

First Report of the Black Soybean Weevil *Rhyssomatus subtilis* Fiedler (Coleoptera: Curculionidae) in Córdoba, Argentina. Crop Damage Estimation

Primer registro del picudo negro de la soja *Rhyssomatus subtilis* Fiedler (Coleoptera: Curculionidae) en la provincia de Córdoba, Argentina, y estimación de daño en el cultivo

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ABSTRACT

The black soybean weevil is an endemic pest in northwestern and northeastern Argentina, causing significant damage. The objective of this study was to confirm the presence of this species in Córdoba, describe symptomatology and evaluate the potential impact on the crop. Surveys were conducted in plots located in the north-central part of the province. Individuals were collected and a quantitative assessment of symptoms and damage was conducted. Twenty compound samples were taken from sectors showing different physiological appearances (green vs. yellowish). In each group, total pod number and damaged pod number allowed calculating damage percentage. Data were analyzed by ANOVA and Fisher's test ($\alpha = 0.05$). All collected individuals matched the morphological descriptions reported in the literature for the species *Rhyssomatus subtilis* Fiedler. Green plants had a higher proportion of damaged pods (0.89) and fewer pods (31.85) compared to yellowish plants (0.53 and 46.65, respectively). This relationship suggests a direct effect on biomass partitioning. Our finding remaps the pest's distribution range, warning areas of high agricultural production in Córdoba and raising the need to link public-private actions to minimize its spread.

Keywords

damaged pods • yield losses • distribution • *Glycine max*

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RESUMEN

El picudo negro de la soja es una plaga endémica en el norte de Argentina, donde genera daños significativos. El objetivo del trabajo fue confirmar la presencia de esta especie en Córdoba, describir los síntomas observados y evaluar el impacto potencial sobre el cultivo. Se realizaron relevamientos en lotes del centro-norte de la provincia, se recolectaron individuos y se realizó una evaluación cuantitativa de los síntomas y daños. Se realizaron veinte muestreos compuestos de cinco plantas cada una en sectores que presentaban plantas con distinto aspecto fisiológico (verdes vs. amarillentas). En cada grupo se evaluó el número total de vainas, el número de vainas dañadas, y se calculó el porcentaje de daño, las diferencias registradas fueron analizadas mediante ANOVA y sus medias diferenciadas por test de Fisher (α 0,05). Todos los individuos recolectados coincidieron con las medidas morfológicas y descripciones registradas en la literatura para la especie *Rhyssomatus subtilis* Fiedler. Las plantas verdes presentaron mayor proporción de vainas dañadas (0,89) y menor número total de vainas (31,85) en comparación con las amarillentas (0,53 y 46,65 respectivamente), con diferencias significativas ($p < 0,05$). Esta relación sugiere un efecto directo del insecto sobre la fisiología del cultivo, asociado con alteraciones en la relación fuente-destino. Este hallazgo amplía el rango de distribución conocida de esta plaga, alertando sobre su posible establecimiento en zonas de alta producción agrícola de Córdoba y planteando la necesidad de vincular acciones público y privadas para minimizar o contener la expansión de la plaga.

Palabras claves

vainas dañadas • pérdidas de rendimiento • distribución • *Glycine max*

INTRODUCTION

Soybean (*Glycine max* L.) is a major pillar of agricultural production in Argentina. In Córdoba Province, soybean occupies approximately 4,758,800 hectares, which represents 62% of the total summer crop area estimated at 7,668,200 hectares (Bolsa de Cereales de Córdoba, 2024). In this context, phytosanitary monitoring has gained importance due to the emergence and spread of pests holding significant agronomic impact.

Until recently, the phytosanitary status of soybean in Córdoba remained relatively stable, with a pest complex dominated by well-known, routinely monitored species. However, in recent seasons, isolated insects, rarely found in the region, have been recorded. Some lack clear antecedents as pests in the local production system (Peralta, 2022).

