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From the "Divine Plagues" to the modern challenges: the case of the Central American locust *Schistocerca piceifrons piceifrons* (Orthoptera: Acrididae) in Mexico[ϕ]

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Introduction

Historically, the Central American locust *Schistocerca piceifrons piceifrons* Walker (Orthoptera: Acrididae) has represented an agricultural threat and a cultural symbol of disaster (Fig. 1). This insect arrived in swarms to Monterrey, Mexico, in 2022 (SADER 2022), where various swarms sparked fear and speculation among resident people from the region, and some residents interpreted such an event as a "divine punishment", which reflects how that ancient perception still prevails Today (Le Gall *et al.* 2019; iHeartMedia 2023).

Biologically, this migratory insect is well adapted to environmentally variable conditions, and it can survive droughts and shifting climates (Foquet *et al.* 2022). It experiences a life cycle phase, called polyphenism, in which it transitions from a harmless, solitary phase to massive swarms of thousands of individuals "that consume virtually everything in their path", and these swarms form when the humidity and food availability are favorable (Harvey 1983).

Historical accounts reinforce their impact in the crops. The *Book of Exodus* describes locusts "covering the ground until it was black… nothing green remained" (Exodus 10:13–

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15), while the Mayan prophecies warned of "bread of locust and water of locust," underscoring their devastating effects on crops an on the water supplies (Barrientos-Lozano *et al.* 2021).

Today, the outbreaks of *S. piceifrons* continue across Mexico and Central America affecting crops, like those of maize (*Zea mays* L.), sugarcane (*Saccharum* spp.), and sorghum (*Sorghum* spp.), with swarms capable of consuming up to 100 ton of plants per day (García-García *et al.* 2008; OIRSA 2024). This work aims to describe the historical, cultural, biological, and economic relevance of the Central American locust *Schistocerca piceifrons* and emphasize its threats and the need for effective and sustainable management strategies to fight it as a plague.

Figure 1. Central American locust *Schistocerca piceifrons piceifrons* perched on grass (Photo by Elvira García).

A brief story of its presence in Mexico

Back in June 2022 in Monterrey, Mexico, as entomologist (Victor Almaraz Valle, pers. com.) I received a message from a friend who was deeply worried since she had seen the news reports of a locust invasion nearing the city and asked me, half-concerned and half-curious,

whether I knew what these insects were and why they were suddenly gathered in some massive manner. To her—and her neighbors' surprise—, some were frightened that they even speculated those swarms were a "divine punishment" for the region.

At that moment, it had only been a brief time since the locust was officially reported in Nuevo Leon, Mexico, earlier that same year. I explained to her that it is a migratory insect species of locust, which is well adapted to survive across different climatic regions of Mexico and Central America and has evolved unique physiological and behavioral strategies to endure droughts under fluctuating climate conditions.

During some biological cycle phase, this insect is harmless and solitary. But it possesses a remarkable ability to switch into a gregarious, migratory phase (polyphenism) when environmental conditions (*e.g.*, humidity and food availability) align just right at a given place and moment. In this phase, they form massive swarms stretching for kilometers and consuming virtually everything in their path including agricultural crops to wild vegetation (Foquet *et al.* 2022).

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Ancient tales: locusts in history and religion

Earliest accounts of massive locust swarms are found in the sacred texts of ancient civilizations. Perhaps, the most famous is the Eighth Plague of Egypt described in the Book of Exodus (1500–1200 BCE), the second-oldest book of the Judeo-Christian Bible. In chapter 10, verses 13–15, reads:

"13 Moses stretched out his staff over Egypt, and the Lord made an east wind blow across the land all that day and night; by morning, the wind had brought the locusts.
14 They invaded all Egypt and settled in every area; never before had there been such a plague of locusts, nor will there ever be again.
15 They covered the ground until it was black. They devoured every plant in the fields and every fruit on the trees left by the hail; nothing green remained on tree or plant in all the land of Egypt."

Other biblical references (Leviticus 11:21–22; Deuteronomy 28:38; Jeremiah 51:27; Joel 1:4, 2:25) speak of the locust (*Schistocerca gregaria* Forsskal) as an existential threat to farmers and herders alike, describing swarming behavior and even mentioning their juvenile stages (Aharoni 1938).

