Occurrence of pests and diseases in cactus pear genotypes

Ocorrência de pragas e doenças em genótipos de palma forrageira

DOI:10.34117/bjdv6n12-581

Recebimento dos originais: 22/11/2020
Aceitação para publicação: 22/12/2020

Alberto Jefferson da Silva Macêdo
Mestre. Aluno de Doutorado no Programa de Pós-graduação em Zootecnia
Instituição: Universidade Federal de Viçosa
Endereço: Av. Peter Henry Rolfs, s/n - Campus Universitário, Viçosa - MG/Brasil, 36570-900
E-mail: alberto.macedo@ufv.br

José Maria Cesar Neto
Mestre em Zootecnia
Instituição: Universidade Federal da Paraíba
Endereço: 12 Rodovia, PB-079, Areia - PB/Brasil, 58397-000
E-mail: netocesar2511@hotmail.com

João Paulo de Farias Ramos
Doutor em Zootecnia. Professor da Universidade Federal da Paraíba
Instituição: Universidade Federal da Paraíba
Endereço: 12 Rodovia, PB-079, Areia - PB/Brasil, 58397-000
E-mail: jpmepapb@yahoo.com.br

Danillo Marte Pereira
Mestre. Aluno de Doutorado no Programa de Pós-graduação em Zootecnia
Instituição: Universidade Federal da Paraíba
Endereço: 12 Rodovia, PB-079, Areia - PB/Brasil, 58397-000
E-mail: danillomarte.zootec@gmail.com

Leydiane Bezerra de Oliveira
Mestra. Aluna de Doutorado no Programa de Pós-graduação em Zootecnia
Instituição: Universidade Federal do Ceará
Endereço: R. Cinco, 100 - Pres. Kennedy, Fortaleza - CE/Brasil, 60355-636
E-mail: leydoliveira_sf@yahoo.com.br

Ana Cecília Souza Muniz
Graduada em Zootecnia
Instituição: Universidade Federal da Paraíba
Endereço: 12 Rodovia, PB-079, Areia - PB/Brasil, 58397-000
E-mail: anaceciliamunizcb1@gmail.com

Joyce Pereira Alves
Graduada. Aluna de Mestrado no Programa de Pós-graduação em Zootecnia
Instituição: Universidade Federal da Grande Dourados
Endereço: R. João Rosa Góes, 1761 - Vila Progresso, Dourados - MS/Brasil, 79825-070
E-mail: joyycepereira16@gmail.com
The objective was to evaluate the occurrence of pests, diseases and mortality rate in nine genotypes of cactus pear (*Nopalea cochenillifera*) destined for forage production. The genotypes were implanted in a complete randomized block design, with nine treatments and three replications. After 330 days of cultivation, the occurrence of pests and diseases and verification of plant mortality were carried out. Among all the pests and diseases observed in this experimental trial, the most prevalent disease regardless of the evaluated genotype was the anthracnose stain "*Colletotrichum gloeosporioides*" (49.20%) and the less frequent diseases were the resine *"Dothiorella ribis"* (6.87%) and soft rot *"Erwinia carotovora"* (2.58%). The only occurrence pest was the cochonilha in scales *"Diaspis echinocacti"* (22.69%). The Texas (V13) and Negro Michoacan (F07) genotypes showed the highest occurrence of pests and diseases, from 50% of the total plants, followed by anthracnose stain and cochineal in scales. On the contrary, the genotypes Tamazunchale (V12) and California (V14) were not affected by any pest or disease. It was observed that the genotypes Nopalea Uruapan (V20) and Blanco San Pedro (V19), had a lower occurrence of pests and diseases, less than 20% of the total plants. The genotypes that presented the highest mortality rate were Texas (V13), Blanco San Pedro (V19) and Polotitlan (V09), with 80, 70 and 65% mortality rate, respectively. The genotypes Nopalea Uruapan (V20) and California (V14) had the lowest mortality rate (20 and 35%), respectively. The genotypes that were least affected by pests and diseases and had the lowest mortality rate are Tamazunchale (V12), California (V14) and Nopalea Uruapan (V20).

