utilizado um delineamento experimental de blocos ao acaso, composto por 4 repetições e 10 tratamentos (comercial: BRS Esplendor (preto) e BRS Estilo (carioca) e o crioulos: Amarelinho, Bolinha Vermelho, Cavalo Bolinha, Mouro, Paquinho, Palhacinho, Preto Jacaré e Roxão). Foram quantificados o número de plantas danificadas por crisomelídeos, incidência de ninfas de mosca-branca, incidência do vírus do mosaico dourado (BGMV), tripes e heterópteros. Além disso, a massa e a qualidade dos grãos (rendimento, grãos normais, grãos manchados e grãos chochos) foram avaliados. A maior incidência de heterópteros ocorreu na primeira época de cultivo. Enquanto o BGMV foi observado apenas na segunda época. As plantas cultivadas na terceira época de semeadura tiveram maior rendimento e menor incidência de insetos. A incidência de insetos variou entre os genótipos em todas as datas de semeadura, com pouca diferença entre os crioulos e os materiais comerciais. A ocorrência de BGMV na segunda safra impediu a produção de feijão em todos os genótipos.

INTRODUCTION

Common beans (*Phaseolus vulgaris* L.) is an important leguminous consumed in several countries, mainly in Southern Africa and in Central and South America (Deshpande, 1992; Barbosa and Gonzaga, 2012; Zaugg et al., 2013). Brazil is one of the largest producers and consumers of the world, with planted area about 2.942,7 mil ha and production of 1.062 kg ha^{-1} (Conab, 2021). Bean production in Brazil is distributed into three seasons of growing: first season sowing in August, second between January and February and third from May (Barbosa and Gonzaga, 2012).

Bean crop is known by its fast development and incidence of several arthropods and pathogens (Labinas, 2002). In tropical regions, insects and diseases are major important biotic factors affecting yield potential of beans (Faria et al., 2016). Mainly insects associated with beans are stinkbugs, whiteflies, thrips, and chrysomelidae (Irwin et al., 1979; Fazolin and Gomes, 1993; Panizzi et al., 2000; Musa and Ren, 2005; Alvarado et al., 2009a, b; Jesus et al., 2010; Boiça Junior et al., 2015). Losses in bean production by herbivorous insects may vary between 33 to 86%, depending on the production conditions (Yokoyama, 2006).

The feeding behavior and piercing-sucking mouthparts of Hemiptera insects such stinkbugs and whiteflies damage the beans plants by direct feeding and virus transmission. Stinkbugs may cause injuries on yield and/or quality of grains (Degrande and Vivan, 2009; Silva et al., 2012 a). Pods abortion and deformation, and colonization by pathogens like bacteria and yeasts are examples of the consequences caused directly and indirectly by these heteroptera (McPherson et al., 1994; Medrano et al., 2009; Depieri and Panizzi 2011). Damage of whitefly include virus transmission, mainly the *Bean golden mosaic virus (BGMV)* one of the major disease of bean cultivation in Latin America. Losses by this disease may reach 100% of planted area (Salguero 1993). Besides, some beetles of Chrysomelidae family found in bean plants are able to transmit viruses such as *Diabrotica speciosa* (Germar) and *Cerotoma arcuata* (Olivier) (Costa et al., 1987).

Due the high importance of this leguminous to population food security around world, the sustainable systems production has been sought, aiming grains quality free of pesticides (Didonet et al., 2009). Organic system of cultivation is based on food production through specific techniques to optimize natural and socioeconomic resources with no chemical management (Brasil, 2003). Creole genotypes are important in organic crops, due its adaptation in these cultivation systems and conservation of biodiversity (Santos et al., 2016; Fernandes, 2017). Creole genotypes of common beans present high productive potential, and high variability in agronomic characteristics such habit and type of grow, brightness and shape of seeds, tegument color, and others, highlighting importance of these materials for sustainable agriculture (Santos and Pereira, 2015).

Several studies show the incidence of insects and diseases in beans crops on conventional systems. Nonetheless, data on insect occurrence on organic systems are scarce. Similarly, the best season of sowing bean genotypes under organic system is unknown. Therefore, the aim of this study is evaluate the performance of genotypes creoles of common bean and the limiting phytosanitary factors in three growing seasons in an organic system.

MATERIALS AND METHODS

Three field experiments were conducted. The trials were implanted in different sowing dates: October 25th 2017, January 31rd and may 24th 2018 under organic system of production at Nossa Senhora Aparecida farm, located in Hidrolândia - GO (16º 57' 58" S; 49º 11' 13" W; 800 meters altitude). The climate in this region is characterized as tropical Aw (hot and semi-humid, with a well-defined dry season from May to October), with an average annual temperature of 22.8 °C and an average precipitation of 1,411 $mm.year^{-1}$, According to the Köppen classification. The farm is composed by 370 ha, with 200 ha certified for organic production since 2009, and remaining area is native vegetation and permanent preservation.

Were used ten genotypes: BRS Esplendor (preto) and BRS Estilo (carioca) obtained from Embrapa Arroz e Feijão; and eight creole genotypes from the collection of Nossa Senhora Aparecida farm obtained from seed exchange fairs and selections on the farm: Amarelinho, Bolinha Vermelho, Cavalo Bolinha, Mouro, Paquinho, Palhacinho, Preto Jacaré and Roxão.

The experimental design used was randomized block design, with ten treatments and four replicates. Each plot was constituted by four rows two meter long, 0.5 meters between rows. Seeding was manually with 12 seeds per meter. Third experiment was artificially irrigated, by conventional spraying. At 15 and 45 days after planting weeding were made. No fertilization was needed, according to the soil analysis and plant's nutritional needs.

Insects incidence was biweekly evaluated from 15 days after plants emergency (DAE). Number of plants damaged by Chrysomelidae (mainly *D. speciosa* and *Cerotoma* spp.) and leaf miner were counted in the two first evaluations (15 and 30 days after emergency). Whitefly nymphs were evaluated in two cm^2 of five leaf by plot (approximately 35 days after planting). The abaxial superficies of these leaves were examined in the laboratory under a stereomicroscope (Leica ®) at 40 × magnification. Only at second experiment were made three evaluations of whitefly nymphs, due its higher population. Thrips was evaluated at fourth assessment by counting number of insects in five flowers in the two central rows of each plot. As the bean materials flourished in different times, the evaluation was made after all treatments presented flowers (approximately 40 after planting). At pod formation and grain filling (at 58 and 66 days after planting), the occurrence of heteroptera was assessed using an entomological net (50 cm in diameter with 1 meter in length), and five net passes per plot. The insects collected were identified and quantified.