On this side of the Atlantic, the Central American locust was just as feared. The Mayan people know it as *"Saak"*, a destructive force capable of bringing society to its knees and even plunging the world into what they called a *"Cosmic Chaos"* (Anónimo ca. siglo XVI/2003; Barrientos-Lozano *et al.* 2021), In the Mayan Chilam Balam prophecies, chilling warnings speak to this dread: *"Years of locust will descend bread of locust and water of locust"* and *"Ten generations, thirteen generations will bear the burden of locusts."*

The first phrase refers to locust of devastating impact on food supplies—locusts devouring crops until nothing remained. The phrase *"water of locust"* ominously warns of water contamination from masses of dead insects in rivers and lakes (Barrientos-Lozano *et al.* 2021). The second prophecy eerily hints at the Maya's keen awareness of locust phase polyphenism. Some scholars have even speculated that recurrent locust outbreaks may have contributed to the Maya civilization's decline (Barrientos-Lozano *et al.* 2021). The Nahua people also documented locust plagues (Fig. 2), noting their explosive population growth linked to climatic changes and their frightening voracity (Flores-Granados 2011).

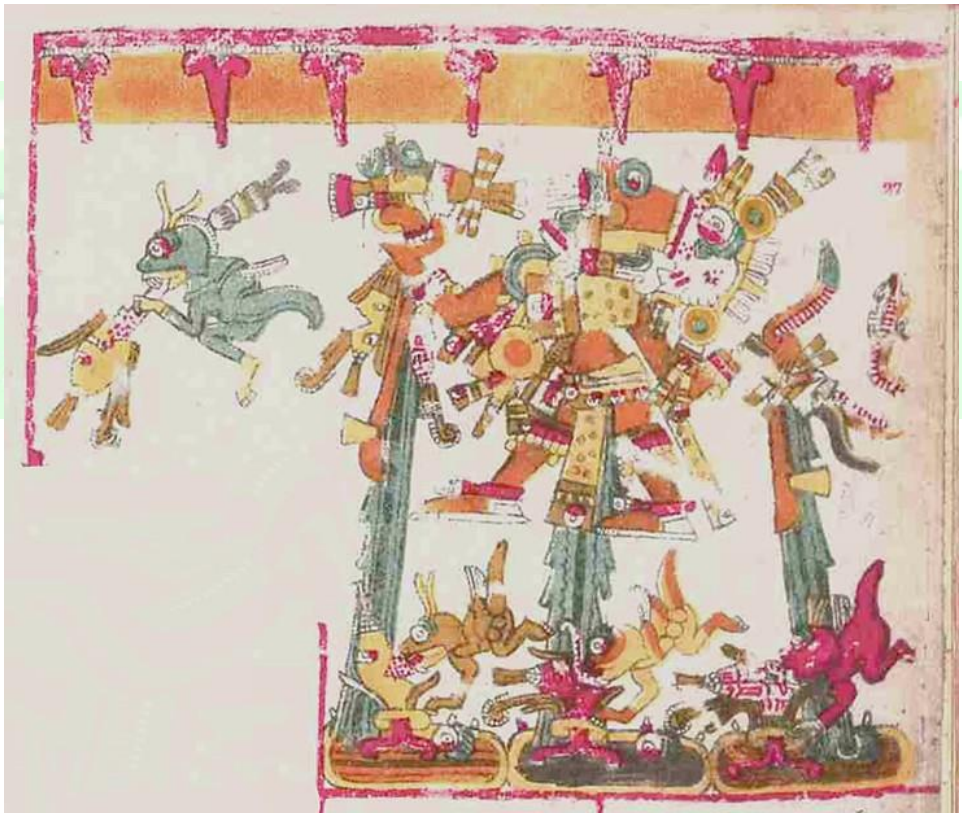

Figure 2. The god Tlaloc (center) flanked by locusts (bottom and left), which are consuming maize ears. Plate 27, top right corner of the Codex Borgia.

These accounts cemented locusts as "agents of ruin"—creatures capable of sparking famine overnight (Harvey 1983). The fact that such narratives appear across cultures as

distant as the Egyptian, Maya, and Nahua, shows how, for millennia, locusts have ranked among humanity's most dreaded natural disasters.

Biology and distribution

The Central American locust is a native insect to the tropical and subtropical Americas, from Costa Rica to Mexico, occasionally reaching Colombia, Venezuela, and Peru (Barrientos-Lozano *et al.* 2021). Two subspecies are recognized: *S. piceifrons*, from Mexico and Central America and *S. piceifrons peruviana*, from Peru (Harvey 1983; Poot-Pech 2023). Both experience the polyphenism— swarming in high densities. Under optimal conditions (average temperatures of ~27°C and annual rainfall above 1,000 mm), adults reproduce and lay egg pods (40–70 eggs) (Hernández-Zul *et al.* 2013). As the nymphs mature, populations can rapidly shift into their gregarious phase, forming vast swarms capable of traveling long distances in search of food (Le Gall *et al.* 2019) (Fig. 3).