**Keywrod:** Cactaceae, Incidence, *Nopalea cochenillifera*, Forage production, Semiarid.
Negro Michoacan (F07) apresentaram maior ocorrência de pragas e doenças, a partir de 50% do total de plantas, seguido de mancha de antracnose e cochonilha de escamas. Ao contrário, os genótipos Tamazunchale (V12) e Califórnia (V14) não foram acometidos por nenhuma praga ou doença. Observou-se que os genótipos Nopalea Uruapan (V20) e Blanco San Pedro (V19), apresentaram menor ocorrência de pragas e doenças, inferiores a 20% do total de plantas. Os genótipos que apresentaram maior taxa de mortalidade foram Texas (V13), Blanco San Pedro (V19) e Polotitlan (V09), com 80, 70 e 65% de taxa de mortalidade, respectivamente. Os genótipos Nopalea Uruapan (V20) e Califórnia (V14) apresentaram menor taxa de mortalidade (20 e 35%), respectivamente. Os genótipos que menos foram acometidos por pragas e doenças e apresentaram menor taxa de mortalidade são Tamazunchale (V12), Califórnia (V14) e Nopalea Uruapan (V20).

Palavras-chave: Cactáceas, Incidência, *Nopalea cochenillifera*, Produção de forragem, Semiárido.

1 INTRODUCTION

Like any other plant culture, the cactus pear can be affected by various pests and diseases, and the *Hemiptera* order stands out and can cause great economic losses. Especially for mealybugs, carmine and scales, insects are capable of causing damage to the production of this culture due to these insects suck the sap of the plant, reducing the photosynthetic area and causing its death (CHIACCHIO, 2008; DUBEUX JÚNIOR et al., 2013; NASCIMENTO et al., 2020).

The pests that affect the culture of the cactus pear are several, from rodents to mites. Currently, two pests that deserve to be highlighted because they multiply quickly and reduce the productive potential of the cactus pear, are the Cochineal carmine “*Dactylopius coccus*” and the Cochineal in scales “*Diaspis echinocacti*” (LOPES et al., 2010; MACÊDO et al., 2020).

Cactus pear culture can also be affected by diseases, the vast majority of which are spread through fungal or bacterial vectors, as in the case of Soft rot, a disease caused by the bacterium “*Erwinia carotovora*”, its main causes of occurrence in the culture of cactus pear are due to excessive moisture in the soil and excessive nitrogen fertilization, the bacteria spreads through the plant tissues mainly in the primary and secondary cladodes causing its degeneration and subsequent tipping and death of the plant (GUTIERREZ, 1993; MACÊDO et al., 2020).

Black rot can affect the cultivation of cactus pear, caused by the fungus “*Lasiodiplodia theobromae*”, causes the degeneration of the tissues that make up the connection between the insertion of the cladodes, which can cause the plant to fall and later death (BARBOSA et al., 2012).

Gomose or Resine can also affect the culture of the cactus pear, caused by the fungus “*Dothiorella ribis*”, causes injuries and as a defense against injury, the plant releases exudation substances that form an elevation in the form of a crank, leading the plant to deplete its reserves, opening entry to other pathogens and causing the death of the plant (BARBOSA et al., 2012).
Another disease that occurs in the cactus pear similar to Soft rot is “Fusarium rot”, because contamination of the cladodes by the fungus “Fusarium solani (Mart. Sacc.)” occurs, causing the rotting and drying of tissues and subsequent death of the plant. Occurring mainly in acidic and excess moisture soils (COELHO, 2005; SOUZA et al., 2010).

It was hypothesized that when evaluating the occurrence of pests and diseases in cactus pear genotypes belonging to the genus *Nopalea* spp., one could identify the genotypes that stood out before the others, that were resistant or tolerant to pests and diseases.

Thus, the objective of this study was to evaluate phytosanitary conditions through the occurrence of pests, diseases and mortality rate in nine cactus pear genotypes of the genus *Nopalea* spp. for forage production.

2 MATERIAL AND METHODS

2.1 EXPERIMENT PLACE AND PERIOD

The experiment was made in Estação Experimental Benjamim Maranhão (Experimental Station), in the city of Tacima, Paraiba, Brazil, in the mesoregion of Paraiba rough, microregion of Curimataú Oriental, coordinates 6°29’16” East and 35°38’13” West, with altitude of 168 m, belonging to Empresa Paraibana de Pesquisa, Extensão Rural e Regularização Fundiária (EMPAER). Were collected weather data during the whole experimental period with cumulative rainfall of 586 mm and average temperature of 25°C was from January to November 2016 (Figure 1).
2.2 TREATMENTS AND EXPERIMENTAL DESIGN

