

1.Sep.2026

N ° 90

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Plant-based compounds against pests

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Plant compounds show activity against fruit flies

Isoeugenol and citronellal caused high mortality and had little effect on the parasitoid used in biological control

31.07.2026 | 14:42 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Paulo Lanzetta / Embrapa

Isoeugenol and citronellal showed high insecticidal activity against adult *Anastrepha fraterculus* and *Ceratitis capitata* in laboratory assays. The compounds also caused low mortality in the parasitoid *Doryctobracon areolatus* and did not reduce its parasitism capacity. The results indicate potential for the use of these substances in integrated fruit fly management programs (DOI 10.3390/insects17080774).

A study by Brazilian researchers evaluated ten compounds found in aromatic plants. The list included seven terpenes or terpenoids (alpha-pinene, beta-pinene, beta-caryophyllene, gamma-terpinene, para-cymene, citronellal, and geropine) and three phenylpropanoids (isoeugenol, methyl cinnamate, and coumarin).

Researchers tested toxicity through ingestion and topical application. Concentrations ranged from 100 to 6.000 milligrams per liter. A commercial insecticide based on spinetoram served as a positive control. Distilled water comprised the negative control.

Death rates

Isoeugenol and citronellal caused the highest mortality rates from ingestion. The rates exceeded 70% in both fruit fly species after 120 hours of exposure. The performance was close to that observed with the reference insecticide.

In topical application, isoeugenol caused mortality equal to or greater than 80% in

Anastrepha fraterculus and *Ceratitis capitata*. The result was also close to the positive control. Citronellal and coumarin showed intermediate performance. Beta-pinene, beta-caryophyllene, geropin, methyl cinnamate, and para-cymene had lower efficacy in this exposure modality.

Concentration-response

Concentration-response curves confirmed the toxicity of all ten compounds.

In *Anastrepha fraterculus*, lethal concentrations for 50% of adults ranged from 23,40 to 42,19 milligrams per liter in the ingestion assay. For 90% mortality, the values ??ranged from 87,13 to 123,34

milligrams per liter.

In *Ceratitis capitata*, lethal concentrations for 50% of insects ranged from 29,11 to 39,10 milligrams per liter. Concentrations required to achieve 90% mortality ranged from 118,19 to 132,44 milligrams per liter.

The spinetoram-based insecticide showed the lowest lethal concentrations for both species, although in some cases the difference was statistically insignificant.

Effect on oviposition

The scientists also analyzed the effect of the compounds on oviposition. Ripe 'Italia' grape berries received the treatments by immersion. Then, females of both species had access to the fruits for 24 hours.

None of the ten compounds reduced the number of oviposition punctures compared to distilled water. The commercial insecticide prevented oviposition in both species. The result shows an absence of ovideterrent effect of the isolated compounds under the evaluated conditions.

Selectivity of compounds

Selectivity for *Doryctobracon areolatus* represented another central point of the work. This parasitoid attacks eggs and young larvae of fruit flies and participates in biological control programs.

Parasitoid mortality from ingestion ranged from 4,11% to 17,12% among the plant compounds. With topical application, rates ranged from 10,44% to 14,24% in most treatments. Spinetoram caused a mortality rate of 38,10% upon ingestion and 31,90% upon topical application.

The treatments did not harm the parasitism of the survivors. Rates ranged from 43,21% to 62,13% and showed no differences between the compounds. The result suggests compatibility between the phytochemicals evaluated and the use of *Doryctobracon areolatus* in integrated pest management.

Ingestion toxicity

Researchers highlight the higher toxicity observed through ingestion. This characteristic favors studies focused on "attract and kill" strategies, in which the insect consumes a bait containing the active ingredient. Formulations can also reduce losses caused by the volatility and sensitivity of the compounds to light, oxygen, and high temperatures.

The data do not yet prove efficacy in orchards. The trials were conducted under controlled conditions. Further studies are needed to evaluate formulations, synergistic mixtures, persistence, doses, selectivity, and field performance. Among the candidates analyzed, isoeugenol and citronellal showed the most promising results for the control of *Anastrepha fraterculus* and *Ceratitis capitata*.

The work was carried out by scientists Letícia Jansen Medeiros, Michele Trombin de Souza, Mireli Trombin de Souza, Christian Peter Demari, Gabriel Radtke Abib, Leandro do Padro Ribeiro, Vanessa Nogueira Soares, Dori Edson Nava, and Daniel Bernardi.

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Heat reduces the effectiveness of insecticides against *Bemisia tabaci*

Study links high temperatures to increased activity of P450 enzymes and lower pest mortality

31.07.2026 | 10:55 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Syngenta

High temperatures reduced mortality in *Bemisia tabaci* MED after treatment with thiamethoxam and abamectin.

Pretreatment at 41 degrees Celsius decreased mortality by 10% under thiamethoxam and by 13% under abamectin. At the same time, cytochrome P450 enzyme activity increased 1,43-fold and 1,48-fold, respectively.

Researchers evaluated responses linked to P450 enzymes under thermal stress and exposure to two insecticides. These enzymes participate in the detoxification of compounds and contribute to tolerance to chemicals (DOI 10.1127/entomologia/3909).

Five genes

The study identified five CYP450 genes in *Bemisia tabaci* MED: BtCYP4c1, BtCYP4g15, BtCYP6dz3, BtCYP6ep1, and BtCYP302a1. Heat increased the expression of BtCYP4c1 most intensely, peaking at 39 degrees Celsius.

Thiamethoxam induced all five genes analyzed and showed the greatest effect on BtCYP6ep1. Abamectin induced four genes, with the exception of BtCYP302a1, and primarily stimulated BtCYP4c1.

Exposure to both insecticides also increased the level of CYP450 proteins.

RNA interference tests confirmed the involvement of these genes in whitefly tolerance. The results indicate a temperature-dependent component in the response of *Bemisia tabaci* to insecticides.

According to the researchers, the data

may support future adjustments in application strategies.

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Agricultural Market - 31.Jul.2026

Brazilian exports are increasing, while wheat and rice gain traction in the domestic market

31.07.2026 | 10:06 (UTC -3)

Vlamir Brandalitze - @brandalitzeconsulting



Rain forecasts for the U.S. Midwest pressured soybean and corn prices on the Chicago Board of Trade. Soybean

contracts for August, September, and November 2026 fell to below \$11,90 per bushel. The 2027 positions remained above \$12 per bushel, but may lose value as the weather in the U.S. normalizes.

In Brazil, soybean shipments maintained a high pace. Exports for the month have already exceeded 13 million tons, compared to 12,2 million tons for the entire month of July of the previous year. The soybean complex, consisting of grain, meal, and oil, surpassed 100 million tons shipped cumulatively, compared to approximately 90 million tons in the same period last year.

The marketing of the Brazilian harvest has advanced in the last three weeks. Sales reached approximately 75% of production,

compared to 75,5% in the previous cycle and a historical average close to 76%. Advance sales of the new harvest reached between 28% and 28,5%. Last year, the rate was 31,5%. The average was around 33,5%. Some of the sales involved barter transactions.

Corn situation

Corn prices in Chicago followed the weather pressure. The September contract fell to less than \$4,50 per bushel.

Contracts closer to 2027 also dropped below \$5 per bushel. Only the 2028 contracts remained above that level.

Despite the decline, the market maintains supportive fundamentals in the long term.

The outlook involves reduced availability of exportable corn among the world's main suppliers, including the United States.

In Brazil, the second crop harvest has reached approximately 65% ??of the area. Mato Grosso has surpassed 90%. The production estimate remains close to 110 million tons. More than 70 million tons have already been harvested.

Much of the harvested grain fulfills scheduled contracts. Producers have begun to reduce the available supply and are waiting for higher prices. This movement could increase pressure on consumers in the coming weeks.

Sorghum situation

The sorghum harvest has also reached 65% in Brazil. Production could reach between 7 million and 8 million tons. The planted area exceeded 2,2 million hectares, setting a new record.

In the United States, approximately 40% of sorghum crops were in good or excellent condition. The previous week, the figure was 45%. Forecasts indicated sporadic rainfall, with no indication of sufficient volumes for a broad recovery of the areas.

Wheat situation

Wheat gained strength in Chicago. Contracts surpassed \$6,60 per bushel. Positions expiring in May 2027 exceeded \$7 per bushel. Conflicts in the Black Sea

region hampered the flow of Russian wheat and affected infrastructure related to grain shipments.

The North American harvest also supported prices. The winter wheat harvest reached 85%, while the spring wheat harvest reached about 5%. Crop conditions remained unfavorable.

In the Brazilian market, mills are awaiting demand from the beginning of August. In Rio Grande do Sul, prices ranged between 1.320 reais and 1.340 reais per ton. In Paraná, prices varied from 1.390 reais to 1.415 reais per ton.

Rice situation

Paddy rice ended July with an average price increase of 10 reais in Rio Grande do Sul. In the western border region, prices reached around 70 reais per sack. In the coastal region, prices ranged from 74 to 76 reais per sack.

In Tocantins, prices ranged between 85 and 90 reais per sack. The upward trend affected different producing regions and led the industry to revise the prices of the processed product.

Bean situation

Beans faced pressure as the harvest progressed. The increased supply reduced prices for higher-quality carioca beans. Lots previously traded above 500 reais per

sack fell to a range between 280 reais and 310 reais.

Commercial beans, classified as types 8 and 8,5, fell from a range between 400 and 450 reais to values ??between 240 and 275 reais per sack. Black beans showed greater stability, with nominal prices between 190 and 215 reais per sack. The sector was awaiting the resumption of retail purchases to replenish stocks.

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ADM will expand oilseed crushing in the United States

Investments in four units are expected to add 700 tons of annual capacity by 2029

30.07.2026 | 10:29 (UTC -3)

Cultivar Magazine, based on information from Jackie Anderson



ADM announced investments to expand oilseed processing capacity at four facilities in the United States. The projects are expected to add approximately 700

metric tons per year to milling capacity. This volume represents additional demand exceeding 25 million bushels for U.S. producers.

The improvements will take place at the plants in Frankfort, Indiana; Deerfield, Missouri; Lincoln, Nebraska; and Spiritwood, North Dakota. The company attributes the investments to the growing demand for renewable fuels and vegetable oils, supported by the US biofuel policy.

In Frankfort, the project includes improvements to storage, process optimization, and equipment upgrades. Completion is expected by the end of 2028.

The Deerfield plant will undergo upgrades to its transportation, rolling mill, extraction,

and utilities systems. ADM anticipates completing the work by the end of 2028 or the beginning of 2029.

In Lincoln, the company will expand its bran storage capacity and eliminate operational restrictions. Completion is also expected by the end of 2028.

The Spiritwood plant, operated by the Green Bison joint venture formed by ADM and Marathon Petroleum Corporation, will undergo operational adjustments and equipment upgrades. The works are expected to be completed by mid-2028.

ADM is also evaluating similar investments in other processing plants in North America. According to the company, the strategy prioritizes adaptations to existing structures to increase throughput and

preserve operational flexibility.