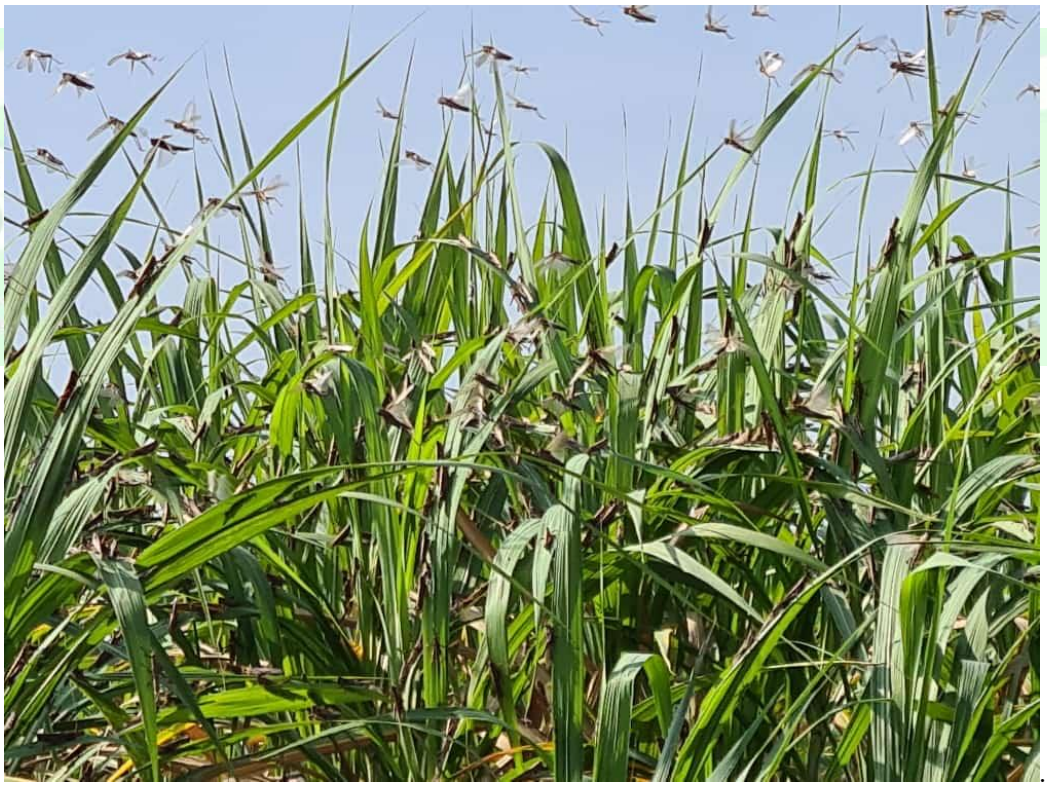

Figure 3. Migratory swarm of the Central American locust (Photo by Dr. Mario Antonio Poot Pech).

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Economic and food security impacts

The economic damage inflicted by this insect to crops is severe. It devastates key crops, such as those of the maize, sugarcane, and sorghum (Fig. 4)—all staples of Mexico and Central America's agricultural economy (García-García *et al.* 2008).