The genus *Rhyssomatus* Schönherr (Coleoptera: Curculionidae) comprises South American native species, several of which are associated with legume crops (Wibmer & O'Brien, 1986; Lanteri *et al.*, 2002). In north-western Argentina (NOA), the weevil complex associated with soybean constitutes an important phytosanitary problem, given direct damage and rapid dispersal capacity. Within this group, *Rhyssomatus subtilis* Fiedler, known as the soybean black weevil, has become a major pest in the region due to its high biotic potential, its impact on reproductive structures and its adaptation to different environments (Socías *et al.*, 2009; Cazado *et al.*, 2014).

In recent years, its presence has been documented in new expansion zones in north-west Argentina (NOA) like eastern Santiago del Estero, on soybean and cotton crops (Casuso *et al.*, 2022). *R. subtilis* shows a strong association with cultivated and volunteer legumes and is characterized by ovipositing in soybean pods, where larvae feed on the seeds, hindering early detection, and causing direct yield losses (Cazado *et al.*, 2014).

Confirmation of the presence of *R. subtilis* in soybean fields of north-central Córdoba would not only imply an expansion of its geographic range but also serve as a warning for phytosanitary surveillance systems in the Pampas region.

This work aimed to document the presence of *R. subtilis* in soybean crops in Córdoba Province, describe field symptomatology, assess damage level and discuss potential agronomic, ecological, and productive implications.

MATERIALS AND METHODS

Sampling Sites

During the 2024/25 growing season, seven sites located in north-center Córdoba, within Colón and Santa María Departments, were visited following grower reports of pod damage. All sites were at advanced reproductive stages (R6-R7), (Fehr & Caviness, 1977) when sampled (table 1).

Table 1. Sampling sites for detection of the soybean black weevil (*Rhyssomatus subtilis*) located in the north-center of Córdoba Province, 2024/25 growing season.

Tabla 1. Sitios de muestreo en el centro-norte de la provincia de Córdoba, campaña agrícola 2024-25, para la determinación de la presencia del picudo negro de la soja (*Rhyssomatus subtilis*).

Site	Farm	Locality	Department	Coordinates
1	Agnolon	Malvinas Argentinas	Colón	31°21'58.37" S / 63°59'33.73" O
2	Dr. Lucero	Malvinas Argentinas	Colón	31°22'36.80" S / 63°59'23.19" O
3	Salazar	Monte Cristo	Colón	31°21'45.87" S / 63°58'1.42" O
4	Caburé	Monte Cristo	Colón	31°22'13.37" S / 64°0'32.79" O
5	Capelino	Villa Posse	Santa María	31°26'41.72" S / 64°2'16.93" O
6	La Curva	Monte Cristo	Colón	31°21'32.00"S / 63°59'23.10"O
7	Santa Julia (UCC)	Malvinas Argentinas	Colón	31°20'47.60"S / 64° 0'45.30"O

Field Characteristics and Management

All seven sites were commercial soybean fields under no-tillage. Only one site had received a specific insecticide spray targeting curculionids. Previous summer-crop rotations differed among fields (table 2). Additionally, a comparative map showed historical phytosanitary monitoring sites in north-central Córdoba and the sites where *R. subtilis* was detected in 2024/25. The historical database (15 seasons, 2009/10-2024/25) was generated by Moha S. A. (firm to which the authors belong). These data were overlaid with the 2024/25 detection sites.

Table 2. Crop management indicators of seven soybean fields showing pod damage caused by the black weevil (*Rhyssomatus subtilis*), Córdoba, 2024/25.

Tabla 2. Detalle de manejo de cultivo de siete lotes de producción de soja con presencia de daño de picudo negro (*Rhyssomatus subtilis*) en vainas. Córdoba, campaña agrícola 2024-25.