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Salivary protein favors sorghum aphids and reduces plant defenses

Silencing of MsSP1 decreased feeding and reproduction of *Melanaphis sorghi* in sorghum

30.07.2026 | 10:18 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Nathlia Damasceno

Researchers have identified a salivary protein from the sorghum aphid, *Melanaphis sorghi*, associated with the insect's feeding, reproduction, and suppression of the plant's immune responses. The protein, named MsSP1, entered sorghum tissues during feeding. Silencing the corresponding gene reduced nymph production and honeydew excretion, an indicator of sap ingestion.

The study analyzed sorghum leaves infested with aphids using liquid chromatography coupled to tandem mass spectrometry (DOI [10.3390/insects17080779](https://doi.org/10.3390/insects17080779)). The team detected 69 proteins originating from the insect in the plant tissues. Five presented signal peptides, a characteristic associated

with protein secretion.

Five candidates

Among the five candidates, the scientists selected MsSP1 for functional assays. The choice considered the annotation and abundance of the protein. MsSP1 has 320 amino acids, a signal peptide in the first 20 residues, and no transmembrane domain. Approximately 21% of the sequence corresponds to serine residues. The terminal region of the protein contains five repetitions of a motif formed by 15 amino acids.

Researchers produced a specific antibody against MsSP1. Immunoblot analysis detected the protein in sorghum leaves 48

hours after aphid feeding. The signal did not appear in uninfested tissues. The result confirmed the release of MsSP1 into the host during stylet insertion and sap withdrawal.

In sorghum protoplasts, the protein remained in the cytoplasm. The signal did not match the nuclear marker used in the experiment. The location reinforced the hypothesis of its action on cellular processes linked to plant defense.

RNA interference

The team evaluated MsSP1 function by RNA interference. Nymphs received double-stranded RNA targeting the MsSP1 gene in an artificial diet with 20% sucrose

and a final concentration of two milligrams per milliliter. After 48 hours, gene expression decreased compared to controls.

Silencing did not cause visible morphological changes nor did it reduce survival during the evaluated period.

However, the treatment limited reproduction. Aphids subjected to double-stranded RNA produced fewer offspring after transfer to plants of the susceptible BTx623 genotype.

Honeydew production

Honeydew production also decreased. This result indicates lower feeding activity, as excretion follows phloem sap intake.

Taken together, the data associate MsSP1 with the feeding and reproductive performance of *Melanaphis sorghi* in sorghum.

Other essays

Another set of assays investigated the protein's interference in plant immunity. Researchers expressed MsSP1 in leaves of *Nicotiana benthamiana*. Then, they used cryptogein, a molecule capable of inducing the production of reactive oxygen species and cell death associated with the defense response.

The presence of MsSP1 reduced the symptoms caused by cryptogein. Tissues showed less cell death, less electrolyte

leakage, and less hydrogen peroxide accumulation. The isolated protein did not cause visible damage or induce an accumulation of this compound.

Virulence effector

The results support the classification of MsSP1 as a candidate virulence effector. During feeding, the aphid releases the protein into the plant tissue. The molecule reduces defense responses and promotes phloem exploration.

The study also points to MsSP1 as a possible target for RNA interference-based control strategies. This application still requires validation under culture conditions and studies on the molecular targets of the protein in sorghum. The researchers also

highlight four other signal peptide candidates, including a maltase A1-like protein, a lysine-rich protein similar to arabinogalactan, and two proteins with no annotated function.

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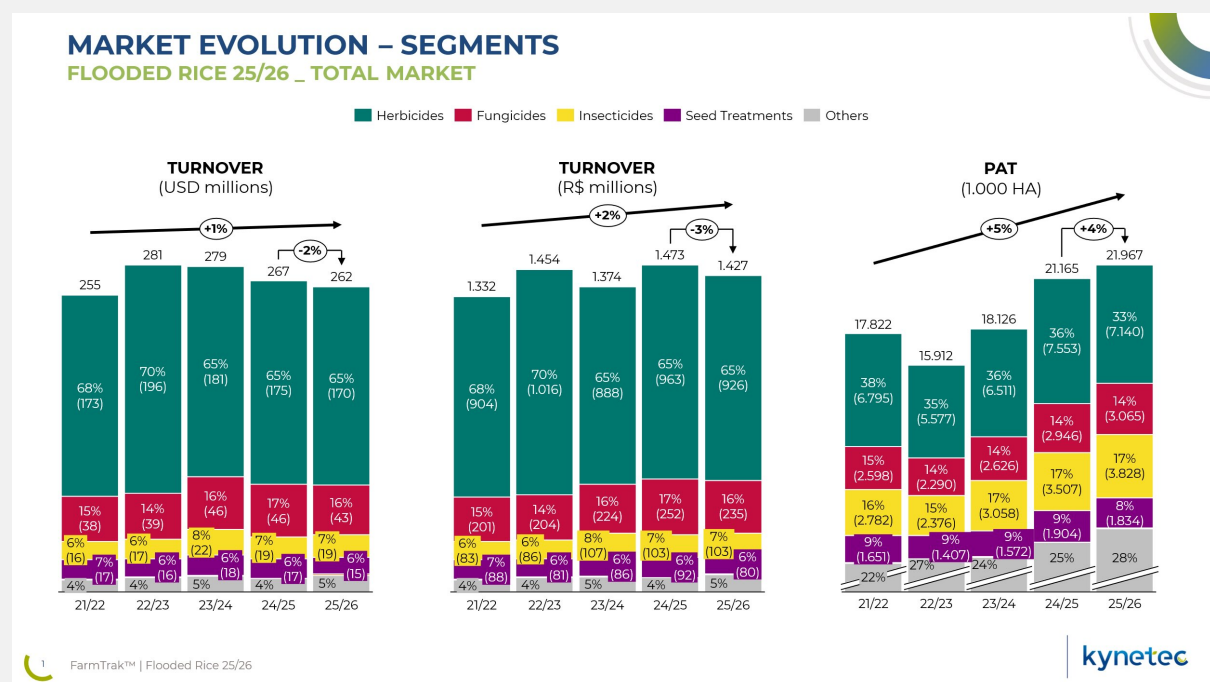


Market for pesticides for irrigated rice shrinks by 2%

Sales total US\$262 million in the 2025/26 crop year, with smaller planted area and lower application costs

30.07.2026 | 09:41 (UTC -3)

Cultivar Magazine, based on information from Fernanda Campos



The market for agricultural pesticides for irrigated rice generated US\$262 million in the 2025/26 crop year. This value

represents a 2% decrease compared to the US\$267 million recorded in the previous cycle, according to the FarmTrak Irrigated Rice study by Kynetec Brazil.

The reduction followed a 6% decrease in cultivated area, estimated at 1,146 million hectares. Application costs also fell by 7%.

The increase in the average number of treatments limited the market contraction. The indicator went from 16 applications in the 2023/24 crop season to 19 in the 2025/26 season. Compared to 2024/25, the increase reached 10%.

Potential area treated

The potential treated area, an indicator formed by the sum of the applications

carried out, increased by 4% and reached 21,967 million hectares. Plant desiccation, blast control, leaf spots and caterpillars were the main management practices.

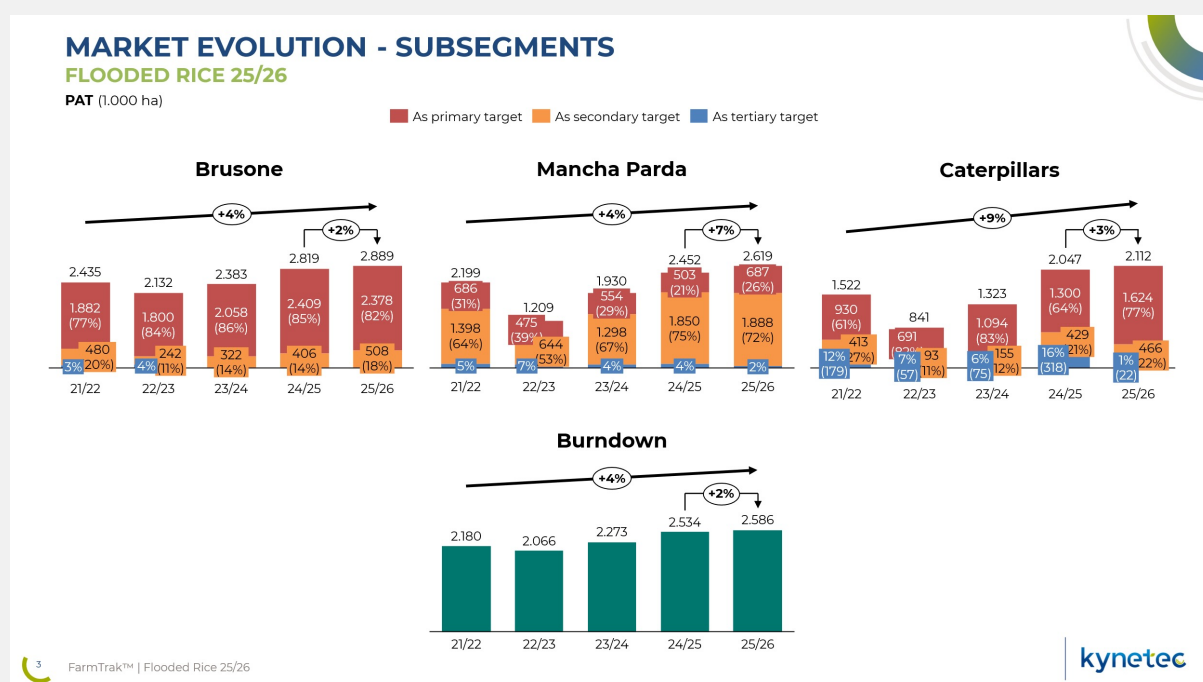
Applications to control leaf spots reached one-third of the cultivated area. The use of insecticides covered 60% of the area. The average number of treatments against caterpillars increased from 1,9 to 2,4 in one year. The survey attributes part of the progress to difficulties in maintaining water levels in some regions.

Sales leadership

Herbicides led sales, accounting for 65% of the market and generating US\$170 million in revenue. Fungicides totaled US\$43 million, equivalent to 16%.

Insecticides generated US\$19 million.
Seed treatment products reached US\$15 million.

The study compiled nearly 380 face-to-face interviews with rice farmers from Rio Grande do Sul, Santa Catarina, and Tocantins.



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AGCO presents figures for the second quarter of 2026

Net income totaled US\$77,2 million, or US\$1,08 per share

30.07.2026 | 09:09 (UTC -3)

Cultivar Magazine, based on information from Rachel Potts



AGCO reported net sales of \$2,6 billion in the second quarter of 2026. This

represents a 1% decrease compared to the same period in 2025. Net income totaled \$77,2 million, or \$1,08 per share. Adjusted earnings reached \$1,43 per share, compared to \$1,35 in the second quarter of the previous year.