The presence of mosaic was observed only at second experiment. Therefore, the number of infected plants was counted in the two central rows of each plot, at 38 days after emergency.

All beans genotypes were manually harvested at physiological maturity, approximately 90 days after sowing. The grain mass was assessed only for first and third experiments, once genotypes did not produce in second experiment due the mosaic severity. Yield (kg ha^{-1}), percentages of normal grain, chocho grain and spotted grain were assessed. The quality of the grains was sampled in 200 grams of grain that were visually separated and classified as normal, spotted and chocho grains, and then weighted.

The Kolmogorov-Smirnov and Levene's tests were used to verify normality of residues and the variances homogeneity of data, respectively. As the presumptions of analysis of variance (ANOVA) were met, all data were submitted ANOVA and the means were compared by the Tukey test ($p<0.05$).

RESULTS AND DISCUSSION

Insect incidence in the first experiment varied between the treatments. Number of plants damaged by chysomelidae did not differ between the genotypes at first evaluation (DAE) ($F_{9, 30}= 0.36$; $p= 0.94$) (Figure 1A). However at second evaluation the Palhacinho was less attacked by the chysomelidae insects, differing of Mouro and Paquinho ($F_{9, 30}= 3.23$; $p\leq 0.05$) (Figure 1B). Damage by leaf miner was higher in Amarelinho and BRS Jacaré, different of Cavalo Bolinha and Mouro ($F_{9, 30}= 2.54$; $p\leq 0.05$) (Figure 1C). Thrips was lower in BRS Esplendor and BRS Estilo flowers and higher on Cavalo Bolinha and Palhacinho ($F_{9, 30}= 2.83$; $p\leq 0.05$) (Figure 1D).

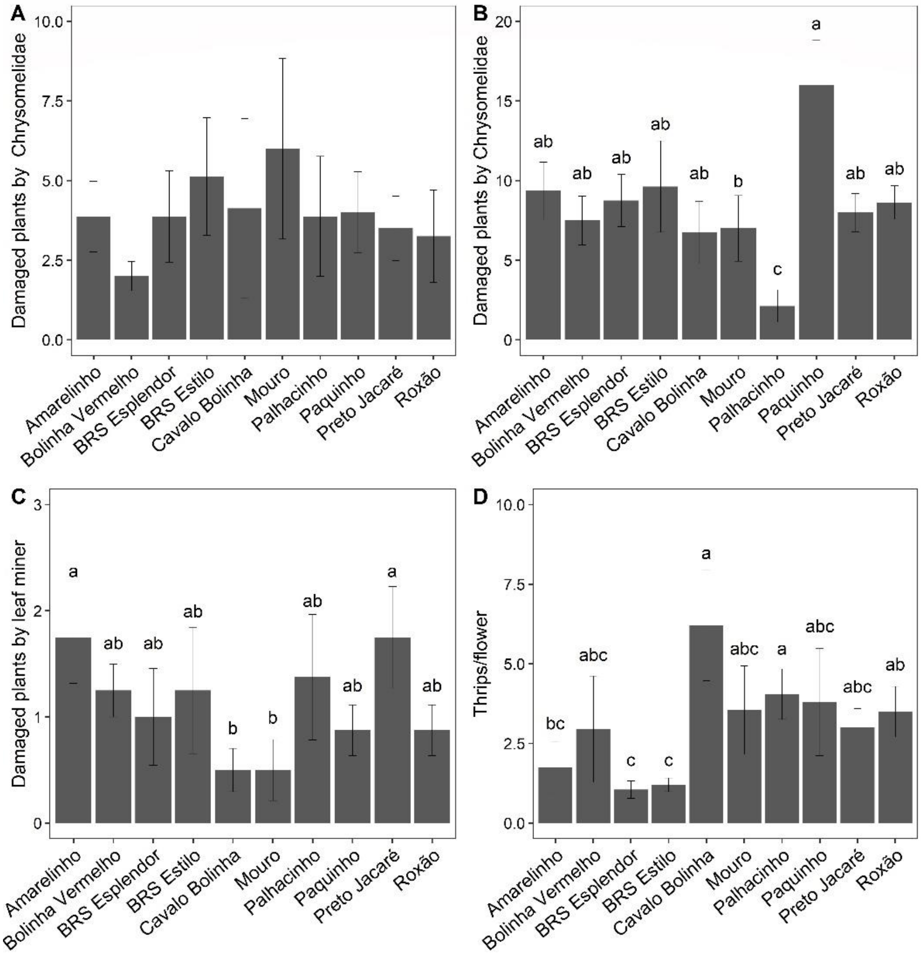

Figure 1: Means (±SE) of plants damaged by Chrysomelidae at first (A) and second (B) evaluation, plants damaged by leaf miner (C) and thrips per flower (D) in common bean genotypes under organic system at first season growing. Means followed by same letter did not differ by Tukey test (p≥0.05).

Number of heteroptera varied only in the second evaluation (58 DAP: $F_{9, 30}$= 0.5, *p*= 0.86; 66 DAP: $F_{9, 30}$= 2.89, *p*= 0.00) (Table 1). Mean of nymphs of whitefly did not differ between the treatments ($F_{9, 30}$=0.69, *p*= 0.709) (Table 1).

Table 1: Means (±SE) of heteropteran (first and second evaluation) and whitefly (cm²) incidence in commom bean under organic system at first season of sowing (2017 October).

Genotypes	**Stink bug/plot**		**Whitefly nymph (cm²)**
	58 (DAP)	**66 (DAP)**	
Amarelinho	4.50 ± 2.52	3.00 ± 0.82 ab	0.10 ± 0.14
Bolinha Vermelho	5.25 ± 3.86	2.25 ± 1.26 b	0.02 ± 0.05
BRS Esplendor	4.00 ± 3.37	1.50 ± 1.29 b	0.07 ± 0.09
BRS Estilo	2.75 ± 1.71	1.50 ± 1.29 b	0.02 ± 0.05
Cavalo Bolinha	5.00 ± 2.72	4.25 ± 4.19 ab	0.17 ± 0.28
Mouro	4.50 ± 1.73	2.75 ± 1.71ab	0.10 ± 0.08
Palhacinho	6.75 ± 2.22	4.00 ± 2.45 ab	0.00 ± 0.00
Paquinho	5.50 ± 2.52	3.50 ± 3.11 ab	0.07 ± 0.09
Preto Jacaré	4.25 ± 4.57	3.75 ± 1.71 ab	0.27 ± 0.48
Roxão	4.25 ± 3.30	8.50 ± 3.32 a	0.10 ± 0.08

DAP: days after planting. Means followed by same letter did not differ by Tukey test (p≥0.05).