Site	Cultivar	Sowing date	Summer crops in the last 7 year's*	Insecticides for weevils
1	DM 46i20 IPRO	12/12/2024	Sy-Sy-Sy-Sy-Mz-Sy-Sy	No
2	DM 46i20 IPRO	14/11/2024	Sy-Mz-Sy-Mz-Sy-Mz-Sy	No
3	DM 50i17 IPRO STS	18/11/2024	Mz-Sy-Sy-Mz-Sy-Sy-Sy	No
4	LDC 5.3	17/11/2024	Sy-Mz-Sy-Mz-Sy-Mz-Sy	No
5	DM 50i17 IPRO STS	16/11/2024	Sy-Mz-Sy-Mz-Sy-Mz-Sy	No
6	NS 5021 STS	20/11/2024	Sy-Sy-Sy-Mz-Sy-Sy-Sy	Yes
7	NS 5021 STS	20/11/2024	Mz-Sy-Mz-Sy-Sy-Mz-Sy	No

* Sy.: Soybean;
Mz.: Maize.

Date, Plot Segmentation and Sampling Procedure

Damage assessment was carried out on April 2, 2025 at Site 1 (Agnolon Farm), with the crop at advanced R6 (Fehr & Caviness, 1971). At the remaining sites (2-7), samples of adult weevils, damaged pods and other affected plant structures were collected for morphological identification.

At Site 1, structured damage evaluation was performed by random sampling within two contrasting areas of the field: (i) zones with naturally yellowing plants (considered slightly damaged) and (ii) zones with completely green plants (considered severely damaged). At each zone, 20 composite samples were taken, each composed of five consecutive plants manually removed along the sowing row. Plants were transported to the laboratory, where all pods per sample were removed and counted. Total pod number and damaged pod number (attributable to *R. subtilis*) were recorded, allowing estimation of relative incidence. Pod set differences among areas and percentage of damaged pods were calculated in each site. ANOVA and Fisher's LSD test ($\alpha < 0.05$) were performed using InfoStat statistical software (Di Rienzo *et al.*, 2010).

At Sites 2-7, only adult curculionids, damaged pods and other affected tissues were collected. Samples were kept in ventilated glass containers and taken to the laboratory for taxonomic confirmation. Photographic records of damage were obtained with a compact digital camera (Olympus Tough TG-4 iHS, Sony ZV-1) and a DJI Mavic Pro drone. Drone images were acquired with stacked exposures to enhance contrast. Chromatic classification of RGB channels was performed using color-histogram thresholds and digital-image analysis tools in Python. Classified zones were delineated by contour detection for visual and quantitative comparison. Color interpretation was based on field observations of symptoms like foliage persistence, green pods, and adult presence.