The experiment was installed in randomized full blocks, with nine treatments and three replicates, with 20 plants per experimental unity. The treatments were constituted of nine cactus pear genotypes of *Nopalea* spp., from the germplasm bank of the Empresa Pernambucana de Pesquisa Agropecuária (IPA), Pernambuco, Brazil, which were donated for researches to EMPAER. They were described below the gender followed by the common name and in parenthesis the identification of the genotype studied in the referred paper:

*Cactus pear genotypes there evaluated:* Negro Michoacan (V07), Polotitlan (V09), Tamazunchale (V12), Texas (V13), Califórnia (V14), Blanco San Pedro (V19), Nopalea Uruapan (V20), Negro Michoacan (F07) e Palma Doce (FD). All *Nopalea* cactus genotypes evaluated are of the species *Nopalea cochenillifera*.

2.3 SOIL CHARACTERISTICS AND PLANTING OF CACTUS GENOTYPES

Before planting, they were collected random soil samples representing the experimental area, in 0-20 cm of depth, to characterize the soil fertility, according to the analysis result (Table 1). It was made mineral fertilization, applying 50 kg P₂O₅ ha⁻¹ in triple superphosphate way (5 g of fertilizer per plant), 70 K₂O ha⁻¹ in potassium chloride way applied in the foundation (6 g of fertilizer per plant) and 50 kg N ha⁻¹ in urea way divided in two applications at 60 days with 40% N and 180 days after planting, applying 60% N (2 g of fertilizer per plant in 1ˢᵗ application and 3 g of fertilizer per plant in the 2ⁿᵈ one), according to the fertilizing recommendations to soil type (CAVALCANTI, 1998).

| Sample | pH | P | K⁺ | Na⁺ | H⁺ + Al³⁺ | Al³⁺ | Ca²⁺ | Mg²⁺ | V% | CEC | OM | SB |
|--------|----|---|----|-----|-----------|------|------|------|----|-----|----|----|
| H₂O₁:₂₅ | mg/dm³ | cmol/dm³ | | | | | | | | | | |
| Average | 6.2 | 86.76 | 200.82 | 0.08 | 1.57 | 0.00 | 0.83 | 0.49 | 58.4 | 3.49 | 9.88 | 1.91 |

Data source: Authors.

The planting occurred in November 2015, and the experimental period had begun in January 2016, ending in November of the same year, with a cladode per hole, in vertical position, spaced 1.0 m between lines and 0.4 m between the plants, with a population of 25,000 plants per hectare. When necessary, they were made periodic weeding to control the occurrence of weeds.
2.4 EVALUATED VARIANTS

The phytosanitary evaluation (PE), was carried out before starting the harvest of the cactus pear, in which precedent the harvest. Subsequently, the trained observer, on the day of the harvest, any suspicion that a plant has some kind of pest or disease, the material was collected and sent to the phytopathology laboratory of the Federal University of Paraíba (UFPB) for proof of identification in the field.

To calculate the mortality rate (MR), it was counted at the end of the experimental period, the remaining plants of each experimental unit were quantified, comparing by the difference between the initial plant quantity subtracting from the final plant quantity, the difference obtained was transformed in percentage value.

2.5 STATISTICAL ANALYSES

Statistical analyzes were performed by descriptive using the software R Core Team (2018).

3 RESULTS AND DISCUSSION

Among the nine cactus pear genotypes evaluated (occurrence of pests and diseases) (Figure 2). Through identification before cutting, it was found that regardless of the genotype, the disease with the highest occurrence was Anthracnose stain (49.20%), followed by the less frequent diseases that were Gomose or Resin and Soft rot (6.87 and 2.58%), respectively. The only pest that affected the evaluated cactus pear genotypes was Cochineal in scales (22.69%).
Figure 2. Occurrence of pests and diseases in the evaluated cactus pear genotypes.

Data source: Authors.

To avoid the occurrence of diseases in a cactus culture, healthy cladodes should be selected and free from contamination, through proper planting, correcting the soil fertility and with cultural treatments, it is unlikely that the cactus culture will be affected by diseases, because in this case culture most diseases that occur are caused by fungi (VASCONCELOS et al., 2009; NASCIMENTO et al., 2020; MACÊDO et al., 2020).