In first experiment all variable about productivity and grain quality were different between the genotypes. Yield ranged about 610 kg ha^{-1} and 1395.62 kg ha^{-1}, differing only between the genotypes Roxão (lower production) and Cavalo Bolinha (higher production) ($F_{9,30}$= 2.67; $p \leq 0.05$) (Figure 2A). Lower percentages of normal grains were observed in Cavalo Bolinha and Mouro ($F_{9,30}$= 12.77; $p \leq 0.05$) (Figure 2B). BRS Esplendor and Preto Jacaré had less spotted grains and differ of BRS Estilo, Cavalo Bolinha, Mouro and Palhacinho ($F_{9,30}$=; 13.77; $p \leq 0.05$) (Figure 2C). Finally, higher quantity of chocho grain was observed in Amarelinho and Paquinho, followed by Bolinha Vermelho, BRS Estilo and Preto Jacaré, and different of Cavalo Bolinha, Mouro, Palhacinho and Roxão ($F_{9,30}$= 6.98; $p \leq 0.05$) (Figure 2D).

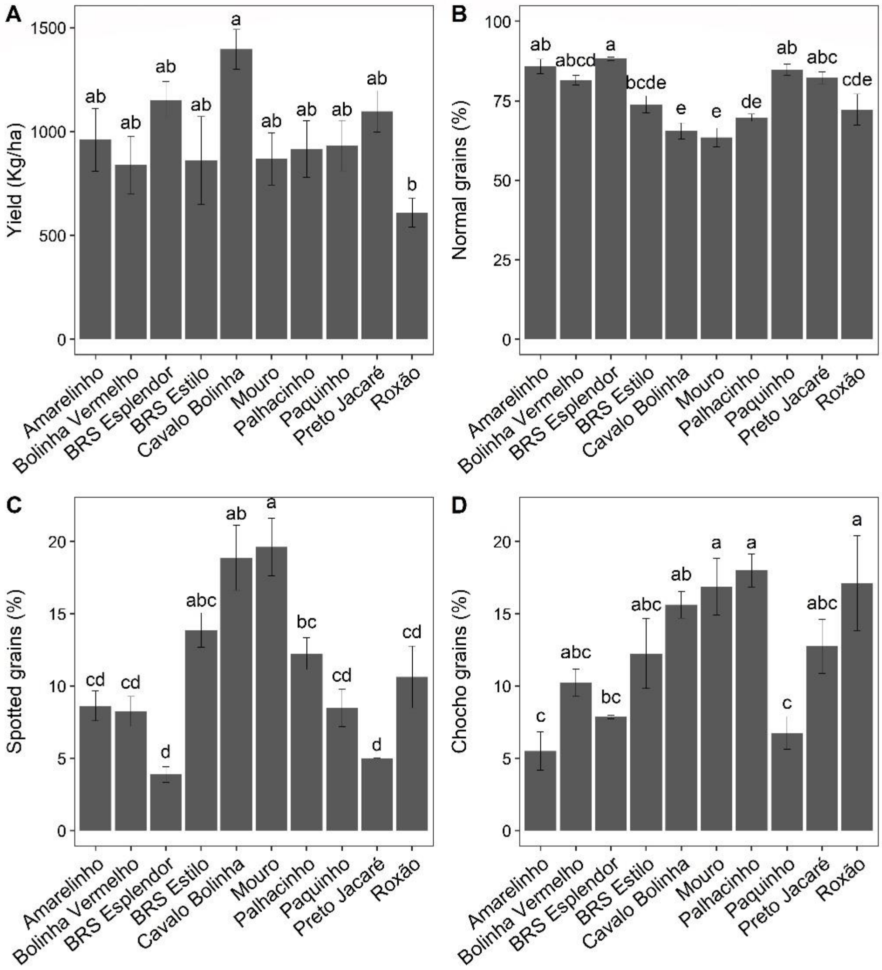

Figure 2: Means (±SE) of yield (A), and percentages of normal grains (B), spotted grains (C) and chochos grains (D) produced by common bean genotypes under organic system at first season growing. Means followed by same letter did not differ by Tukey test (p≥0.05).

In the second season of growing, the number of plants damaged by chrysomelidae insects was different between the treatments in both evaluation (first evaluation: $F_{9,\ 30}$= 2.73; $p \leq 0.05$, $F_{9,\ 30}$= 2.44; $p \leq 0.05$) (Figure 3A). At first evaluation, genotypes Palhacinho and Paquinho were the most attacked and BRS Estilo the less. Interestingly in the second evaluation, the Palhacinho had less plants damaged by chrysomelidae, differing of Paquinho, Amarelinho, BRS Esplendor, BRS Estilo, Mouro, Preto Jacaré and Roxão (Figure 3B). There is no damaged plant by leaf minor in this season.

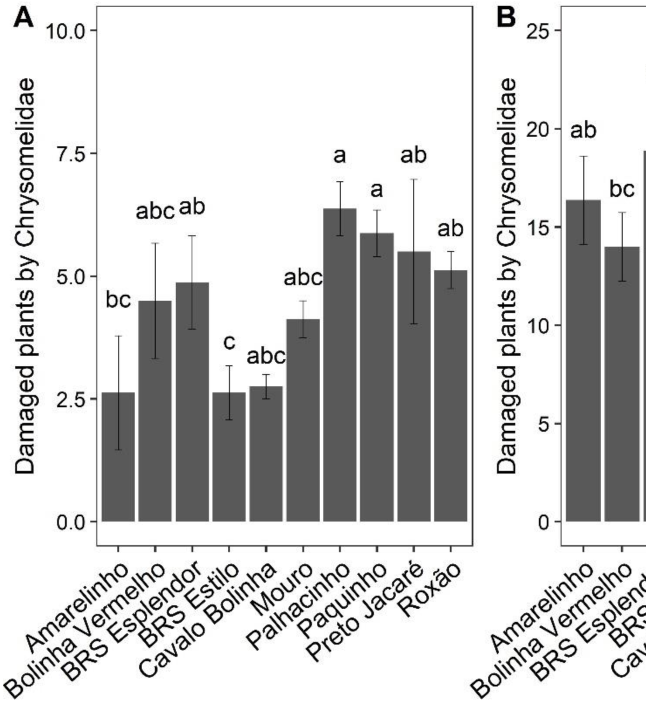

Figure 3: Means (±SE) of plants damaged by Chrysomelidae at first (A) and second (B) evaluation in common bean genotypes under organic system at second season growing. Means followed by same letter did not differ by Tukey test (p≥0.05).