Insect Identification

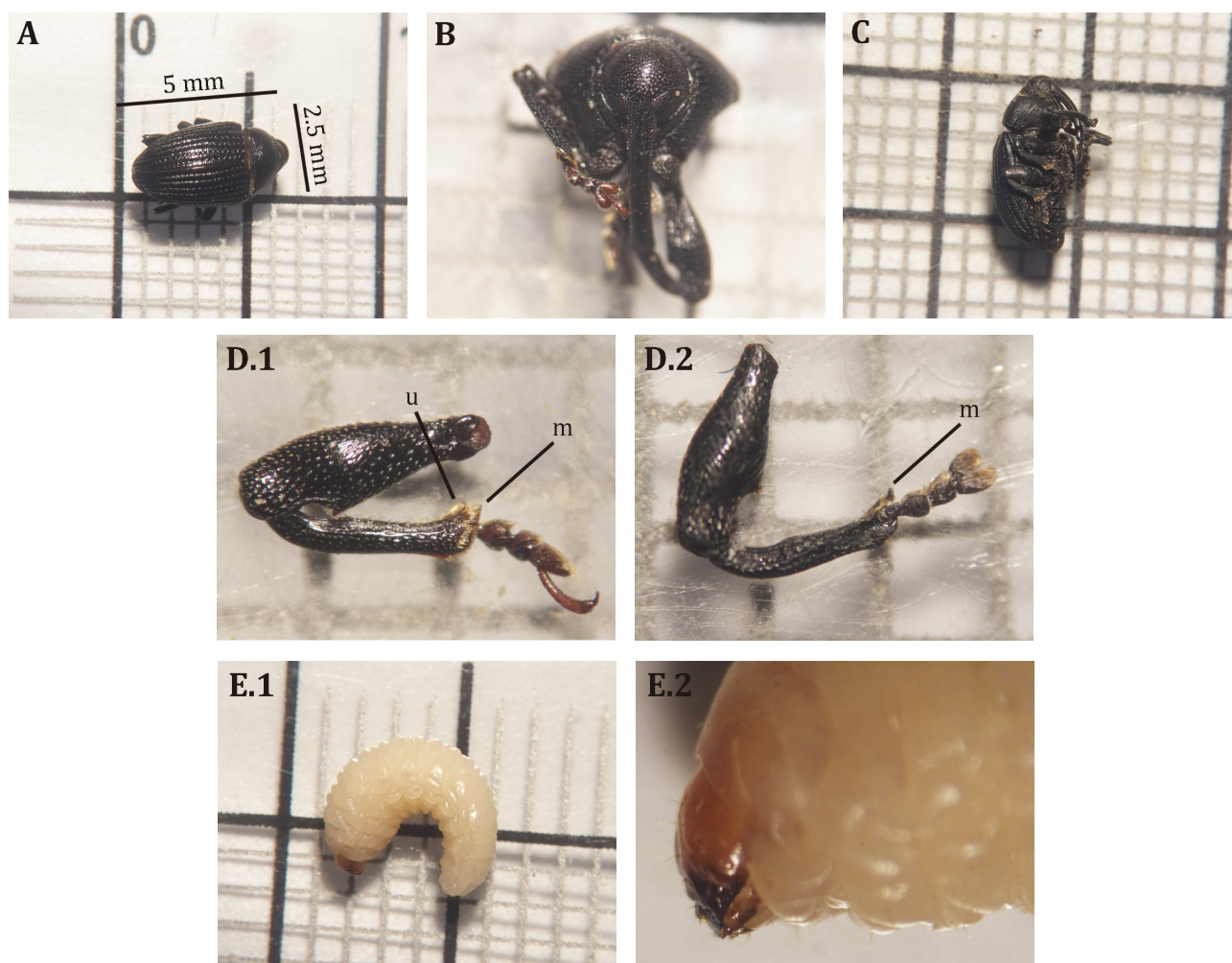
The collected specimens were morphologically identified in the laboratory with binocular magnifying glass and using taxonomic keys Fiedler (1937-1938).

RESULTS

Insect Identification

All collected individuals matched the descriptions recorded for *Rhyssomatus subtilis* Fiedler (Coleoptera: Curculionidae) (Fiedler, 1937-1938; Socías *et al.*, 2009; Cazado *et al.*, 2014). The finding was reported to Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA) through the Sistema Nacional de Vigilancia y Monitoreo de plagas (SINAVIMO) (communication No. 1368) on April 12, 2025.

Córdoba specimens were identified based on the original characters of Fiedler (1939) and the morphological syntheses of Socías *et al.* (2009) and Cazado *et al.* (2014): (I) length 4.8-5.2 mm, width 2.5-3 mm, body oval-elongate, somewhat sub-rhombic; (II) integument dark brown-black, lacking scales or bands; (III) head very finely and densely punctate, strongly arched, the eyes separated dorsally by more than the width of the rostrum; (IV) rostrum very slender, moderately curved, considerably longer than the head and pronotum, recessed at the base so that the head and the base of the rostrum are not aligned in profile; (V) elytra with longitudinal striae and well-marked rows of punctures; (VI) female fore leg with a weak, angulate femur and the presence of an unculus (u) and mucro (m) on the tibia; (VII) apodous larvae 5-6 mm long, body curved in a "C" shape, milky white, with a light-brown to caramel head (figure 1, page 142).



A) adult dimensions and color details; B) frontal view of the head, its punctures and eyes separated above the rostrum; C) adult lateral view; D.1) detail of female fore legs with presence of uncus (u) and mucro; D.2) detail of male fore legs only with presence of mucro; E.1) lateral view of apodous larva with curved body; E.2) lateral view of head in apodous larva.