While in the case of pests, the most harmful is the Cochineal carmine “Dactylopis coccus”, but its presence has not been verified in any of the nine cactus pear genotypes evaluated, however when the genotypes are resistant to the Cochineal carmine they may not be resistant to Cochineal in scales “Diaspis echinocacti”, its occurrence because it is not so intense, this pest can be well tolerated in well-nourished and managed cactus pear crops (SANTOS et al., 2006; VASCONCELOS et al., 2009).

The Texas (V13) and Negro Michoacan (F07) cactus pear genotypes showed a higher occurrence of pests and diseases, 50 and 30% for Anthracnose stain and 30% for Cochineal in scales, respectively. The Negro Michoacan cactus pear genotype (V07) showed 25% of occurrence for Anthracnose stain. Unlike the Tamazunchale (V12) and California (V14) cactus pear genotypes, which were not affected by any pest or disease. It was observed that the cactus pear genotypes Nopalea Uruapan (V20) and Blanco San Pedro (V19), presented a lower occurrence of pests and diseases, less
than 20% of the total of plants, being 6.25% for Soft rot and 16.67% for Cochineal in scales (Figure 3).

Figure 3. Frequency of pests and diseases in each of the nine cactus pear genotypes evaluated.

Lopes et al. (2010) evaluating Cochineal carmine resistance in 22 cactus genotypes belonging to the genus *Opuntia* spp. and *Nopalea* spp. verified that the genus Miúda, Orelha de elefante mexicana, Orelha de elefante africana and Orelha de onça were resistant to Cochineal carmine, it is still unclear how the resistance of these cactus genotypes to pest works, but it is believed that it may be due to the presence of some chemical substance present in these cactus genotypes that inhibit the development of the pest.

According to Figure 4, it was found that the mortality rate ranged from 20 to 80%, that is, all genotypes evaluated showed mortality. The genotypes that presented the highest mortality rate were Texas (V13), Blanco San Pedro (V19) and Polotitlan (V09), with 80, 70 and 65% mortality rate, respectively. The cactus genotypes Nopalea Uruapan (V20) and California (V14) had the lowest mortality rate (20 and 35%), respectively.
According to the mortality rate assessment, it was found that under the same conditions as the nine cactus genotypes evaluated, the mortality rate above 50% indicates that these genotypes probably did not show adaptability to the conditions to which they were exposed, because in addition to the high rate of mortality will possibly present low agronomic performance, due to the production yield of dry and green matter decreasing as the plant population per hectare also decreases (MACÉDO et al., 2020).

When it is intended to assess the occurrence of pests or diseases that can affect these xerophilous forage crops, characteristics such as adaptability of the culture under the cultivation environment are essential, when assessing the mortality rate of the stand implanted, even if in a small proportion, are results indispensable in the screening process to evaluate possible new genotypes and the continuity of the genotypes evaluated in larger-scale plantations (SANTOS et al., 2006; SOUZA et al., 2010; DUBEUX JÚNIOR et al., 2013; NASCIMENTO et al., 2020).

Silva et al. (2015) evaluating three cactus clones found a higher mortality rate in the Miúda clone and lower mortality rate in the Orelha de elefante mexicana clone, the authors attributed these results to the fact that the Miúda cactus is more demanding in edaphoclimatic and cultivation conditions when compared to cactus belonging to the genus Opuntia spp. if cultivated without proper care, the Miúda cactus is likely to have low agronomic production, second with a high mortality rate.
4 CONCLUSION

The cactus pear genotypes that were least affected by pests and diseases and that presented the lowest mortality rate are Tamazunchale (V12), California (V14) and Nopalea Uruapan (V20).

ACKNOWLEDGEMENT

The authors express gratitude for the support of the Grupo de Estudos em Forragicultura (GEF), as well as for the contribution of the Paraiba Research Company, Rural Extension and Land Regularization (EMPAER), Coordination for the Improvement of Higher Education Personnel (CAPES) and the National Council of Scientific and Technological Development (CNPq).
REFERENCES

BARBOSA, M.L.; SILVA, T.G.F.; ZOLNIER, S.; SILVA, S.M.S.; ARÚJO JUNIOR, G.N.; JARDIM, A.M.R.F. The influence of cladode morphology on the canopy formation of forage cactus plants. 

Revista Ceres, v. 64, n. 5, p. 465–475, 2018. https://doi.org/10.1590/1983-21252018v31n121rc

CAVALCANTI, F.J.A. Recomendações de adubação para o Estado de Pernambuco – 2ª aproximação. 2ª ed. Recife: Instituto Agronômico de Pernambuco; 1998.