The thrips incidence in flowers did not differ between the treatments ($F_{9, 30}$= 0.58; *p*= 0.802) (Table 2). Number of heteroptera only differed between the genotypes at second evaluation (58 DAP: $F_{9, 30}$= 0.94; *p*= 0.510; 66 DAP: $F_{9, 30}$= 2.97; $p \leq 0.05$), BRS Esplendor, BRS Estilo and Roxão had the higher incidence of heteroptera, different of Amarelinho, Cavalo Bolinha, Mouro and Paquinho (Table 2).

Table 2: Means (±SE) of heteropteran (first and second evaluation) and thrips incidence in commom beans genotypes under organic system at second season of sowing (2018 January).

Genotypes	Thrips/flower	58 (DAP)	66 (DAP)
Amarelinho	0.95 ± 0.34	3.5 ±	
Bolinha Vermelho	0.60 ± 0.43	1.5 ±	
BRS Esplendor	1.25 ± 1.31	3.75 ±	
BRS Estilo	1.05 ± 0.38	2.25 ±	
Cavalo Bolinha	0.85 ± 0.64	1.50 ±	
Mouro	0.80 ± 0.58	2.50 ±	
Palhacinho	0.75 ± 0.70	2.50 ±	
Paquinho	0.95 ± 0.50	2.00 ±	
Preto Jacaré	1.40 ± 0.86	2.25 ±	
Roxão	0.65 ± 0.19	1.50 ±	

DAP: days after planting. Means followed by same letter did not differ by Tukey test (p≥0.05).

Nymphs of whitefly ranged between the genotypes in the first two evaluations. At first evaluation, the number of whitefly nymphs was higher in Bolinha Vermelha and Palhacinho differing only of Amarelinho ($F_{9, 30}$= 3.12; $p \leq 0.05$) (Figure 4A). In second assessment BRS Esplendor had the lower number of nymphs, followed by Amarelinho, BRS Estilo and Paquinho, and different of others genotypes ($F_{9, 30}$= 8.33; $p \leq 0.05$) (Figure 4B). At third evaluation the nymphs incidence did not differ between the treatments ($F_{9, 30}$=1.72; *p*= 0.128).

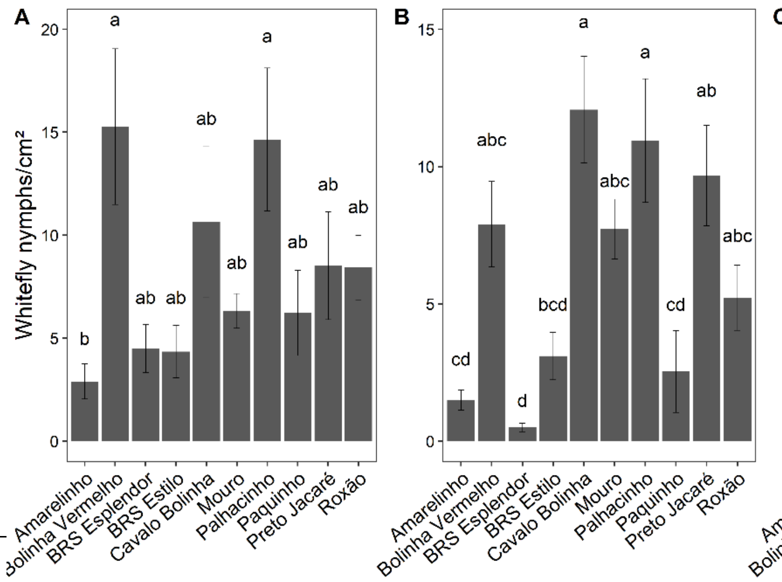

Figure 4: Means (±SE) of whitefly nymph incidence at first (A), second (B) and third (C) evaluation in common bean genotypes under organic system at second season growing. Means followed by same letter did not differ by Tukey test (p≥0.05).

The total of nymhps was lower on genotypes Amarelinho, BRS Esplendor, and BRS Estilo ($F_{9, 30}$= 4.69; $p≤0.05$) (Figure 5A). Consequently, the number of plants with mosaic symptom was lower in these genotypes, followed by BRS Estilo, Cavalo bolinha, Paquinho and Roxão ($F_{9, 30}$= 4.3; $p≤0.05$) (Figure 5B).

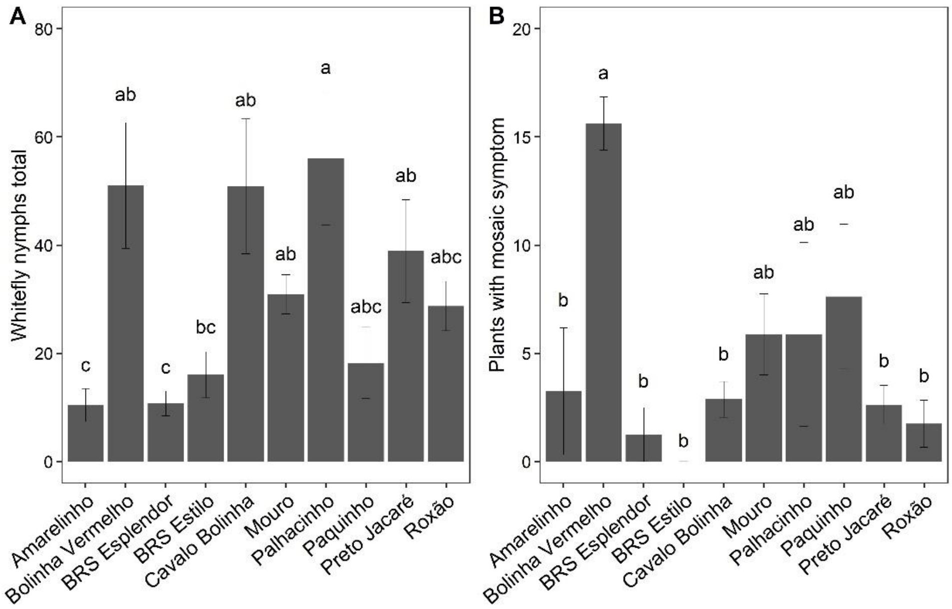

Figure 5: Means (±SE) of total whitefly nymph incidence (A) and in plants with mosaic symptom (B) in common bean genotypes under organic system at second season growing. Means followed by same letter did not differ by Tukey test ($p≥0.05$).