The company attributed the performance to producers' caution in purchasing machinery. High production costs, macroeconomic uncertainties, and uneven agricultural profitability conditions delayed investments.

In Latin America, sales fell 25%, not considering exchange rates. Regional revenue reached US\$271,3 million. Lower demand affected all product categories. The regional operation posted a loss of US\$21,8 million.

In Brazil, tractor sales to producers fell 11% in the first half of the year. Combine harvester sales decreased by 39%. AGCO attributed the scenario to production costs, particularly imported fertilizers, as well as credit and financing conditions.

North America saw a 19,8% increase in sales, excluding currency adjustments. High-horsepower tractors and haymaking equipment drove the growth.

AGCO forecasts sales between US\$10,1 billion and US\$10,2 billion in 2026.

Adjusted operating margin is expected to be close to 7,5%. Adjusted earnings per share are projected to range from US\$5,50 to US\$5,75. The company plans to match production to demand and dealer network inventory.

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Viruses alter the severity of bacterial diseases in tomato plants

ToBRFV and PepMV increased bone marrow necrosis but reduced symptoms of bacterial cancer

30.07.2026 | 08:33 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Heinz USA - Bugwood - BY CC 30

Infections with the tomato brown rough fruit virus (ToBRFV) and the cucumber mosaic virus (PepMV) altered the intensity of two bacterial diseases in tomato plants. Plants infected with both viruses showed a 40% to 100% increase in the area of lesions caused by bacteria associated with pith necrosis. In contrast, the viruses reduced the wilt symptoms caused by *Clavibacter michiganensis*, the agent of bacterial canker.

The results are part of a study conducted in Israel with samples collected from commercial crops between 2021 and 2026 (DOI 10.64898/2026.07.29.741454). The research also included bacterial isolates obtained from outbreaks recorded in 2014 and 2015.

Researchers investigated outbreaks of vascular collapse in tomato plants grown in a protected environment. Most occurrences presented symptoms typical of pith necrosis. The plants exhibited internal darkening, degradation of stem tissues, wilting, and, in the most intense cases, collapse.

Bacterial community

Analyses revealed a diverse bacterial community in plants with pith necrosis. Bacteria from the orders Pseudomonadales and Enterobacterales predominated in the samples. Cases of bacterial canker, on the other hand, remained exclusively associated with *Clavibacter michiganensis*.

Most of the sampled plants tested positive for ToBRFV, PepMV, or both. This combined occurrence prompted trials to evaluate the influence of viruses on bacterial diseases.

Scientists tested different isolates recovered from tomato plants with symptoms. Only four agents consistently produced pith necrosis under controlled conditions: *Pseudomonas mediterranea*, *Pseudomonas capsici*, *Pseudomonas viridiflava*, and *Xanthomonas euvesicatoria* pathovar *perforans*.

Varied intensity

The intensity varied between species and plants. *Pseudomonas viridiflava* caused

mild to moderate lesions, generally restricted to the inoculation point.

Xanthomonas euvesicatoria pathovar *perforans* generated moderate lesions, extending beyond the entry site.

Pseudomonas capsici caused moderate to severe necrosis. In some cases, the damage extended along a large part of the stem. *Pseudomonas mediterranea* produced responses ranging from mild to severe, also with wide variation between repetitions.

Field samples

Other bacteria appeared in high populations in the field samples, but did not reproduce bone marrow necrosis in the assays. The result suggests possible

activity as opportunistic colonizers or dependence on environmental conditions not reproduced in the experiment.

Isolates of *Pectobacterium aroidearum* and *Pectobacterium brasiliense* caused soft rot and rapid plant collapse between 48 and 96 hours after inoculation. The symptoms differed from the internal darkening typical of pith necrosis.

Coinoculation trials

In co-inoculation assays, ToBRFV and PepMV amplified lesions caused by *Pseudomonas mediterranea*, *Pseudomonas capsici*, and *Pseudomonas viridiflava*. The combination of the two viruses produced the most consistent

effect. Isolated inoculation of each virus also indicated an increase in disease, but with less statistical regularity.

The growth of the lesions did not correspond to an equivalent expansion of the bacterial populations. The viral infection caused little or no increase in stem colonization. The bacterial population measured two centimeters above the inoculation point decreased approximately 500 times compared to the entry site.

This pattern indicates the influence of viruses on the tomato plant's response and on the expression of symptoms, without a proportional increase in bacterial multiplication. The physiological mechanisms involved remain undefined.

The effect changed in bacterial canker. Plants infected with ToBRFV, PepMV, or both viruses showed less intense wilting after inoculation with *Clavibacter michiganensis*. The amount of bacteria in the tissues remained similar between plants with and without viral infection.

Interactions between pathogens

Researchers point to the need to consider interactions between pathogens in the diagnosis and management of tomato diseases. The presence of a virus can amplify or reduce bacterial symptoms, depending on the agent involved. This response limits interpretations based on

infections evaluated in isolation.

The study also highlights differences between controlled trials and outbreaks observed in commercial crops. Inoculated plants developed internal necrosis, but did not reproduce all the vascular collapse recorded in greenhouses. Factors such as irrigation, humidity, temperature, plant density, fertilization, and training practices may play a role in the process. These hypotheses were not tested in this study.

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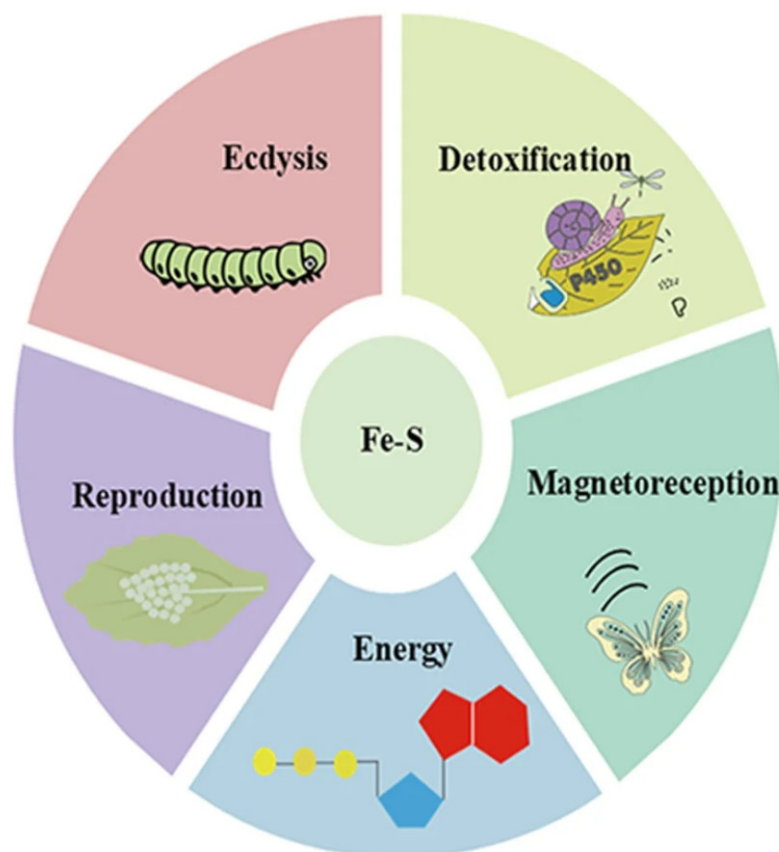
ESTE PRODUTO É PERIGOSO À SAÚDE HUMANA, ANIMAL E AO MEIO AMBIENTE; USO AGRÍCOLA: VENDA SOB RECEITUÁRIO AGRÔNOMICO; CONSULTE SEMPRE UM AGRÔNOMO; INFORME-SE E REALIZE O MANEJO INTEGRADO DE PRAGAS; DESCARTE CORRETAMENTE AS EMBALAGENS E OS RESTOS DOS PRODUTOS; LEIA ATENTAMENTE E SIGA AS INSTRUÇÕES CONTIDAS NO RÓTULO, NA BULA E RECEITA; E UTILIZE SEMPRE OS EQUIPAMENTOS DE PROTEÇÃO INDIVIDUAL.

Iron-sulfur clusters open new avenues in insect control

Study points to central functions in metabolism, reproduction, molting, detoxification, and magnetic orientation

30.07.2026 | 06:43 (UTC -3)

Schubert Peter, Cultivar Magazine



Iron-sulfur clusters participate in central processes of insect physiology and may offer new targets for pest management. These structures are involved in energy production, reproduction, molting, detoxification, and magnetic field perception. This study gathered evidence on the synthesis, transfer, and function of these structures in different species (DOI 10.3390/insects17080791).

Iron-sulfur clusters function as protein cofactors. They contain iron and sulfur atoms arranged in different configurations. The most studied forms include the [2Fe-2S] and [4Fe-4S] clusters. These structures transfer electrons, form catalytic centers, support proteins, and participate in the perception of environmental signals.

Start of synthesis

Synthesis begins in the mitochondria. The ISCU protein acts as an assembly platform. The complex formed by NFS1, ISD11, and ACP1 provides sulfur. Frataxin provides iron. Ferredoxins and other proteins transfer electrons and guide the cluster to target proteins.

Insects exhibit particularities in this pathway. Studies with *Drosophila melanogaster* indicate greater structural stability of frataxin and a higher affinity for ferrous iron. The ISCU protein also shows good solubility and a lower tendency to aggregate. In *Aedes albopictus*, some core proteins maintain high similarity to mammalian proteins. Others, involved in

cluster assembly and transfer, show less than 25% similarity.

Adaptation to the environment

Researchers link these differences to the insects' adaptation to environmental variations. As ectothermic animals, they undergo metabolic changes in response to temperature fluctuations. These oscillations affect the production of reactive oxygen species. Iron-sulfur clusters exhibit sensitivity to oxidative damage. Maintaining a stable synthesis pathway may help preserve mitochondrial function.

Participation in energy metabolism emerges as one of the most relevant functions. Iron-sulfur clusters make up complexes I, II, and III of the respiratory chain. They also participate in enzymes of the tricarboxylic acid cycle. Disruption of assembly affects several points in the production of adenosine triphosphate.

Reduced activity

In *Drosophila melanogaster*, alterations in complex I reduced its activity by more than 80%. The insects showed a reduction of up to 91% in maximum distance traveled and a six-fold decrease in larval movement speed. In another study, the loss of the SDHAF3 protein reduced the activity of complex II by approximately 50%.

Results with *Spodoptera exigua* reinforce its role in metabolism. Suppression of a subunit of complex III, linked to a [2Fe-2S] cluster, caused a 36,6% drop in adenosine triphosphate levels in the larvae.

Interference in reproduction

The pathway also interferes with reproduction. In *Nilaparvata lugens*, reduced ISCA1 expression caused a 65,34% drop in total egg production. The hatching rate fell by 88,07%. The data suggest the participation of iron-sulfur clusters in the regulation of the AMPK/TOR axis, associated with vitellogenin synthesis and ovarian

development.

Cellular cycle

The effects also extend to the cell cycle. In *Drosophila melanogaster*, alterations in assembly proteins reduced the amount of cyclin B. The mitotic index of follicular cells fell to about 1%. The number of cells decreased by approximately 75%.