A) dimensiones y detalles de color de adulto; B) vista frontal de cabeza, sus puntuaciones y ojos separados por encima de la probóscide; C) adulto vista lateral; D.1) detalle de patas delanteras de hembra con presencia de uncus (u) y mucro; D.2) detalle de patas delanteras de macho solo con presencia de mucro; E.1) vista lateral de larva ápoda con cuerpo curvado; E.2) vista lateral de la cabeza en larva ápoda.

Figure 1. *Rhyssomatus subtilis* adults and larvae.

Figura 1. Adultos y larvas de *Rhyssomatus subtilis*.

Sampling

Adults, larvae, eggs, and soybean crop damage matched the literature describing *R. subtilis* at the seven evaluated sites (figure 2, page 143).

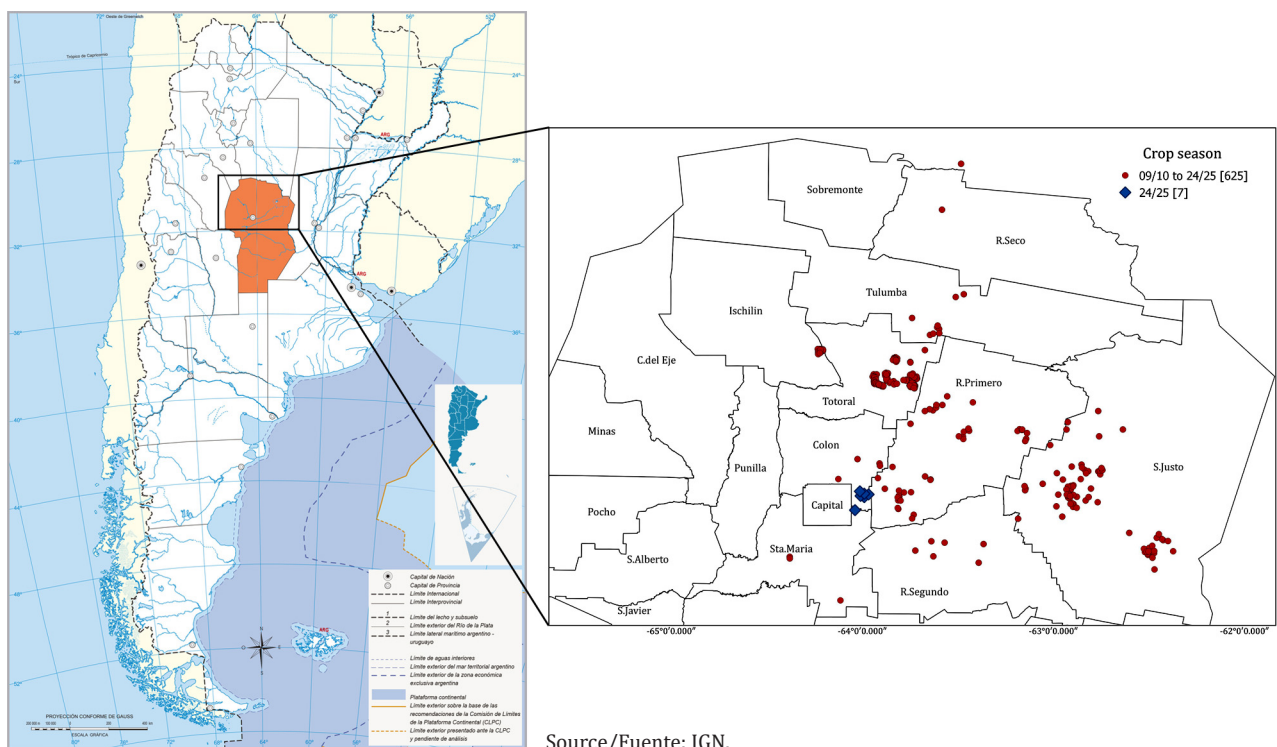
Considering historical phytosanitary monitoring points previously surveyed by Moha S.A. over 15 growing seasons, and the seven sites where we detected *R. subtilis* during the 2024/25 season, the geographical distribution of the new detections is shown in relation to previously pest-free areas (figure 3, page 143).



A) Adult, B) Larva, C) Egg.
A) Adulto, B) Larva, C) Huevo.