At third season of growing, the number of damaged plants by chrysomelidae differ between the genotypes in both dates of evaluation ($F_{9, 30}$= 2.89; $p≤0.05$, $F_{9, 30}$= 7.48; $p≤0.05$) (Figure 6A; 6B). Plants of Paquinho were more injured by these insects, differing from Mouro and Preto jacaré in first evaluation; and from Cavalo bolinha, Bolinha vermelho, Palhacinho, Roxão Mouro and Preto jacaré on second evaluation. Mean of plants damaged by leaf miner also varied between the treatments, Cavalo bolinha and Palhacinho had the higher number of plants damaged by this chewer and Amarelinho was less injured ($F_{9, 30}$= 3.73; $p≤0.05$) (Figure 6C). Number of thrips/flower was lower on genotypes BRS Estilo, Cavalo bolinha, Mouro, Palhacinho and Paquinho, different only of Amarelinho, with highest number of thrips ($F_{9, 30}$= 1.21; $p≤0.05$) (Figure 6D).

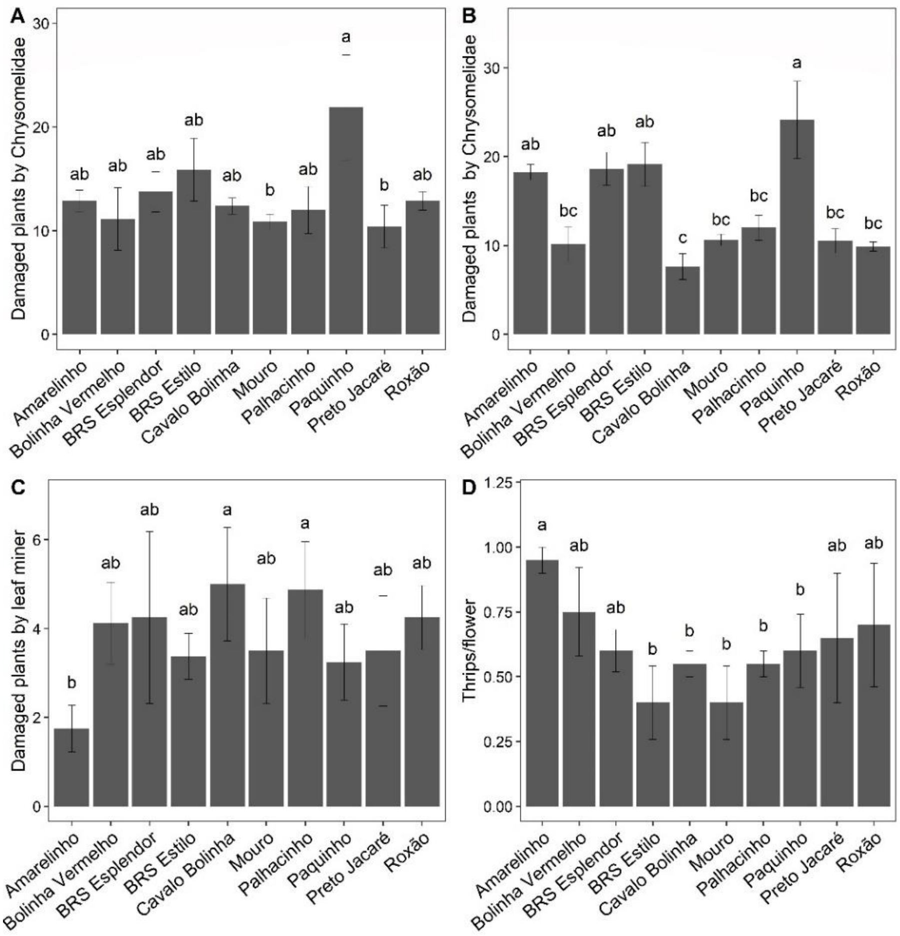

Figure 6: Means (±SE) of plants damaged by Chrysomelidae at first (A) and second (B) evaluation, plants damaged by leaf miner (C) and thrips per flower (D) in common bean genotypes under organic system at third season growing. Means followed by same letter did not differ by Tukey test ($p \geq 0.05$).

In this experiment, the presence of whitefly nymph was not observed, and stink bug incidence was not different in the beans materials in none of two evaluations ($F_{9,\ 30}= 0.38$; p=0. 937; $F_{9,30}= 0.82$; p =0. 597) (Table 3).

Table 3: Means (±SE) of stink bug (first and second evaluation) incidence in commom beans genotypes under organic system at third season of sowing (2018 May).

Genotypes	**Stink bug/plot**	
	58 (DAP)	**66 (DAP)**
Amarelinho	1.00 ± 1.00	2.50 ± 1.00
Bolinha Vermelho	1.00 ± 1.15	1.00 ± 0.82
BRS Esplendor	0.25 ± 0.50	1.75 ± 1.25
BRS Estilo	0.50 ± 1.00	2.00 ± 1.15
Cavalo Bolinha	0.75 ± 0.96	0.75 ± 1.50
Mouro	1.00 ± 0.82	1.25 ± 1.50
Palhacinho	0.50 ± 1.00	1.25 ± 0.95
Paquinho	0.75 ± 0.95	2.00 ± 1.82
Preto Jacaré	0.00 ± 0.00	1.00 ± 1.41
Roxão	0.80 ± 1.47	1.00 ± 0.82

DAP: Days after planting. Means followed by same letter did not differ by Tukey test (p≥0.05).

Yield and quality of grains did not differ between the beans materials in third season of sowing. Yield was about 1092.71 Kg ha^{-1} to 1812.08 Kg ha^{-1} with no significant difference ($F_{9,30}$= 0.77; p= 0.646) (Figure 7A). Normal grains, spotted grains and chocho grains did not differ between the treatments (normal: $F_{9,30}$= 1.248, p= 0.305; spotted: $F_{9,30}$=1.25, p= 0.302; chocho: $F_{9,30}$= 0.95, p= 0.496) (Figure 7B, 7C, 7D, respectively).