Embryos also showed failures in chromosome segregation, defects in the mitotic spindle, and reduced hatching.

In ecdysis, clusters provide electrons to mitochondrial cytochrome P450 enzymes. These enzymes participate in the production of ecdysteroids. In *Helicoverpa armigera*, ferredoxin interacts with

CYP302A1, CYP315A1, and CYP314A1. Electron transfer supports steps in hormone synthesis.

Disruption of heme synthesis in *Drosophila melanogaster* reduced ecdysone to levels below the detection limit of 2.5 picograms per larva. The pupation rate reached zero in the third instar. Alterations in the frataxin gene also reduced 20-hydroxyecdysone levels and halted development.

Distinct organization

Insect ferredoxins exhibit a distinct functional organization compared to that observed in mammals. In insects, two forms participate in the synthesis of ecdysteroids and the assembly of clusters.

In *Drosophila melanogaster*, disruption of each gene reduced 20-hydroxyecdysone levels by 87% and 83%, respectively.

The same network may influence detoxification. In *Nilaparvata lugens*, reduced ISCA1 expression decreased the expression of CYP6CS1v2 and CYP439A2. These genes encode P450 enzymes associated with detoxification. The review highlights, however, the need for direct functional validation.

Magnetic orientation

Iron-sulfur clusters also participate in magnetic orientation. The ISCA1 protein, called MagR, forms a complex with cryptochrome. This association connects

the perception of the geomagnetic field to the circadian rhythm. Alterations in frataxin impaired the geomagnetic orientation of *Nilaparvata lugens*.

According to the study, the iron-sulfur cluster pathway brings together essential functions in different stages of development. In larvae, it supports energy production and detoxification. During metamorphosis, it participates in hormone synthesis. In adults, it influences reproduction, navigation, and environmental perception.

Researchers point to the potential for developing selective molecules against specific insect components. Intervention in this pathway could simultaneously affect energy metabolism, development, detoxification capacity, and environmental

perception. Further progress depends on the complete identification of the proteins involved and their structural comparison with proteins from non-target organisms.

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FMC reports a 17% drop in sales

Company lowers projections for 2026 after revenue decline in the quarter

29.07.2026 | 17:58 (UTC -3)

Cultivar Magazine



FMC Corporation reported revenue of \$867 million in the second quarter of 2026, a 17% decrease compared to the same period in 2025. Excluding its Indian business, revenue totaled \$841 million, a

20% decline. This result led the company to lower its revenue, adjusted EBITDA, and earnings per share projections for the year.

The company reported a net loss of US\$187 million in the quarter. A year earlier, it had recorded a net profit of US\$67 million. Earnings per share were negative US\$1,49. Adjusted earnings per share reached US\$0,26, a decrease of 62%.

Adjusted EBITDA totaled US\$153 million, a 26% decrease year-over-year. The margin on revenue excluding India reached 18,1%, compared to 19,7% in the second quarter of 2025.

Reduction in orders

The decline was mainly due to reduced orders from trading partners for amides and lower demand for traditional products. Pressure on farmers' margins affected the North American market. Volume fell by 10%, while prices dropped by 7%. Exchange rates contributed two percentage points to revenue.

The growth portfolio advanced at a mid-single-digit pace. Performance was supported by new active ingredients and products containing Cyazypyr. Sales of branded products containing Rynaxypyr remained close to the previous year's level, excluding India. New formulations sustained demand.

Regional realities

Latin America generated revenue of US\$278 million, a 10% decrease. Without the currency effect, the decline reached 16%. The region showed the greatest price pressure among the markets served by the company. Brazil, however, registered growth in the volume of branded products.

In North America, revenue fell 22% to \$249 million. FMC attributed the result to competition and tight producer margins.

The region comprising Europe, the Middle East, and Africa generated US\$214 million, a decrease of 18%. Expected losses in registrations and high temperatures affected the volumes.

In Asia, excluding the 2026 Indian operation, revenue reached US\$101 million. This figure represents a 37%

decrease compared to the previous period, still influenced by India's contribution in 2025. On a comparable basis, Asian sales declined by 6%. Australia and New Zealand showed growth.

Cash flow

Cash generation showed improvement. Cash from operations reached US\$363 million, an increase of US\$297 million. Free cash flow totaled US\$357 million, compared to US\$40 million in the second quarter of 2025. The result included an initial payment of US\$200 million related to the licensing of the active ingredient rimisoxafen.

Annual revenue

The FMC now projects annual revenue, excluding India, between US\$3,50 billion and US\$3,70 billion. The midpoint indicates a 7% drop compared to 2025. Without the previous year's Indian contribution, the reduction would reach 5%.

The company forecasts adjusted EBITDA between US\$620 million and US\$680 million, a 23% drop at the midpoint. The estimate for adjusted earnings per share has been revised to a range of US\$1,19 to US\$1,49, indicating a 55% contraction.

The new guidance considers lower prices in the mid to high single digits. FMC expects stable volume, excluding India.

Growth in new active ingredients, increased direct sales in Brazil, and commercial progress in Latin America and the region comprising Europe, the Middle East, and Africa should offset the reduction in orders from diamide partners.

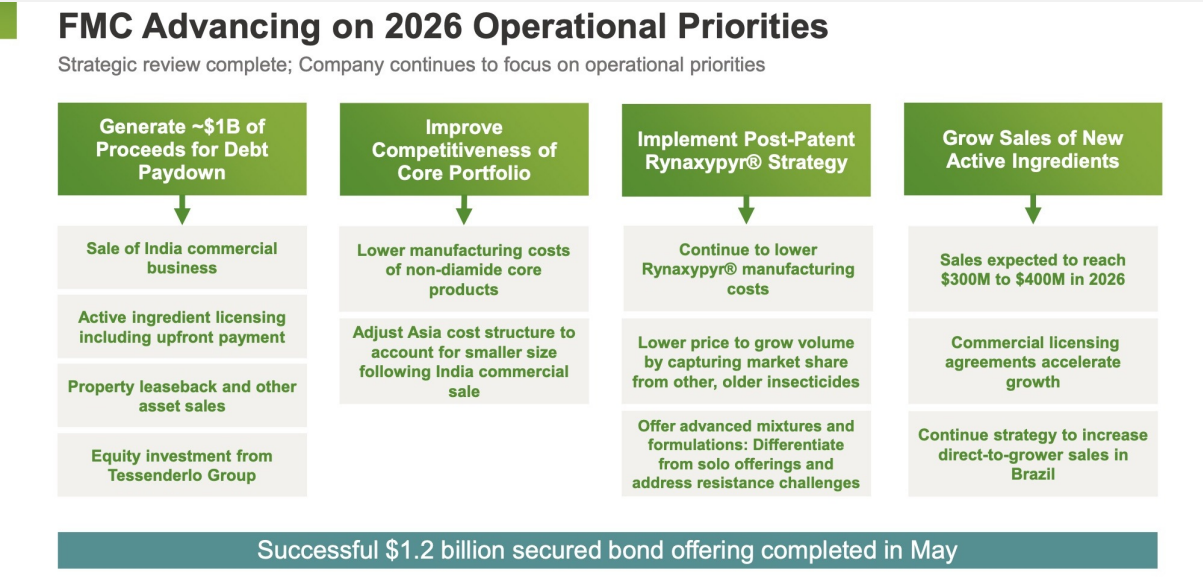
For the third quarter, the company projects revenue between US\$840 million and US\$900 million, excluding India. The midpoint represents a 9% decrease. North American distributors are expected to shift orders to the fourth quarter, aiming to bring purchases closer to the application period and control inventory.

Recovery in the fourth quarter

FMC forecasts a recovery in the fourth quarter. Revenue is expected to range between US\$1,06 billion and US\$1,20 billion, with 4% growth at the midpoint. The projection considers increased direct sales to Brazilian farmers, the development of new active ingredients, and a resumption of orders from distributors in North America.

The company also maintained its plan to raise approximately \$1 billion to reduce debt. The actions include the sale of its Indian business for \$252 million, the licensing of rimisoxafen for \$200 million, a sale and subsequent leaseback transaction of a property in Newark for \$114 million, and a \$400 million investment from the Tessenderlo Group. Some of the transactions are subject to

closing conditions and regulatory approvals.



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BORN TO **FARM**

No-till farming expands the ecological role of ants

Study points to gains in pest control, seed removal, and soil structure

29.07.2026 | 15:51 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Russ Ottens / University of Georgia - Bugwood

No-till farming systems can favor ant communities and enhance ecological services in annual crops in temperate regions. Maintaining nests, galleries, and foraging routes allows these insects to remain longer throughout the growing season. Potential benefits include pest predation, weed seed removal, and improved soil structure. This conclusion was presented by researchers from Pennsylvania State University and the University of Illinois (DOI 10.1002/ps.71152).

The study compiled results from different regions and evaluated the functional role of ants in low-till farming systems.

Researchers highlight greater abundance, species richness, and predatory activity in

no-till areas compared to conventional tillage areas.

Intensive operations

Plowing and other intensive operations can destroy nests, disrupt tunnels, and reduce populations. No-till farming preserves these structures. This stability favors the establishment of colonies and the continuity of activity throughout the crop cycle.

A survey conducted in 90 agricultural areas in North Carolina and Virginia, in the United States, recorded differences in the composition of communities between tillage systems. Thirteen of the 17 common species occurred more frequently in areas

under conservation practices. The group included no-till, strip cropping, raised bed cropping, and tillage with mulch.

Results obtained in Brazil also indicated greater abundance, richness, and diversity in uncultivated areas. In a Brazilian study, cited by the Americans, no-till farming yielded 16 ant species. The conventional system yielded nine. Predatory activity also increased in uncultivated plots.

Different mechanisms

Ants act through different mechanisms. Many species consume eggs, larvae, and other insect stages. Colonies remain active for much of the growing season. This characteristic can maintain pressure on

pests during periods with less presence of other natural enemies.

Ant activity doesn't depend solely on consumption. The movement of ants can disrupt the feeding and egg-laying of herbivores. Chemical signals can also repel insects from plants. Some species reach organisms located in the soil or under crop residues. Underground networks facilitate encounters with cutworm and beetle larvae.

Various effects

The effects, however, vary between species and environments. Some ants maintain relationships with sap-sucking insects. They consume sugary secretions

and can protect aphids from predators. This interaction can increase the pest population. For this reason, researchers recommend assessing the composition of the community before adopting measures aimed at ant conservation.

Seed removal represents another possible service. Granivorous ants collect seeds on the surface and transport the material to nests or underground storage areas. In agricultural areas of eastern Spain, no-till farming resulted in greater removal of weed seeds. The density of *Messor barbarus* nests also increased in undisturbed soils. In another Spanish region, annual plowing eliminated *Messor capitatus* from the evaluated crops.