Figure 2. Details of *Rhyssomatus subtilis* specimens found in north-central Córdoba during the 2024-25 growing season.

Figura 2. Detalle de especímenes de *Rhyssomatus subtilis* encontrados en el centro-norte de Córdoba durante la campaña agrícola 2024-25.



Source/Fuente: IGN.

Figure 3. Comparative map between historical phytosanitary monitoring sites (2009-10 to 2024-25) surveyed by Moha S.A. (red circles) and sites with detection of *Rhyssomatus subtilis* during the 2024/25 season (blue diamonds), showing the location of the new detections in relation to previously monitored areas with no pest records.

Figura 3. Mapa comparativo entre sitios históricos de monitoreo fitosanitario (2009-10 a 2024-25) realizados por la consultora Moha S.A. (círculos rojos) y los sitios con detección de *Rhyssomatus subtilis* durante la campaña 2024/25 (rombos azules), donde se denota la localización de las nuevas detecciones en relación con las áreas previamente monitoreadas sin registro de la plaga.

Damage Assessment

At Site 1, plants with contrasting physiological appearances revealed significant differences regarding proportion of damaged pods and total number of pods per plant (figure 4). Damage percentage was significantly higher ($p < 0.0001$) in green plants (0.89 ± 0.01) than in yellowing plants (0.53 ± 0.01). The CV was 9.04 %, and the adjusted R^2 was 0.89, indicating modeling high explanatory power. Likewise, total number of pods differed significantly ($p = 0.0015$), averaging 46.65 ± 3.05 pods in yellowing plants *versus* 31.85 ± 3.05 in green plants. These results indicate a strong association between damage intensity and plant physiological status, suggesting that *R. subtilis* may be affecting both pod number and pod integrity at crop advanced reproductive stages.

At the remaining sites (2-7), although quantitative assessments were not conducted, damage was observed at varying degrees of severity. In all cases, adults were found on plants and damaged pods, together with signs of integument perforation, injured seeds, and *R. subtilis* larvae feeding (figure 4).

A.1, A.2, A.3) Plants with different behavior (green vs. yellowing); B.1, B.2, B.3) detail of affected pods; C.1) drone image of the field with high infestation in Malvinas Argentinas, Córdoba, showing sectors with yellowing and green plants; C.2) image of the same field produced through chromatic classification based on the assessments performed.

In red, sectors with lower infestation (yellowing plants due to natural senescence) and in green, sectors with higher infestation (green plants with foliage retention).

A.1, A.2, A.3) Plantas con distintos comportamientos (verdes vs. amarillentas); B.1, B.2) detalle de vainas afectadas; C.1) Imagen aérea (drone) del lote con alta afección en la localidad de Malvinas Argentinas, Córdoba, donde se visualizan sectores de plantas amarillentas y plantas verdes; C.2) Imagen de ese lote realizada con clasificación cromática con base en las evaluaciones realizadas, siendo el color rojo la representación de sectores con menor afección (plantas amarillentas por senescencia natural) y en verde los sectores con mayor afección (plantas verdes con retención foliar).