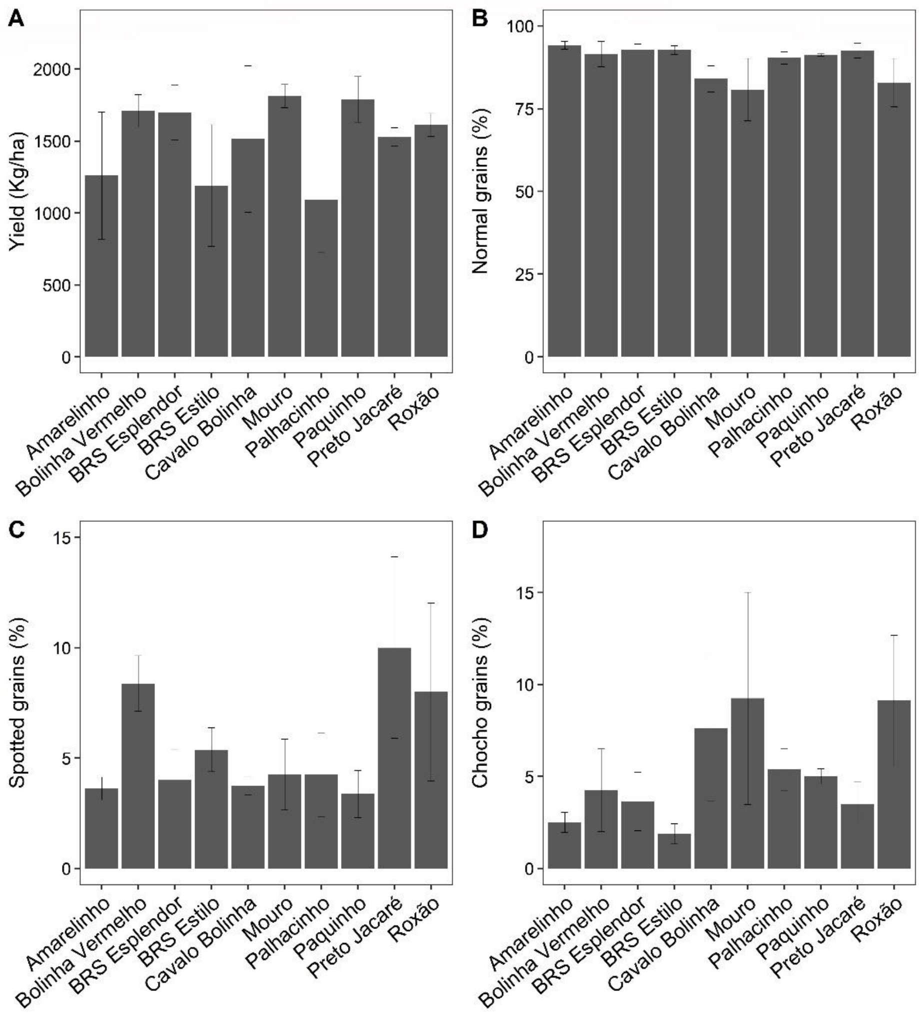

Figure 7: Means (±SE) of yield mean (A), and percentages of normal grains (B), spotted grains (C) and chochos grains (D) produced by common bean genotypes under organic system at third season growing. Means followed by same letter did not differ by Tukey test ($p \geq 0.05$).

Here we found that the second season (sowing in January) is unviable for production of all common bean genotypes tested under organic system. Although the incidence of important insect as chrysomelidae, heteroptera, leaf miner and thrips was relatively low at all three seasons of sowing, the high population of whitefly on second growing strongly affected the production of bean genotypes, mainly due mosaic transmission. Furthermore, we observed that cultivation of common bean (including commercial and creoles genotypes) in dry season as May, might favor the yield and quality of grain, both by lower incidence of insect and better climatic conditions.

Highest number of heteroptera was observed on first season (sowing in October) with minor differences between the treatments. Likewise, common beans and soybeans planted in similar dates to ours (mid September and November/December, respectively) present larger number of stinkbugs (Souza et al., 2015; Ramos et al., 2017). Species found were mainly *Piezodorus guildinii* (Pentatomidae) and *Neomegalotomus* spp. (Miridae). These insects are known to damage leguminous crops, causing injuries on yield and/or quality of grains (Degrande and Vivan, 2009; Silva et al., 2012). Lower yield and quality of grains produced on first season may be related by the higher incidence of these insects. The genotype Roxão had the highest number of heteroptera and resulted in the lowest yield. Damage by *Neomegalotomus* spp. feeding in developing beans or as a vector of yeast spot decreased seed mass and increased seedling mortality (Chandler, 1989; Panizzi et al., 2000). Besides, *P. guildinii* is considered the stinkbug causing the greatest qualitative and quantitative losses of soybeans (Corrêa-Ferreira and Azevedo 2002).

Plants damaged by leaf miner was low, reaching maximum of five injured plants, at third season of growing. Thrips incidence in the flowers was higher in first season, mainly on genotypes Cavalo bolinha and Palhacinho. While leaf miner injury the leaves and decrease the photosynthesis rate (Trumble et al., 1985; Yldirin et al., 2010), thrips may damage plants by direct and continuous sap suction (Vieira 1988; Boiça Júnior et al., 2015). Plants damaged by leaf miner insects and thrips incidence were found in low number in beans genotypes in this study.

The most prevalent genera of chrysomelidae were *Diabrotica* and *Cerotoma* and whitefly species found was *B. tabaci.* Number of plants damaged by chrysomelidae varied between the treatments in almost all date of evaluation, whereas the whitefly nymphs incidence was significant only at second season of sowing. Some treatments were more attacked by chrysomelidae and whitefly nymphs than others were, with minor difference between each other. Both chrysomelidae species and whiteflies may cause damage as by defoliation and reducing photosynthetic activity (Gassen 1989) and by transmission of plant viruses (Costa et al., 1987; Shortt et al., 1982; Giesler et al., 2002). Plants cultivated in this season developed well until 38 DAE, when we detected the presence of *Bean Golden Mosaic Virus* symptoms.