Soil attributes

The construction of nests also modifies the physical and biological attributes of the soil. The galleries form biopores and increase the movement of air, water, and nutrients. These channels can promote infiltration, drainage, nutrient transport, and root growth. The activity of the colonies also interferes with microbial communities and nutrient cycling.

Experiments cited in the study recorded an increase of more than 20 times in the infiltration rate near nest entrances, compared to points without nests. Another study observed a 36% increase in wheat productivity after the combined action of ants and termites in a dry environment.

The researchers attribute the result to the improved infiltration caused by the tunnels.

hedge plants

The use of cover crops can enhance these effects. Vegetation increases habitat complexity, provides shelter, and expands food availability. Roots and debris increase organic matter and support soil organisms used as prey.

A study conducted in southwestern Michigan evaluated organic rotations of corn, soybeans, and wheat with cover crops. The organic areas maintained moderate ant activity throughout the growing season. In conventional plots, foraging occurred primarily after harvest.

The coincidence between ant activity and crop development doubled the potential for pest suppression during the evaluated periods.

Integrated management

The conservation of colonies also depends on insecticide management. Broad-spectrum products and systemic molecules can cause lethal and sublethal effects. Seed treatments, soil applications, and foliar sprays reduce abundance and diversity throughout the cycle.

Integrated pest management offers a strategy to limit these losses. A meta-analysis cited by the researchers evaluated 34 crops. The use of action

levels reduced insecticide applications by 44%, without compromising pest control or productivity. The approach also favored a greater abundance of beneficial arthropods.

Proposed actions

Scientists propose integrating no-till farming, cover crops, and integrated pest management. This combination preserves nests, expands resources, and reduces unnecessary applications. However, data is still lacking to measure the economic impact of these services on annual crops in temperate climates.

Researchers advocate for further studies on community composition, seasonal

activity, and predation of economically important species. Molecular analyses of gut contents and stable isotope studies can identify less visible interactions, including subterranean and nocturnal predation.

Quantifying these effects should indicate whether ants are able to reduce populations below economic damage levels. The study recommends paying attention to cutworms, wireworms, slugs, and pest stages maintained in the soil or straw. The evaluation also needs to consider water infiltration, seed removal, and the economic return of conservation practices.

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Coamo expands grain receiving facilities in Paraná

Five new units will serve producers in the North, North Pioneer, and South-Central regions of the state

29.07.2026 | 15:40 (UTC -3)

Coamo, Cultivar Magazine edition



Coamo recently announced the acquisition/lease of agricultural facilities located in the municipalities of

Sertanópolis, Ibiporã, Primeiro de Maio, Irerê (a district of Londrina), and Imbituva, in Paraná. This initiative is part of the cooperative's strategy for sustainable growth and operational strengthening to serve producers in the North, North Pioneer, and Central-South regions of the state.

The cooperative is starting operations and will function in these facilities to receive the 2026/2026 corn harvest from producers.

"This is an evolution that we began with operations in the units of Bela Vista do Paraíso, Assaí, Cambé, Sabaúdia, Tamarana and Mauá da Serra and, now, with these five new ones," recalls the CEO of Coamo, Airton Galinari.

According to Galinari, entering new regions will allow the company to bring to farmers the full portfolio of services already offered to cooperative members in the states of Paraná, Mato Grosso do Sul, and Santa Catarina. “Among Coamo's differentiators are technical assistance, the supply of inputs, the various production marketing options, as well as the Credicoamo program and the grain storage and receiving infrastructure. Coamo is very strong in this, dominating the entire chain, from production to global markets,” he emphasizes.

Investments made

The expansion is also aligned with investments made by the cooperative in

other areas of the production chain. “We are growing in industries, in port activity, in logistics in general. So, this combines very well with adding more production, receiving more grains and supplying more inputs. I think we have great expertise in this and, for sure, the main beneficiaries will be the cooperative members in the region,” points out Galinari.

According to the president, the growth is in line with the demands of the commodities market, which requires scale and structure to maintain competitiveness. "This is a movement that follows the market. We work in the commodities market, and the commodities market doesn't tolerate small operators," he assesses.

In addition to expanding its physical structure, the cooperative is already seeing strong interest from local producers in joining the institution. “What we are seeing is a great movement of affiliation with the cooperative. So, we have many proposals from these regions, already incorporating them into the Coamo cooperative membership. Last month alone there were more than 300. A very intense movement, and the expectation is that it will continue every month,” he concludes.

The board will also soon hold meetings with producers from the new municipalities to present the philosophy and guidelines, as well as the products and services to be offered by the cooperative.

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Thrips exhibit reduced performance after switching to onions

Study links adaptation of Thrips tabaci to detoxification genes and hormonal metabolism

29.07.2026 | 15:13 (UTC -3)

Cultivar Magazine



Photo: Wenderson Araujo - CNA

The L2 strain of *Thrips tabaci* showed lower survival and fecundity on onion during three successive generations. The insect completed its life cycle on this host, but maintained lower performance than that recorded on red cabbage (DOI 10.1002/ps.71155).

Researchers evaluated the biological and molecular response of thrips after transfer from red cabbage to onion bulbs. The first generation reared on onions showed a sharp reduction in age-specific survival. Peaks of fecundity and maternity also decreased. This disadvantage persisted across all three generations analyzed.

Transcriptomic analysis

Transcriptomic analysis identified 3.862 differentially expressed genes in the first generation, 6.549 in the second, and 9.484 in the third. Some of these genes participated in pathways linked to cytochrome P450-mediated detoxification and insect hormone biosynthesis.

The study grouped together eight gene expression patterns. This set formed a regulatory core associated with adaptation during host switching.

The results indicate a central role for detoxification mechanisms and hormonal metabolism in the feeding plasticity of *Thrips tabaci*. The work also established a stable system for rearing the L2 strain in onion bulbs and identified molecular targets for future research on adaptation to different crops.

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Saiba mais!



Exports of agricultural machinery grew 17,5% in the first half of the year

Exports totaled US\$876,64 million and helped offset the contraction in the domestic market

29.07.2026 | 14:33 (UTC -3)

Cultivar Magazine



Brazilian exports of agricultural machinery and implements grew 17,5% in the first

half of 2026, totaling US\$876,64 million. This increase helped to mitigate the impact of the contraction in the domestic market. During the same period, the segment's total net revenue fell 21,3% to R\$26,64 billion, while domestic revenue declined 24,9% to R\$22,13 billion. These data are part of a survey conducted by the Brazilian Association of Machinery and Equipment Industries (Abimaq).

In June, net revenue from the agricultural sector reached R\$ 4,97 billion. This figure represents an 8,3% increase compared to May, but was 22,3% lower than the result for June of last year. Domestic sales generated R\$ 4,15 billion in the month. There was a monthly increase of 5,6% and a year-on-year decrease of 26,3%.

The result reflected the slowdown in the machinery and equipment industry.

Apparent national consumption totaled R\$ 33,95 billion in June. The indicator advanced 10,1% compared to May, without seasonal adjustment, and retreated 7% compared to June 2025. In the accumulated semester, investments in machinery and equipment fell 13,8%.

Abimaq identified the most intense contractions in agricultural activities and in the manufacturing industry.

Causes for the scenario

The association links the weakening of the domestic market to the cost of credit.

Restrictive monetary policy has increased

the cost of capital and reduced the viability of new investments. This environment has also delayed decisions regarding equipment replacement and modernization.

Role of exports

Exports mitigated some of the contraction in the agricultural sector. External sales of agricultural machinery and implements totaled US\$160,67 million in June. This result surpassed May by 20,9% and June 2025 by 17,2%. Between January and June, exports reached US\$876,64 million, representing a growth of 17,5%.

Agricultural imports reached US\$124,47 million in June. The value increased 12,5%

??compared to May and 17,7% year-on-year. However, in the first half of the year, external purchases decreased by 4,7%, totaling US\$626,07 million.

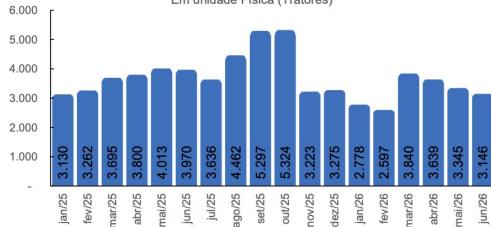
In the machinery industry as a whole, imported products accounted for 47,7% of national consumption in the first half of the year. This share increased by 2,1 percentage points compared to the same period in 2025. Purchases from China grew by 15,9%. In the group of Chinese equipment aimed at agriculture, the expansion reached 17,2%.

Tratores

Desempenho em unidades físicas

Vendas ao Usuário Final

Em unidade Física (Tratores)



Vendas de Fábrica

Em unidade Física (Tratores)



Exportação

Em unidade Física (Tratores)



Em unidade Física (Tratores)

	Mensal		Interanual	
	Jun/26- Mai/26	Jun/26- jun/25	Var.% no ano	Var.% 12 meses
Venda de Fábrica	-3,4%	-20,7%	-16,9%	-1,1%
Venda para o Usuário Final	-5,9%	-20,8%	-11,5%	3,1%
Exportação	-20,8%	50,9%	40,2%	23,8%

ABIMAQ

Fonte: DEEE/ABIMAQ.

22

Tractor sales

Physical performance showed a reduction in tractor sales. In June, factories sold 3.636 units. The volume fell 3,4% compared to May and 20,7% compared to June 2025. In the first half of the year, factory sales declined by 16,9%.

Tractor deliveries to end users totaled 3.146 units in June. This represents a

monthly decrease of 5,9% and a year-on-year reduction of 20,8%. The year-to-date decline reached 11,5%.

Tractor exports moved in the opposite direction compared to the previous year. The sector shipped 620 units in June. This number fell 20,8% compared to May, but exceeded June 2025 by 50,9%.

Accumulated shipments in the first half of the year increased by 40,2%.

Colheitadeira



Em unidade Física (colheitadeiras)

	Mensal	Interanual		
	Jun/26- Mai/26	Jun/26- jun/25	Var.% no ano	Var.% 12 meses
Tratores				
Venda de Fábrica	90,2%	-78,7%	-45,2%	-23,7%
Venda para o Usuário Final	29,6%	-41,4%	-31,1%	-32,4%
Exportação	15,4%	-37,5%	48,7%	27,1%

Fonte e Elaboração: DEEE/ABIMAQ



23

Harvester sales

The combine harvester market continued its more intense contraction. Factory sales reached 78 units in June, a 90,2% increase over May. Compared to June 2025, there was a 78,7% decrease. The accumulated volume for the year fell by 45,2%.

Deliveries of harvesters to end users reached 140 units in the month. There was a monthly growth of 29,6% and an annual decrease of 41,4%. Between January and June, sales to end users decreased by 31,1%.

Employment also reflected the adjustment in the sector. The agricultural machinery and implements industry ended June with

114,5 people employed. This number fell 0,5% compared to May and 9,2% compared to June 2025. The average for the first half of the year showed a reduction of 3,3%.