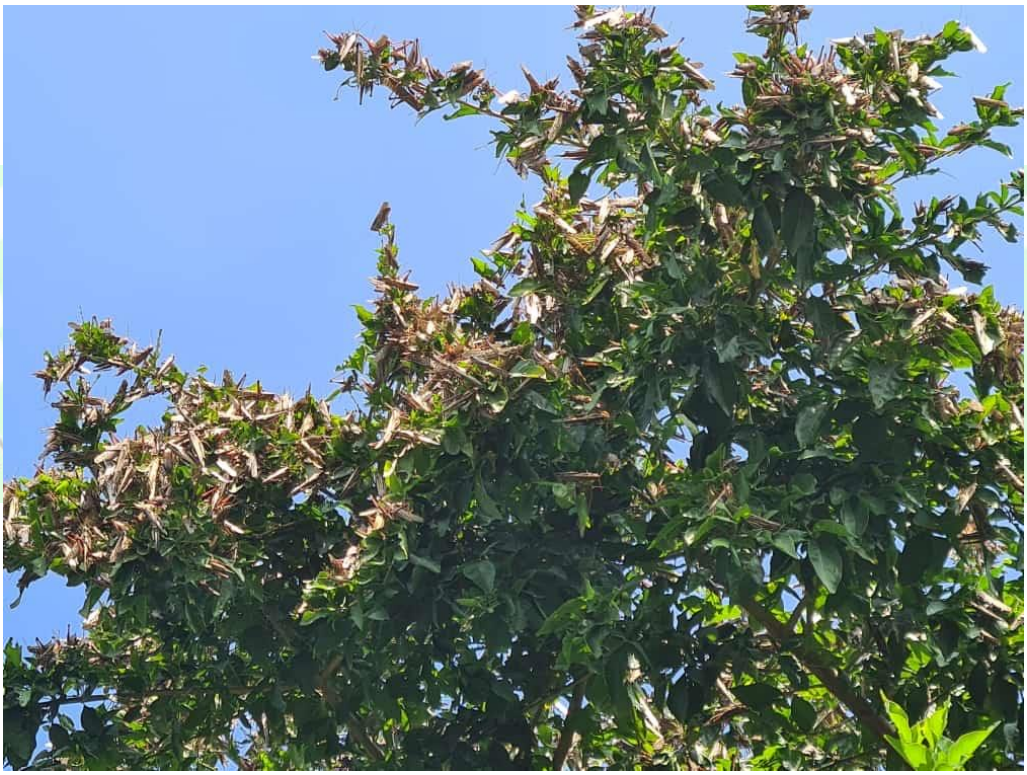

Figure 4. Central American locust feeding on a citrus tree (Photo by Dr. Mario Antonio Poot Pech).

Beyond crops, it also consumes wild vegetation such as the alamo *Ficus cotinifolia* to the María Negra *Cordia curassavica*. This diet adaptation allows the insect to thrive across ecosystems, making outbreaks difficult to predict and contain (García-García *et al.* 2008).

Economically, the locust swarms can cause losses of up to 100 ton of crops per day; moreover, the high costs of their control campaigns can reach 1.7 million USD (OIRSA 2024; SENASICA 2025). While pesticides are a common tool against this population insect, some

biocontrol agents, like the fungus *Metarhizium anisopliae* (Metschnikoff), have also been used as population control (Hernández-Velázquez *et al.* 2007; SENASICA 2019).

Current situation in Mexico

In Mexico, locust was officially declared a national plague as early in 1824 (SADER 2020). While some population control campaigns have been ongoing for nearly two centuries, outbreaks persist—especially in southeastern Mexico, in Yucatan, Campeche, and Quintana Roo. However, recently, locust swarms reached the northeastern regions in Nuevo Leon (Barrientos-Lozano *et al.* 2021).

In 2022, locust swarms were reported near the Vicente Guerrero Dam in Tamaulipas into Linares, Nuevo Leon, prompting widespread media coverage (SADER 2022). For an agriculturally important region, like Nuevo Leon, this swarm presence raised serious concerns about the local food security and economic stability. Despite efforts —such as climate-based predictive models and targeted pesticide use— extreme weather and the locust's migratory nature complicate the population control (SADER 2022).

Population control strategies

Modern locust population control management blends the traditional methods with newer, more sustainable approaches to fight against this plague. Dynamic simulation models help predict outbreaks' presence based on climate patterns and improve the response times to the displacement (Hernández-Zul *et al.* 2013). Meanwhile, the integration of biocontrol agents and reduction blanket of pesticide use is key to lowering the additional environmental impacts (SENASICA 2019). Yet, as climate instability intensifies worldwide and the locust populations adapt to the global changing conditions, the population control of their swarms remains a daunting challenge.

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Conclusion

From the ancient Mayan prophecies to modern-day headlines, the Central American locust *Schistocerca piceifrons piceifrons* Walker remains a living link between history and the present-

day agriculture. The biology of this insect —an extraordinary capacity for population booms— combined with human-driven ecosystem disruption and climate change, keeps it an ever-looming threat not only to the biodiversity but for the crops worldwide. The echoes of past calamities, once seen as a "divine punishment," still resound in our fields today. And, while science has armed us with better tools to face this age-old foe, its resilience ensures that our struggle with this plague is far from over.

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References

Aharoni I. 1938. On some animals mentioned in the bible. Osiris 5: 461-478.

Anónimo. 2003. Popol Vuh: las antiguas historias del Quiché (A. Recinos, Trad.). Fondo de Cultura Económica. (Obra original publicada ca. siglo XVI).

Barrientos-Lozano L, Song H, Rocha-Sánchez AY and Torres-Castillo JA. 2021. State of the art management of the Central American locust *Schistocerca piceifrons piceifrons* (Walker, 1870). Agronomy 11(6):1024. https://doi.org/10.3390/agronomy11061024.