BGMV may cause plants growth reduction, deformation and yellowed leaves, pods deformation, reduced number and size of pod and decrease in weight of seeds (Faria et al., 2000). In Brasil the losses by this disease is about 40% to 85% of production, and may reach 100% if whitefly population is high on initial plant development (Menten et al., 1980; Galvez and Morales 1989; Quintela, 2004; Aragão, 2014). In our study, the production of all beans material at second season of growing was unfeasible by the BGMV infection. Although the incidence of vectors and the plants with virus symptoms differed between the treatments, no genotype was able to produce in this season. We hypothesized that the high rainfall associated with occurrence of mosaic prevented the production of all creoles and commercials genotypes.

Third season of sowing resulted in the higher yield of all genotypes. The beans productivity in this season was higher than the Brazilian average (1.062 kg ha^{-1}) (Conab, 2020), with low percentages of non-normal grains. The ideal temperature to common beans production is between 12ºC and 30ºC (Didonet and Silva (2009). Climatic conditions of this season was characterized by the low rainfall, mild temperatures (median low than 25º) and higher thermic amplitude, favoring the common beans production both by optimum climatic conditions and by unflavored the phytosanitary factors that jeopardize this crop production.

Rescue and conservation of propagation materials is one of the basis of organic system of cultivation. Creole seed are varieties developed, adapted or produced by family farmers. These creole materials keep natural richness of ancestral knowledge, and must be preserved, and disseminated (Cunha, 2013). In general, we observed that the commercial materials did not differ from the majority of creoles, suggesting that in favorable conditions of growing, the commercial genotypes or creole might result in similar productive potential under organic systems of production. Although these commercial genotypes were less damaged (sometimes) by chrysomelidae and leaf miner, they were not capable to produce under low incidence of whitefly and mosaic, showing that the genetic breeding of these commercial materials might be not enough to prevent losses by this disease.

CONCLUSIONS

BGMV incidence jeopardizes all bean genotypes with no production in rainfall season; third season of growing (May) result in higher yield and grain quality of bean genotypes. Besides, our findings underscore the potential of using creole genotypes, the severity of BGMV and the importance of climatic conditions on beans production.

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REFERENCES

ALVARADO A, GRILLO H, GÓMEZ S, ARIAS MA. **Complejo de chinches (Hemiptera: Pentatomidae) en frijol común**. Inventario y presencia em tres localidades de Villa Clara. Centro Agrícola, v. 36, p. 75–82, 2009a.

ALVARADO A, GRILLO H, GÓMEZ S, ARIAS MA. **Afectación del complejo de chinches (Heteroptera; Pentatomidae) en variedades de frijol común en tres localidades de Villa Clara.** Centro Agrícola, v. 36, p. 35–40, 2009b.

ARAGÃO FJL, FARIA JC. First transgenic geminivirus-resistant plant in the field. **Nature Biotechnology**, v. 27, n. 12, p. 1086-1088, 2009. doi:10.1038/nbt1209-1086.

BARBOSA F, GONZAGA A. **Informações técnicas para o cultivo do feijoeiro-comum na Região Central-Brasileira**. Embrapa Arroz e Feijão. Santo Antônio de Goiás, Brasil, 2012.

BOIÇA JÚNIOR AL, COSTA EN, SOUZA BHSD, SILVA AGD, CHIORATO AF. Infestation of *Caliothrips phaseoli* (Thysanoptera: Thripidae) on bean cultivars grown in the winter, rainy, and dry seasons in Brazil. **Environmental entomology**, v. 44, p. 1139-1148, 2015.

BRASIL (2003) **Lei Nº. 10.831**, de 23 de dezembro de 2003. Dispõe sobre a agricultura orgânica e dá outras providências. Disponível em:< http://www. planalto. gov. br/ccivil_03/leis/2003/l10> Acesso em 03 dez. 2018.

CHANDLER L. The broad-headed bug *Megalotomus parvus* (Westwood) Heteroptera:Alydidae), a dey season pest of beans in Brazil**. Annual Report Bean Improvment Cooperation**, v. 32, p. 84–85, 1989.

CONAB. Companhia Nacional de Abastecimento. **Perspectivas para a Agropecuária**. Brasília, v. 5, p.1-111, 2021.

CORRÊA-FERREIRA BS, AZEVEDO J. Soybean seed damage by different species of stink bugs. **Agricultural and Forest Entomology**, v. 4, p. 145-150, 2002.

COSTA CL, SANTOS OR, ULHOA SC. Disseminação diferencial do vírus do mosaico-do-sul do feijoeiro pela população natural de besouros vetores. **Fitopatologia Brasileira**, v. 12, p. 146, 1987.

COSTA RICA. **Las moscas blancas (Homoptera: Aleyrodidae) em America Central y Caribe**: Memória. Turrialba: CATIE. (Informe Técnico 205), 1992.

CUNHA FL. **Sementes da Paixão e as Políticas Públicas de Distribuição de Sementes na Paraíba**. 2013. Master Dissertation. Universidade Federal Rural do Rio de Janeiro, Seropédica.

DEGRANDE PE, VIVAN LM. **Pragas da soja**. In: Yuyama MM, Suzuki S, and Camacho SA. Rondonópolis: Fundação MT, 2009, 418 p. (Boletim de Pesquisa de Soja).

DESHPANDE, S.S. Food legumes in human nutrition: a personal perspective. **Food Science and Nutrition**, v. 32, p. 333-363, 1992.

DEPIERI RA, PANIZZI AR. Duration of feeding and superficial and indepth damage to soybean seed by selected species of stink bugs (Heteroptera: Pentatomidae). **Neotropical Entomology**, v. 40, p. 197–203, 2011.

DIDONET AD, MOREIRA JAA, FERREIRA EPB. Sistema de Produção Orgânico de Feijão para Agricultores Familiares. Embrapa. 2009. 8p. (Circular técnico n.173).

FARIA JC, BEZERRA IC, ZERBINI FM, RIBEIRO SG, LIMA MF. Current status of diseases caused by geminiviruses in Brazil. **Fitopatologia Brasileira**, v. 25, n. 2, p. 125-137, 2000.

FARIA JC, ARAGÃO FJL, SOUZA TLPO, QUINTELA ED, KITAJIMA EW, RIBEIRO SDG. Golden mosaic of common beans in Brazil: management with a transgenic approach. Embrapa Arroz e Feijão-Artigo em periódico indexado (ALICE), 2016.

FAZOLIN M, GOMES TCA. Dinâmica populacional de *Cerotoma tingomarianus* Bechyné em caupi e puerária em Rio Branco. Anais-sociedade Entomologica do Brasil, v. 22, p. 491-495, 1993.