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ATENÇÃO ESTE PRODUTO É PERIGOSO À SAÚDE HUMANA, ANIMAL E AO MEIO AMBIENTE; USO AGRÍCOLA; VENDA SOB RECEITUÁRIO AGRÔNOMICO; CONSULTE SEMPRE UM AGRÔNOMO; INFORME-SE E REALIZE O MANEJO INTEGRADO DE PRAGAS; DESCARTE CORRETAMENTE AS EMBALAGENS E OS RESTOS DOS PRODUTOS; LEIA ATENTAMENTE E SIGA AS INSTRUÇÕES CONTIDAS NO RÓTULO, NA BULA E RECEITA; E UTILIZE SEMPRE OS EQUIPAMENTOS DE PROTEÇÃO INDIVIDUAL.

SLC Agrícola inaugurates the company's largest cotton gin in Piauí

The unit processes up to 80 bales per hour and serves the production of up to 25 hectares per harvest

29.07.2026 | 13:34 (UTC -3)

Cultivar Magazine, based on information from Gabriel Queiroz



Photo: SLC

SLC Agrícola inaugurated its largest cotton gin. The unit is located at Fazenda Parnaguá, in Piauí, and processes up to 80 bales per hour. The structure can benefit the production of approximately 20 hectares per harvest, with the possibility of reaching 25 hectares.

In the first harvest, the cotton gin is expected to receive cotton harvested from approximately 7 hectares of the Parnaguá Farm. The project also allows the company to supply other operations in Piauí and Maranhão.

The facility occupies a total area of 70 square meters. The built area totals 10,2 square meters. The structure includes four cotton ginning machines, each with 244 saws, a bale storage area, and a

warehouse for 10 tons of cottonseed.

The warehouse has an aeration system designed to preserve the kernels during storage. The solution arose from a study supported by the company. The study defined technical parameters for Brazilian climatic conditions.

According to SLC Agrícola, the system should reduce the risk of losses and damage, preserve product quality, and extend the storage period.

The project integrated decisions regarding agricultural production, industrial capacity, infrastructure, and storage. The sizing considered the volumes received during peak harvests, the capacity of the ginning machines, and the storage of products generated during processing.

The unit will also absorb the commercial cotton production from Fazenda Perpétua. Before the current harvest, the property only maintained experimental areas with the crop.

“Our goal was to organize a continuous flow, with fewer waiting points and greater control over operational conditions,” says Leonardo Celini, Operations Director at SLC Agrícola.

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ANTES DA MECÂNICA,**

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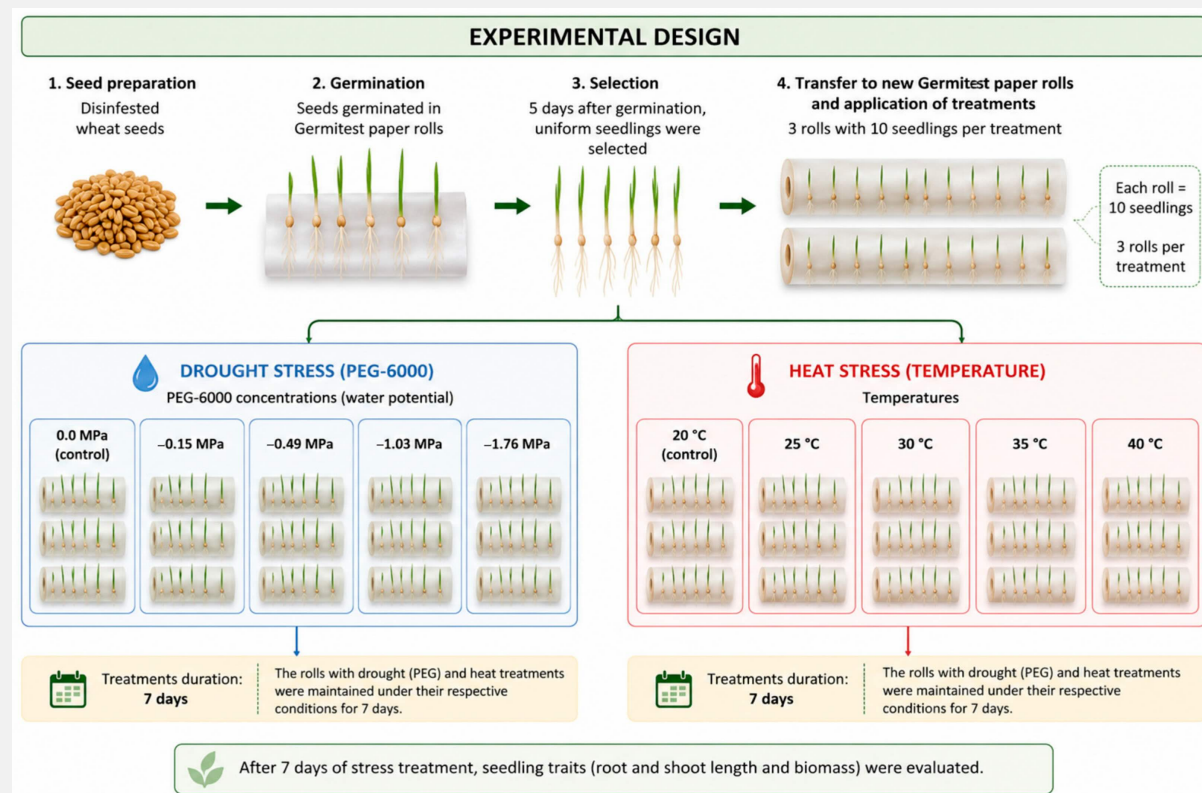
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Root system guides selection of stress-tolerant wheat

Study with 28 cultivars highlights root characteristics associated with tolerance to heat and water deficit

29.07.2026 | 09:54 (UTC -3)

Schubert Peter, Cultivar Magazine



Schematic view of the preliminary test for the definition of simulated thermal and water stress - DOI 10.3390/seeds5040042

Root system characteristics can guide the early selection of Brazilian wheat cultivars with greater establishment capacity under heat and water deficit. A study by researchers at the Federal University of Pelotas evaluated 28 commercial materials and identified a high genetic contribution to root length and dry mass. The results also pointed to promising cultivars for further greenhouse and field testing (DOI 10.3390/seeds5040042).

Scientists worked with *Triticum aestivum* seedlings under controlled conditions. The trial compared a stress-free treatment, maintained at 25 degrees Celsius, with two adverse conditions. Heat stress occurred at 35 degrees Celsius. The drought simulation used polyethylene glycol 6000 at a concentration of 40%, with an osmotic

potential of minus 1,76 megapascals.

Each treatment remained active for seven days. The team measured shoot length, root length, shoot dry mass, and root dry mass. The experiment employed three independent replicates. Each experimental unit contained ten seedlings in a Germitest paper roll.

Osmotic stress

Osmotic stress produced broader effects. Simulated water restriction altered shoot length, root length, and root dry mass. Heat affected only root length. Neither treatment produced a significant difference in shoot dry mass.

Under heat, the relative performance of root length ranged from 46,59% to 82,04% compared to the stress-free treatment.

This range allowed for the separation of genotype responses. The clustering test placed 19 cultivars in the highest root performance group and nine in the lowest group.

The tolerance indices highlighted TBIO Capaz, TBIO Ponteiro, TBIO Talismã, TBIO Astro, and TBIO Audaz for maintaining root growth under 35 degrees Celsius. The results considered the stress tolerance index and the geometric mean of productivity applied to the seedling characteristics.

Stress response

The response to osmotic stress showed greater complexity. Relative root length ranged from 41,71% in the ORS Turbo group to 71,28% in the ORS Absoluto group. Shoot length ranged from 49,94% in the TBIO Motriz group to 64,96% in the ORS Feroz group.

Root dry mass increased in all cultivars under osmotic stress. The relative values ??ranged from 117,14% to 193,17%. This behavior may reflect greater formation of lateral roots or cellular adjustments. The result does not, by itself, represent greater depth of the root system.

The indices applied to root length under osmotic stress highlighted TBIO Capaz, TBIO Talismã, TBIO Ponteiro, ORS Falcão, TBIO Audaz, and TBIO Astro. For

shoot length, the highest values
??appeared in ORS Completo, TBIO
Talismã, ORS Gladiador, ORS Absoluto,
and ORS Guardiã.

Dry mass assessment

In the evaluation of root dry mass, ORS Falcão, ORS 1403, TBIO Talismã, TBIO Valente, and ORS 2301 showed the highest tolerance and stability indices. The combination of principal component analysis and tolerance indices selected ORS Gladiador for shoot length under osmotic stress. ORS 1403 appeared in both approaches for maintaining root mass.

Genetic parameters reinforced the potential of root traits for breeding programs. Broad-sense heritability reached 0,71 for root length under heat. Under osmotic stress, root length and root dry mass showed heritability close to 0,70. Shoot length showed a value close to 0,51. The genetic coefficients of variation for root length and dry mass exceeded 10% under osmotic stress. According to the researchers, these results show a significant contribution of the genotype to the observed variation. These characteristics may support the initial screening of materials intended for environments subject to heat and water limitation.

Multivariate analysis

Multivariate analysis explained 80% of the phenotypic variation in the first two components. The clusters revealed distinct strategies. Some cultivars maintained greater root elongation. Others directed more biomass to the roots.

Wheat expansion

This work presents potential applications in expanding wheat cultivation to regions with high temperatures and prolonged droughts, such as areas of the Cerrado. Selection at the seedling stage allows for the elimination of sensitive materials before longer evaluations. It also provides information for choosing parents in

breeding programs.

The results do not allow for recommending cultivars for commercial cultivation based solely on this trial. The study used controlled conditions and calibrated stress levels with a single cultivar, ORS Feroz. Soil, microbiota, nutrient availability, and water distribution can modify root architecture. The selected materials still need to undergo validation in greenhouses and the field.

The study was conducted by Antônio de Azevedo Perleberg, Julio Cesar Paes Jacome de Araújo Filho, Thaís Monteiro Miranda, Taís Amanda Mundt, Antonio Costa de Oliveira, Luciano Carlos da Maia, Camila Pegoraro, and Vívian Ebeling Viana.

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Baits alter the behavior of the Argentine ant

Boric acid increases nest aggregation;
thiamethoxam increases external activity

29.07.2026 | 09:00 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Rebekah D Wallace / University of Georgia - Bugwood - BY CC 3.0

Low concentrations of boric acid and thiamethoxam in sugar baits elicited opposite behavioral responses in colonies

of Argentine ants, *Linepithema humile*. Boric acid increased the concentration of workers inside the nest and reduced activity in the foraging area.

Thiamethoxam drove the ants out of the shelter and increased circulation in the external environment. The results came from a study conducted at the University of California, Riverside, in the United States (DOI 10.3390/insects17080785).

The research evaluated sublethal effects of the two active ingredients. The scientists sought to simulate the dilution of the insecticides after trophallaxis, the process of food sharing among members of the colony. This transfer can expose a large part of the population to doses lower than lethal concentrations.