Flores-Granados F. 2011. Las plagas de langosta en el área maya: ambiente e historia de una calamidad en la época prehispánica. Península 6(2):27-46.

Foquet B, Little DW, Medina-Durán JH and Song H. 2022. The time course of behavioural phase change in the Central American locust *Schistocerca piceifrons*. Journal of Experimental Biology 225(23): jeb244621. https://doi.org/10.1242/jeb.244621.

García-García PL, Cano-Santana Z, Castellanos-Vargas I, Tovar-Sánchez E and Mora-Jarvio M. 2008. Nutritional ecology of *Schistocerca piceifrons piceifrons* adults from Socorro Island, Mexico. Journal of Orthoptera Research 17(1):107-110. https://dx.doi.org/10.1665/1082-6467(2008)17[107:NEOSPP]2.0.CO;2.

Harvey A. 1983. *Schistocerca piceifrons* (Walker) (Orthoptera: Acrididae), the swarming locust of tropical America: a review. Bulletin of Entomological Research 73(2):171-184. https://doi.org/10.1017/S0007485300008786.

Hernández-Velázquez V, Berlanga-Padilla A and Toriello C. 2007. Reduction of feeding by *Schistocerca piceifrons piceifrons* (Orthoptera: Acrididae), following infection by *Metarhizium anisopliae* Var. *acridum*. Florida Entomologist 90(4):786-789. https://doi.org/10.1653/0015-4040(2007)90[786:ROFBSP]2.0.CO;2.

Hernández-Zul MI, Quijano-Carranza JA, Yáñez-López R, Ocampo-Velázquez RV, Torres-Pacheco I, Guevara-González R. and Castro-Ramírez AE. 2013. Dynamic simulation model of Central American locust *Schistocerca piceifrons* (Orthoptera: Acrididae). Florida Entomologist 96(4):1274-1283. https://doi.org/10.1653/024.096.0405.

iHeartMedia (December 8 2023). Watch: Locust swarm sparks apocalyptic fears in Mexico. iHeart. Retrieved 16/08/2025 from https://www.iheart.com/content/2023-12-08-watch-locust-swarm-sparks-apocalyptic-fears-in-mexico/.

Le Gall M, Overson R and Cease A. 2019. A global review on locusts (Orthoptera: Acrididae) and their interactions with livestock grazing practices. Frontiers in Ecology and Evolution 7:263. https://doi.org/10.3389/fevo.2019.00263.

Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA). 2024. Ficha técnica: Langosta centroamericana (*Schistocerca piceifrons piceifrons*). Retrieved 16/08/2025 from https://web.oirsa.org/wp-content/uploads/2024/01/Ficha-tecnica-Langosta-Centroamericana.pdf.

Poot-Pech MA. 2023. Probability of a Central American locust *Schistocerca piceifrons piceifrons* upsurge in the Yucatan Peninsula, Mexico. Journal of Orthoptera Research 32(1):33-42. https://doi.org/10.3897/jor.32.73824.

Secretaría de Agricultura y Desarrollo Rural (SADER). (February 10 2020). Langosta Centroamericana. Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria. Retrieved 16/08/2025 from https://www.gob.mx/senasica/documentos/langosta-centroamericana-110919.

Secretaría de Agricultura y Desarrollo Rural (SADER). (March 17 2022). Controla Agricultura diez brotes de langosta centroamericana en Nuevo León. Gobierno de México. Retrieved 16/08/2025 from https://www.gob.mx/agricultura/prensa/controla-agricultura-diez-brotes-de-langosta-centroamericana-en-nuevo-leon.

Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA). 2019. Manual operativo de la campaña contra la langosta (*Schistocerca piceifrons piceifrons*, Walker, 1870). Secretaría de Agricultura y Desarrollo Rural. Retrieved 16/08/2025 from https://www.gob.mx/cms/uploads/attachment/file/483901/Manual_Langosta_Junio_2019.pdf.

Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA). (January 22 2025). Actúa Agricultura contra la langosta centroamericana. Secretaría de Agricultura y Desarrollo Rural. Retrieved 16/08/2025 from https://www.gob.mx/agricultura/prensa/actua-agricultura-contra-la-langosta-centroamericana.

Almaraz-Valle VM, García-Méndez V, Revelo-Tobar HG. 2025. From the "Divine Plagues" to the modern challenges: the case of the Central American locust *Schistocerca piceifrons piceifrons* (Orthoptera: Acrididae) in Mexico. Bioagrociencias 18 (2): 109-117.
DOI: http://doi.org/10.56369/BAC.6496