FERNANDES GB. Sementes crioulas, varietais e orgânicas para a agricultura familiar: da exceção legal à política pública. In: SAMBUICHI, R.H.R.O. et al. **A política nacional de agroecologia e produção orgânica no Brasil**: uma trajetória de luta pelo desenvolvimento rural sustentável, 2017.

GALVEZ GE, MORALES FJ. Whitefly-transmitted viruses. In: Schwartz HF and Pastor-Corrales MA (Eds.). **Bean Production Problems in the Tropics**, 2. ed.Centro Internacional de Agricultura Tropical: Colombia. 1989, p. 379-406.

GIESLER LJ, GHABRIAL SA, HUNT TE, HILL JH. Bean pod mottle virus: a threat to U.S. Soybean production. **Plant Disease**, v.86, p. 1280-1289, 2002.

HALLMAN GJ, MORALES CG, DUQUE MC. Biology of *Acrosternum marginatum* (Heteroptera: Pentatomidae) on common beans. **Florida Entomologist**, p. 190-196, 1992.

IRWIN ME, YEARGAN KV, MARSTON NL. Spatial and seasonal patterns of phytophagous thrips in soybean fields with comments on sampling techniques. **Environmental Entomology**, v. 8, p. 131–140, 1979.

JESUS FGD, BOIÇA JUNIOR AL, CARBONELL SAM, STEIN CP, PITTA RM, CHIORATO AF. Infestação de *Bemisia tabaci* biótipo B e *Caliothrips phaseoli* em genótipos de Feijoeiro. **Bragantia**, v. 69, p. 637-648, 2010.

LABINAS, AM. **Controle de pragas na cultura do feijão (*Phaseolus vulgaris* L.) e avaliação econômica**. 2002. Doctoral Thesis. Universidade Estadual Paulista, Faculdade de Ciências Agronômicas, São Paulo.

McPHERSON RM, TODD JW, YEARGAN KV. Stink bugs. In: Higley, L.G.; Boethel, D.J. **Handbook of soybean insect pests**. Entomologica Society of America, Lanham, 1994, p. 87–90.

MEDRANO EG, ESQUIVEL J, BELL AA, GREENE J, ROBERTS P, BACHELER J, MAROIS J, WRIGHT D, NICHOLS R, LOPEZ J. Potential for *Nezara viridula* (Hemiptera: Pentatomidae) to transmit bacterial and fungal pathogens into cotton bolls. **Current Microbiology**, v. 59, p. 405-412, 2009.

MENTEN JOM, TULMANN NETO A, ANDO A. Avaliação dos danos causados pelo virus do mosaico dourado do feijoeiro (VMDF). **Turrialba**, v. 30, p. 173-176, 1980.

MUSA PD, REN S. Development and reproduction of *Bemisia tabaci* (Homoptera: Aleyrodidae) on three bean species. **Insect Science**, v. 12, p. 25–30, 2005.

PANIZZI AR. Wild hosts of pentatomids: Ecological significance and role in their pest status on crops. **Annual Reviews Entomology**, v. 42, p. 99-122, 1997.

PANIZZI AR, SCHAEFER CW, NATUHARA Y. Broad-headed bugs. In: SCHAEFER, C.W.; PANIZZI AR. **Heteroptera of Economic Importance**, CRC Press LLC, Boca Raton. 2000. p. 321-336.

QUINTELA ED. **Manejo integrado dos insetos e outros invertebrados pragas do feijoeiro**. Belo Horizonte. 2004. p. 113-136. Informe Agropecuário.

SALGUERO V. Perspectivas para el manejo del complejo mosca blanca-virosis. **Las moscas blancas en América Central y el Caribe**. CATIE. Turrialba, Costa Rica, 1993. p. 20.

SANTOS NCB, PEREIRA LB. Potencialidades da produção orgânica. In: ARF, O. et al. **Aspectos gerais da cultura do feijão *Phaseolus vulgaris***. 2015. Fepaf: Botucatu.

SANTOS ADS, DA SILVA ED, TAVARES E, CURADO F, DE SALES JFS, PEREIRA L **Desempenho de variedades crioulas e comerciais de feijão-macassar ou feijão-caupi no agreste paraibano**. Embrapa Tabuleiros Costeiros. 2016. 7p. (Comunicado Técnico 186).

SHORTT BJ, SINCLAIR JB, HELM CG, JEFFORDS MR, KOGAN M. Soybean seed quality losses associated with bean leaf beetles and *Alternaria tenuissima*. **Phytopathology**, v. 72, p. 615-618, 1982.

SILVA FAC, SILVA JJ, DIPIERI RA, PANIZZI AR. Feeding activity, salivary amylase activity, and superficial damage to soybean seed by adult *Edessa meditabunda* (F.) and *Euschistus heros* (F.) (Hemiptera: Pentatomidae). **Neotropical Entomology**, v. 41, p. 386-390, 2012.

SOUZA ES, SILVA JPGF, BALDIN ELL, PIEROZZI CG, CUNHA LS, CANASSA VF, PANNUTI LER, LOURENÇÃO AL. Response of soybean genotypes challenged by a stink bug complex (Hemiptera: Pentatomidae). **Journal of Economic Entomology**, v. 109, p. 898-906, 2015.

TRUMBLE JT, TING IP, BATES L. Analysis of physiological, growth, and yield responses of celery to *Liriomyza trifolii*. **Entomology Experimentalis et Applicatta**, v. 38, p. 15-21, 1985.

VIEIRA RMS. Pragas e doenças da bananeira. **Actas I Colóquio da Banana**, Funchal, p. 44-57, 1988.

YILDIRIM EM, ÜNAY A, CIVELEK HS. The effect of *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) on some leaf characteristics of bean (*Phaseolus vulgaris* L.). **Journal of Food, Agriculture and Environment**, v. 8, p. 3, 2010.

YOKOYAMA LP. Tendências de mercado e alternativas de comercialização do feijão. Santo Antônio de Goiás: EMBRAPA-CNPAF, 2002, 4p.

ZAUGG I, MAGNI C, PANZERI D, DAMINATI MG, BOLLINI BB, BANCHER S, SPARVOLI F. QUES, a new *Phaseolus vulgaris* genotype resistant to common bean weevils, contains the Arcelin-8 allele coding for new lectinrelated variants. **Theoretical and applied genetics**, v. 126, n. 3, p. 647-661, 2013.