The Argentine ant represents an invasive pest in agricultural, urban, and natural environments. The species maintains an association with insects that produce honeydew, or sugary exudates, and can favor populations of sap-sucking pests. Its ability to form supercolonies and displace native arthropods also amplifies its ecological impact.

Laboratory colonies

The experiment used laboratory colonies with an average of 294 worker bees. Most groups contained one to three queens, as well as similar quantities of eggs and immature forms. Each colony remained in an arena consisting of a nesting tube, a moisture source, and a foraging area.

The researchers prepared a bait with 0,2% boric acid and another with 0,00005% thiamethoxam. Both contained a 25% sucrose solution. The control group received only the sugar solution. Each treatment included ten colonies.

The team provided ten microliters of bait per colony in a single application. There was no other food source. Images of the nest and the surrounding area were recorded before application and every 24 hours for three days.

Boric acid

Boric acid increased ant density inside the nest by 25,6%. At the same time, activity outside the nest decreased by 56,3%. On

the third day, the treated colonies showed denser clusters near the moisture source and fewer worker ants in the foraging area.

The average number of ants in the external area dropped from 17,4 at the beginning of the trial to 7,6 on the third day. Inside the nest, the total number of worker ants in the group increased from 189,6 to 216,6 during the same period.

Effects of boric acid

Scientists link this response to the effects of boric acid on the insects' digestive system. The substance can cause damage to the epithelial cells of the midgut and Malpighian tubules, structures linked to absorption, excretion, and water balance.

The higher concentration of worker ants near moisture may represent a response to water loss. The research did not confirm this mechanism, but it points to this hypothesis.

Thiamethoxam: reverse response

Thiamethoxam produced the opposite response. Nest density decreased by 36,5%, while external activity increased by 862,3%. The average number of worker bees in the foraging area increased from 19,9 before application to 191,5 on the third day.

There was also a reduction in the number of ants gathered inside the nest. The

average dropped from 269 to 90 workers. The volume occupied by the group decreased from 2,46 milliliters to 1,27 milliliters. The data indicate a loss of cohesion within the colony and the displacement of a large proportion of the workers outside the shelter.

Thiamethoxam belongs to the neonicotinoid group. The active ingredient acts on nicotinic acetylcholine receptors in the nervous system of insects and can cause neuronal overstimulation. In the study, exposure increased the time ants spent in illuminated areas.

Individual essay

In an individual trial, each worker ant remained for ten minutes in an arena divided into light and dark zones. Ants treated with thiamethoxam spent an average of 313,5 seconds in the illuminated area. The control group remained in the same location for 264,7 seconds. In the dark zone, the average time dropped from 325,9 seconds in the control group to 283,5 seconds after exposure to the insecticide.

Total distance traveled

No treatment altered the total distance traveled by the ants. The groups walked between 819 and 848 centimeters during the ten minutes of observation. This result

indicates the maintenance of individual mobility. The differences occurred in the choice of location and in the collective organization.

Implications for management

The results have implications for management. The rapid drop in foraging after boric acid application may reflect not only mortality but also the continued presence of worker bees inside the nest. This behavior can reduce further visits to the bait and limit additional exposures.

With thiamethoxam, increased external circulation can increase bait consumption and promote the distribution of the active

ingredient throughout the colony. At the same time, the presence of many ants outside the nest may give the impression of increased infestation in the first few days after treatment.

The study monitored the colonies for three days after application. Scientists recommend further evaluations over longer periods. Future trials may indicate whether the changes persist, increase, or disappear, as well as verify any recovery of the exposed worker bees.

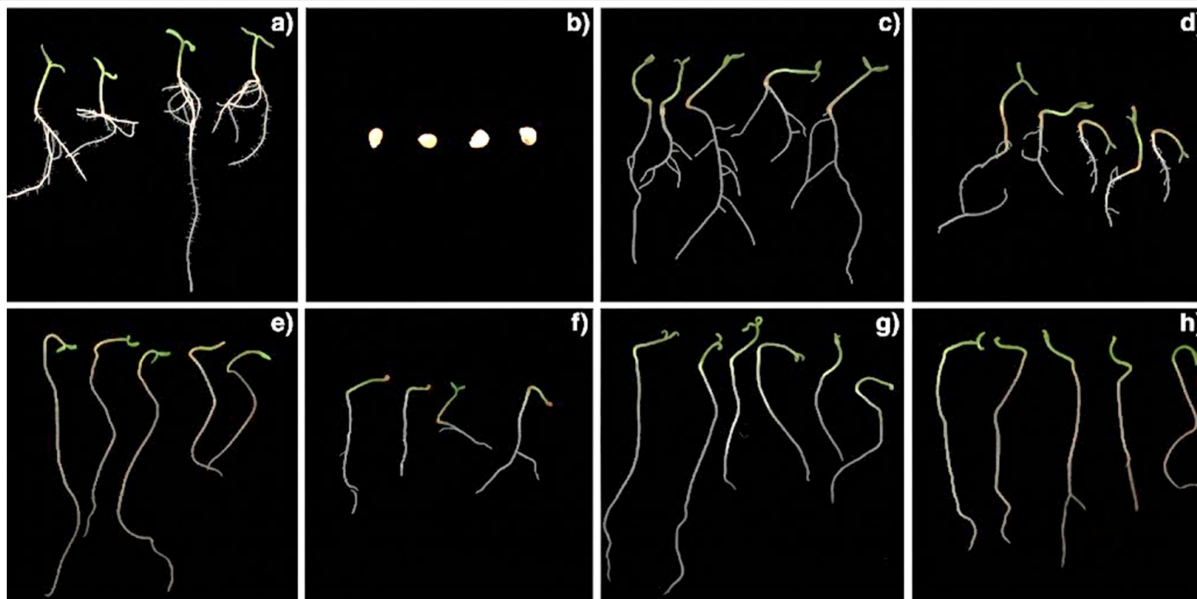
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Potassium nitrate restores tomato germination under saline stress

Conditioning with KNO₃ increased germination to 81% in seeds exposed to salt

29.07.2026 | 08:00 (UTC -3)

Schubert Peter, Cultivar Magazine



Tomato seeds and seedlings after 14 days of germination: (a) control; (b) seeds exposed to saline stress without priming (100 mM NaCl); and seedlings from seeds subjected to priming treatments followed by exposure to saline stress (100 mM NaCl): (c) 25 mM KNO₃; (d) 50 mM KNO₃; (e) PEG 6000 at 0,4 MPa; (f) PEG 6000 at 0,8 MPa; (g) 0,1 mM SNP; (h) 0,2 mM SNP
- DOI 10.3390/seeds5040043

Conditioning seeds with potassium nitrate at 50 millimoles per liter restored tomato germination under saline stress. The treatment increased germination to 81%, enhanced antioxidant activity, and reduced lipid peroxidation. Without conditioning, a sodium chloride solution at 100 millimoles per liter prevented all germination (DOI 10.3390/seeds5040043).

Researchers from the Federal University of Espírito Santo and the Federal Institute of Espírito Santo evaluated three techniques on tomato seeds: osmoconditioning with polyethylene glycol 6000, haloconditioning with potassium nitrate, and chemoconditioning with sodium nitroprusside.

Better performance

Potassium nitrate at 50 millimoles per liter showed the best performance under salinity. The treatment increased catalase activity by 103% compared to unconditioned seeds exposed to salt. It also reduced malondialdehyde content, an indicator of cell membrane damage, by 18%.

A concentration of 25 millimoles per liter resulted in 56% germination. Polyethylene glycol and sodium nitroprusside promoted partial recovery, with rates between 14% and 29%.

Iron toxicity

The study also analyzed iron toxicity induced by Fe-EDTA at four millimoles per liter. Excess iron reduced germination by 79% and increased malondialdehyde content by 425%. All treatments stimulated antioxidant enzymes. None reduced lipid peroxidation or restored seedling growth to control levels.

The results indicate greater potential for haloconditioning with potassium nitrate to protect tomato germination under salinity. For iron toxicity, the treatments tested did not prevent oxidative damage.

The research was conducted by Anny Nogueira Fraga, Josinei Rodrigues Filho, Marina Reis Pires, Viviana Borges Corte, and Hildegardo Seibert França.

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Bunge raises profit and forecast after progress in processing

Second-quarter results show growth driven by soybeans, oilseeds, and Viterra's integration

29.07.2026 | 07:45 (UTC -3)

Cultivar Magazine



Bunge reported net income attributable to shareholders of US\$678 million in the second quarter of 2026, compared to

US\$354 million in the same period of 2025. Diluted earnings per share reached US\$3,47. On an adjusted basis, the indicator increased from US\$1,31 to US\$2,00 per share.

Performance was boosted by the soybean and oilseed processing and refining segments. Adjusted EBIT for these segments totaled US\$796 million, more than double the US\$373 million recorded a year earlier.

Soybean segment

In the soybean segment, adjusted EBIT increased from US\$304 million to US\$445 million. The company processed 11,524 million metric tons of soybeans, compared to 9,304 million tons in the second quarter

of 2025. The increase occurred in South America, North America, and Europe. The greater production capacity in Argentina had the greatest impact on the growth.

The oilseed processing and refining business posted adjusted EBIT of US\$255 million, compared to US\$14 million in the previous year. Processed volume increased from 1,947 million to 3,490 million metric tons. Bunge attributed the growth to capacity expansion in Argentina, Canada, and Europe, as well as more favorable market conditions.

Grains and milling

Grain sales and milling recorded adjusted EBIT of US\$67 million, compared to US\$29 million. Volumes reached 23,852

million metric tons, supported by the expansion of grain receiving and handling infrastructure following the integration of Viterro.

Based on these results, Bunge raised its adjusted earnings per share forecast for 2026. The range increased from US\$9,00 to US\$9,50 to US\$9,25 to US\$9,75. The company anticipates higher results in soybeans and slightly higher results in oilseeds. For grain trading and milling, it projects performance lower than the previous estimate.

Bunge Global SA Earnings Highlights

(US\$ in millions, except per share data)	Quarter Ended June 30,		Six Months Ended June 30,	
	2026	2025	2026	2025
Net income per share-diluted	\$ 3.47	\$ 2.61	\$ 3.81	\$ 4.10
Adjusted Net income per share-diluted ⁽¹⁾	\$ 2.00	\$ 1.31	\$ 3.83	\$ 3.12
Adjusted Segment EBIT ^{(1) (2)}	\$ 796	\$ 373	\$ 1,457	\$ 779
Soybean Processing and Refining	\$ 445	\$ 304	\$ 822	\$ 545
Softseed Processing and Refining	255	14	450	96
Tropical Oils and Specialty Ingredients	29	26	74	49
Grain Merchandising and Milling	67	29	111	89
Adjusted Corporate and Other EBIT ^{(1) (3)}	\$ (131)	\$ (80)	\$ (231)	\$ (124)
Adjusted Total EBIT ⁽¹⁾	\$ 665	\$ 293	\$ 1,226	\$ 655

(1) Adjusted Net income per share – diluted, Adjusted Segment EBIT, Adjusted Corporate and Other EBIT, and Adjusted Total EBIT are non-GAAP financial measures. Reconciliations to the most directly comparable U.S. GAAP measures are included in the appendix attached to this slide presentation which are also posted on Bunge's website.