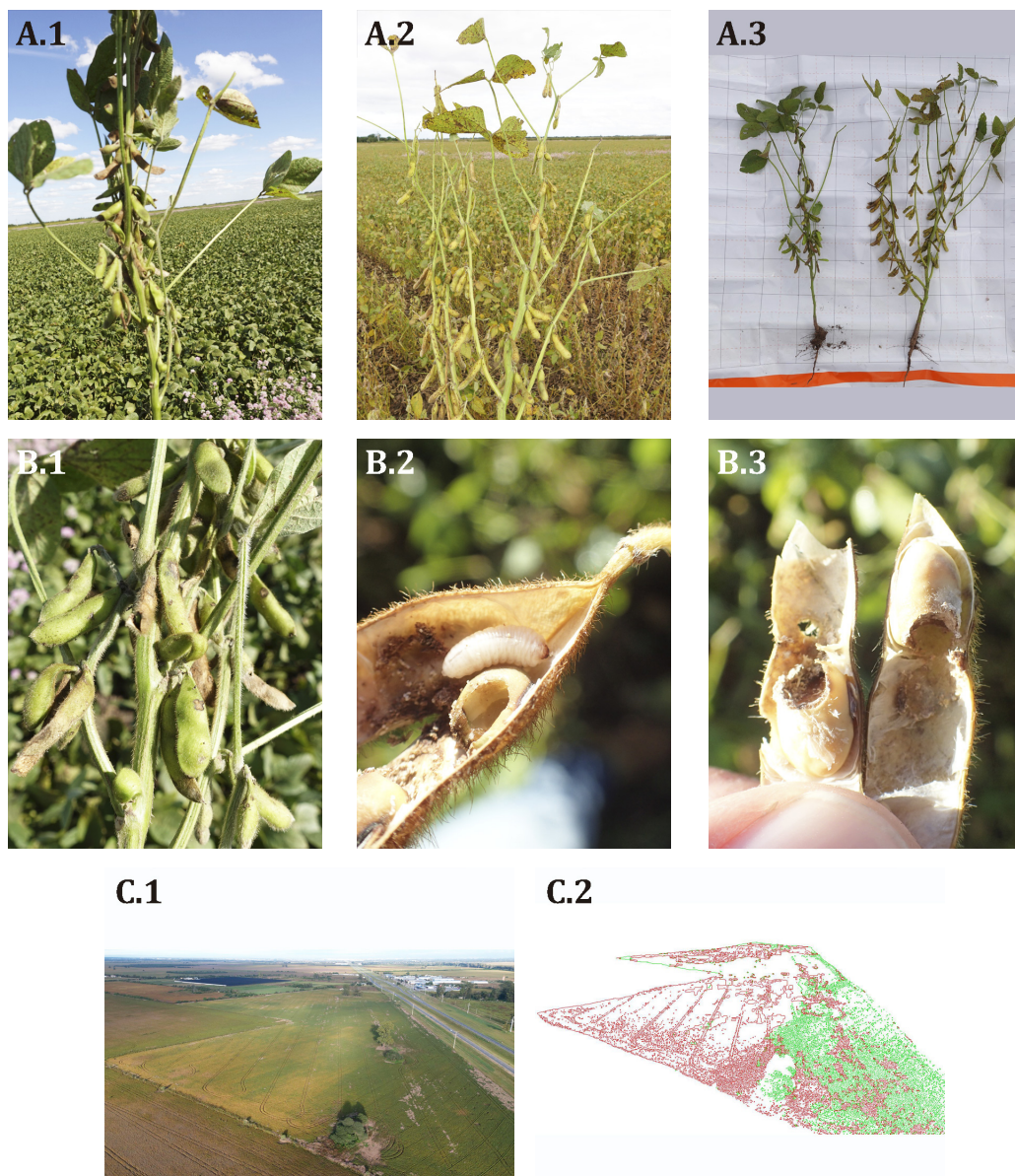


Figure 4. Damage recorded by *Rhyssomatus subtilis* in north-central Córdoba during the 2024-2025 growing season.

Figura 4. Detalle de los daños registrados por *Rhyssomatus subtilis* en el centro-norte de Córdoba durante la campaña agrícola 2024-2025.

DISCUSSION

Confirmation of *R. subtilis* Fiedler in the Colón and Santa María Departments of Córdoba extends its geographic distribution towards center Argentina by approximately 450 km with respect to historical reports from NOA (Salta, Tucumán and Santiago del Estero). The species has been verified in more than 53 localities in that region (Cazado *et al.*, 2014), with these new determinations confirming a significant latitudinal dispersal capacity, colonizing new soybean areas of the Chaco ecoregion.

The adults sampled from north-central Córdoba exhibited cited characters (Socías *et al.*, 2009; Cazado *et al.*, 2014), ruling out possible confusion with other local curculionid species of wider regional distribution like *Pantomorus leucoloma* (Aragón, 2007) (table 3).

Table 3. Comparative table of morphological traits of soybean black weevil (*Rhyssomatus subtilis*) and alfalfa weevil (*Pantomorus leucoloma*).