CHIACCHIO, F.P.B. Incidência da cochonilha do carmim em planta forrageira. Bahia Agrícola, v. 8, p. 12-14, 2008.

COELHO, R.S.B. Doenças da palma. In: MENEZES, R.S.C.; SIMÕES, D.A.; SAMPAIO, E.V.S.B. (Ed.). A palma no Nordeste do Brasil: conhecimento atual e novas perspectivas de uso. Recife: Ed. Universitária da UFPE, 2005. p. 57-63.

DUBEUX JÚNIOR, J.C.; SANTOS, M.V.F.; CAVALCANTE, M.; SANTOS, D.C. Potencial da palma forrageira na América do Sul. Cactusnet Newsletter, v. 13, p. 29–40, 2013.

GUTIERREZ, L.H. Plagas y enfermedades del Nopal en México. Universidad Autónoma de Chapingo, CIESTAAM, Reporte de Investigación 11, 52p., 1993. Disponível em: <http://ciestaam.edu.mx/plagas-enfermedades-del-nopal-en-mexico/>. Acesso em: 14 mai. 2017.

LOPES, E.B.; BRITO, C.H.; ALBUQUERQUE, I.C.; BATISTA, J.L. Seleção de genótipos de palma forrageira (Opuntia spp.) e (Nopalea spp.) resistentes a cochonilha-do-carmim (Dactylopius opuntiae Cockerell, 1929) na Paraíba, Brasil. Engenharia Ambiental, v. 7, n. 1, p. 204-215, 2010.

MACÊDO, A.J.S.; CESAR NETO, J.M.; OLIVEIRA, L.B.; EDVAN, R.L.; SANTOS, E.M. A cultura da palma, origem, introdução, expansão, utilidades e perspectivas futuras: Revisão de Literatura. Brazilian Journal of Development, v. 6, n. 8, p. 62966-62987, 2020. DOI: https://doi.org/10.34117/bjdv6n8-652

NASCIMENTO, R.R.; EDVAN, R.L.; AMORIM, D.S.; ARAÚJO, J.S.; DA SILVA, A.L.; SOUSA, S.V.; NASCIMENTO, K. DOS S.; BARROS, L. DE S.; TOMAZ, J.L.S. Métodos de cultivo de mudas de três variedades de palma forrageira/Seedling cultivation methods of three varieties of forage cactos. 

Brazilian Journal of Development, v. 6, n. 5, p. 32689-32697, 2020. DOI:10.34117/bjdv6n5-640

R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Disponível em: <https://www.R-project.org/>. Acesso em: 10 jan. 2018.

SANTOS, D.C.; FARIAS, I.; LIRA, M.A.; SANTOS, M.V.F.; ARRUDA, G.P.; COELHO, R.S.B.; DIAS, F.M.; MELO, J.N. Manejo e utilização da palma forrageira (Opuntia e Nopalea) em Pernambuco. Recife: Empresa Pernambucana de Pesquisa Agropecuária-IPA, 2006. (IPA, Documentos, 30). Disponível em: <http://www.ipa.br/publicacoes_tecnicas/Pal01.pdf>. Acessado em: 17 dez. 2017.

SILVA, T.G.F.; PRIMO, J.T.A.; MORAIS, J.E.F.; DINIZ, W.J.S.; SOUZA, C.A.A.; SILVA, M.C. Crescimento e produtividade de clones de palma forrageira no semiárido e relações com variáveis meteorológicas. Revista Caatinga, v. 28, n. 2, p. 10–18, 2015.
SOUZA, A.E.F.; NASCIMENTO, L.C.; ARAÚJO, E.; LOPES, E.B.; SOUTO, F.M. Ocorrência e identificação dos agentes etiológicos de doenças em palma forrageira (*Opuntia ficus-indica* Mill) no semiárido paraibano. *Biotemas*, v. 23, n. 3, p. 11–20, 2010.

VASCONCELOS, A.G.V.; LIRA, M.A.; CAVALCANTI, V.L.B.; SANTOS, M.V.F. WILLADINO, L. Seleção de clones de palma forrageira resistentes à cochonilha do carmim (*Dactylopius* spp.). *Revista Brasileira Zootecnia*, v. 38, n. 5, p. 827–831, 2009.