Tabla 3. Tabla comparativa de características morfológicas para la diferenciación entre el Picudo negro de la soja (*Rhyssomatus subtilis*) y el Gorgojo de la alfalfa (*Pantomorus leucoloma*).

Trait	<i>Rhyssomatus subtilis</i> (Soybean black weevil)	<i>Pantomorus leucoloma</i> (alfalfa weevil)
Adult length	4.8-5.2 mm	8-12 mm (≈ 10 mm average)
Color	Slightly shiny black, no scales, no bands	Brownish-gray with a continuous white stripe along the elytral margins; brown scales
Rostrum	Long, slender, curved (≈ head + pronotum)	Relatively short and robust
Pronotum	Two converging oblique ridges	Convex, no ridges; often with light scale lines
Elytra	Deep longitudinal striae with well-marked rows of punctures	Striae covered by scales; powdery appearance
Type of damage in soybean	Damage to terminal shoots by adults and pod perforations (R5-R7) with grain feeding by larvae (occasionally other legumes)	Seedling defoliation and root damage by larvae (mainly in alfalfa; occasional in soybean)

In the NOA region, yield losses of up to 100% have been documented under high, uncontrolled populations of *R. subtilis*. In the grain-filling reproductive phase (R5 to R6)- a critical stage-losses can reach 60% (Cazado *et al.*, 2014). In eastern Santiago del Estero Province, pod damage ranges between 21% and 42% (Casuso *et al.*, 2023).

Site 1 showed that plants with the highest proportion of damaged pods, approximately 90% attributable to *R. subtilis*, displayed an active vegetative state (green). In contrast, less damaged plants, 53% damaged pods, exhibited a normal progression of crop senescence (yellowing), coinciding with previous studies (Cazado *et al.*, 2014; Casuso *et al.*, 2023).

Different physiological maturity among plants with greater damage suggests that affected reproductive structures may have altered biomass partitioning, generating stem greening and vegetative-tissue retention as a compensatory response to physiological imbalance.

This behavior partly resembles the green stem syndrome (GSS) in soybeans, characterized by persistent green tissues at harvest, linked to physiological imbalances in assimilate redistribution, abiotic stress, insect or disease damage, and even management practices (Rotundo *et al.*, 2012; Salvaggiotti *et al.*, 2020). Particularly, the loss of sink structures like pods or seeds can result in sugar accumulation in vegetative tissues, delaying maturity and provoking symptoms like GSS (Egli & Bruening, 2006).

A similar situation occurs in the so-called “soja loca” (“crazy soybean”) syndrome, reported mainly in Brazil and northern Argentina, where prolonged leaf retention, green stems and pod abortion have also been associated with infections by the nematode *Aphelenchoides besseyi* and hormonal alterations (Ferreira *et al.*, 2010). Although nematodes were not detected in our study, symptoms shared some eco-physiological patterns like the loss of reproductive structures and the persistence of active vegetative tissues. This reinforces the need to broaden entomological and eco-physiological monitoring.

Larval activity caused direct seed loss and partitioning alterations, leading to physiological imbalances like those described in the green stem and/or crazy soybean syndromes. These effects compromise yield and hinder visual assessment of phenological progress, generating risks in harvest scheduling.

To date, no documented records of *R. subtilis* existed for Córdoba Province. This finding becomes invaluable from agronomic, sanitary, and ecological perspectives, marking a significant expansion in the known geographic distribution of this pest in Argentina.

We highlight the need to adapt monitoring schemes within regional phytosanitary surveillance systems to facilitate timely detection of *R. subtilis*, and advance local studies assessing population behavior, crop-pest interactions and possible integrated management strategies.

CONCLUSIONS

For the first time, the presence of the soybean black weevil *R. subtilis* was confirmed in fields of Córdoba Province.

Physiological differences were observed among plants with different levels of damage, linked to the intensity of the infestation.

The productive sector of Córdoba is on alert due to the presence of a new pest with high damage potential. Public-private actions should minimize pest spread.

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