(2) Adjusted Segment EBIT comprise our Soybean Processing and Refining, Softseed Processing and Refining, Tropical Oils and Specialty Ingredients, and Grain Merchandising and Milling reportable segments.

(3) Corporate and Other includes salaries and overhead for corporate functions, including acquisition and integration costs related to the Viterro Acquisition, that are not allocated to the Company's individual reporting segments, as well as certain other activities including Bunge Ventures, the Company's captive insurance activities, and accounts receivable securitization activities.

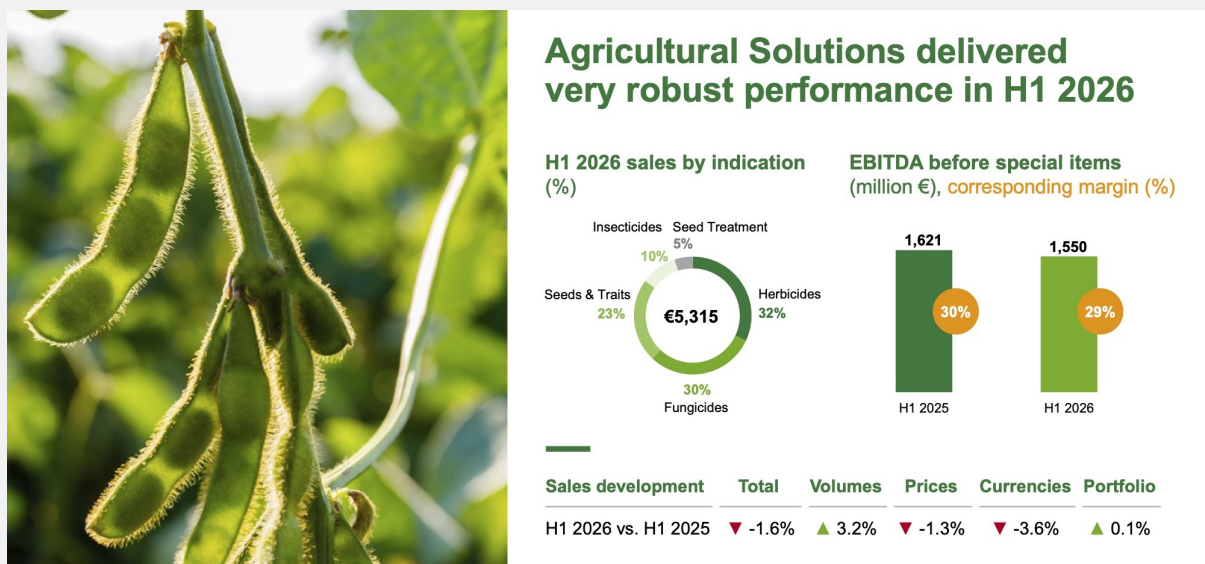
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BASF expands agricultural results in the second quarter

Agricultural Solutions increases EBITDA and moves towards its planned IPO in 2027

29.07.2026 | 07:08 (UTC -3)

Cultivar Magazine



BASF's Agricultural Solutions division reported sales of €2,210 billion in the second quarter of 2026, a 0,6% increase over the same period in 2025. EBITDA before special items reached €448 million,

a 7,5% increase. The segment's cash flow totaled €881 million, an 8,5% increase.

The figures show a recovery in profitability during the quarter, despite the effects of currency exchange rates and the price reductions observed year-to-date.

In the first half of the year, the agricultural sector generated €5,315 billion in revenue.

This figure was 1,6% lower than the €5,401 billion recorded a year earlier.

EBITDA before special items reached €1,550 billion, a decrease of 4,4%. The corresponding margin reached 29%, compared to 30% in the first half of 2025.

Increase in volumes

Commercial performance was supported by increased volumes in all regions. BASF

highlighted advances in fungicides, herbicides, and seed treatment. Total volume grew 3,2% in the first half of the year. Prices fell 1,3%. Currency fluctuations reduced sales by 3,6%. Portfolio effects added 0,1%.

Herbicides accounted for 32% of the division's sales during the period.

Fungicides represented 30%. Seeds and genetic traits accounted for 23%.

Insecticides accounted for 10%. Seed treatment accounted for the remaining 5%.

The next strategic step for the agricultural segment involves achieving the conditions for an initial public offering of shares by mid-2027. According to management, the process is on schedule.

The acquisition of AgBiTech also had a positive effect on the portfolio. BASF completed the transaction in March 2026. The acquired company operates in biological solutions for insect control. The impact on consolidated sales remained small during the period.

BASF Group

At BASF Group, second-quarter sales totaled €17,206 billion, a 16,4% increase. EBITDA before special items grew 53,6% to €2,449 billion. The margin increased from 10,8% to 14,2%. This result was supported by higher prices, volume growth, and reduced fixed cash costs.

The group raised its EBITDA forecast before special items for 2026. The new

range is between €6,9 billion and €7,7 billion. The previous estimate was between €6,2 billion and €7 billion. The free cash flow forecast remained between €1,5 billion and €2,3 billion.

BASF attributed the revision to better-than-expected performance in the first half of the year. The company also maintained a difference of €800 million between the projection limits. The decision takes into account the geopolitical uncertainties mentioned by management during the presentation of the results.

BASF Group^a

		Q2			H1		
		2026	2025	+/-	2026	2025	+/-
Sales	million €	17,206	14,788	16.4%	33,226	31,297	6.2%
EBITDA before special items	million €	2,449	1,595	53.6%	4,805	4,090	17.5%
EBITDA	million €	1,965	1,323	48.6%	4,151	3,392	22.4%
EBITDA margin before special items	%	14.2	10.8	.	14.5	13.1	.
Depreciation and amortization ^b	million €	1,028	927	10.9%	1,953	1,838	6.3%
Income from operations (EBIT)	million €	937	395	137.1%	2,198	1,555	41.4%
Special items in EBIT	million €	-542	-291	-86.4%	-715	-723	1.1%
EBIT before special items	million €	1,479	686	115.6%	2,913	2,278	27.9%
Income before income taxes	million €	780	221	253.6%	1,879	1,234	52.3%
Income after taxes from continuing operations	million €	589	28	.	1,473	846	74.0%
Income after taxes from discontinued operations	million €	3,565	80	.	3,627	99	.
Income after taxes	million €	4,154	108	.	5,100	945	439.7%
Net income	million €	4,144	79	.	5,072	887	471.7%
Earnings per share from continuing operations ^c	€	0.67	0.01	.	1.66	0.89	85.0%
Earnings per share from discontinued operations ^c	€	4.11	0.08	.	4.16	0.10	.
Earnings per share ^c	€	4.78	0.09	.	5.81	0.99	484.5%
Adjusted earnings per share ^c	€	1.28	0.48	166.7%	2.60	2.06	26.3%
Research and development expenses	million €	472	479	-1.6%	909	958	-5.1%
Personnel expenses	million €	3,189	3,050	4.6%	6,194	6,118	1.2%
Employees (June 30)		94,910	110,918	-14.4%	94,910	110,918	-14.4%
Assets (June 30)	million €	83,867	77,668	8.0%	83,867	77,668	8.0%
Investments including acquisitions ^d	million €	856	1,082	-20.9%	1,695	2,017	-16.0%
Equity ratio (June 30)	%	44.6	43.1	.	44.6	43.1	.
Net debt (June 30)	million €	17,117	21,281	-19.6%	17,117	21,281	-19.6%
Cash flows from operating activities	million €	524	1,585	-66.9%	-273	603	.
Free cash flow	million €	-189	533	.	-1,564	-1,266	-23.5%

a Owing to the divestiture of the automotive OEM coatings, automotive refinish coatings and surface treatment business units to Carlyle, the affected business units were classified as discontinued operations in accordance with IFRS 5 until the closing of the transaction on June 30, 2026. The prior-year earnings figures listed up to and including income taxes have been restated.

b Depreciation and amortization of property, plant and equipment and intangible assets (including impairments and reversals of impairments).

c As a result of the share buyback program, which commenced in November 2025, the weighted average number of outstanding shares amounted to 872,743,259 in the second quarter of 2026 and 867,183,730 in the first half of 2026. In the second quarter of 2025 as well as in the first half of 2025, the weighted average number of outstanding shares amounted to 892,522,164.

d Additions to intangible assets and property, plant and equipment.

Due to rounding, individual figures may not add up to the totals shown and percentages may not correspond exactly to the figures shown.

Segment data – Agricultural Solutions

Million €	Q2			H1		
	2026	2025	+/-	2026	2025	+/-
Sales to third parties	2,210	2,198	0.6%	5,315	5,401	-1.6%
of which Fungicides	652	643	1.3%	1,598	1,520	5.1%
Herbicides	836	866	-3.5%	1,707	1,769	-3.5%
Insecticides	250	259	-3.5%	515	543	-5.3%
Seed Treatment	144	111	29.1%	271	257	5.5%
Seeds & Traits	329	319	3.2%	1,224	1,312	-6.7%
EBITDA before special items	448	417	7.5%	1,550	1,621	-4.4%
Special items in EBITDA	-33	-64	48.1%	-57	-79	27.5%
EBITDA	415	353	17.5%	1,493	1,542	-3.2%
EBITDA margin before special items (%)	20.3	19.0	.	29.2	30.0	.
Depreciation and amortization ^a	140	144	-3.3%	274	303	-9.5%
EBIT before special items	309	272	13.4%	1,277	1,320	-3.2%
Special items in EBIT	-34	-64	46.9%	-59	-80	26.8%
Income from operations (EBIT)	275	209	31.9%	1,219	1,240	-1.7%
Investments including acquisitions ^b	66	70	-4.8%	257	141	81.9%
Segment cash flow	881	811	8.5%	-279	-166	-68.0%
Assets (June 30)	16,361	15,834	3.3%	16,361	15,834	3.3%
Research and development expenses	253	232	9.0%	477	452	5.4%

^a Depreciation and amortization of property, plant and equipment and intangible assets (including impairments and reversals of impairments)

^b Additions to property, plant and equipment and intangible assets

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Coffee berry borer favors its natural enemies, ants

Ants occupy fruits perforated by the pest and can expand biological control in shaded coffee plantations

28.07.2026 | 16:28 (UTC -3)

Schubert Peter, Cultivar Magazine



Nest of *Pseudomyrmex elongatus* - Photo: Jonathan R. Morris

The coffee berry borer can create shelter for ants capable of preying on it. The interaction was recorded in an organic, shaded coffee plantation in Chiapas, Mexico. Researcher Jonathan R. Morris found seven species of ants inside fruits perforated by *Hypothenemus hampei*. Five of them showed signs of reproduction inside the fruits. The discovery indicates an unusual ecological effect: the pest itself modifies the environment and favors populations of its natural enemies (DOI 10.1002/ecy.70463).

The coffee borer bores into the fruits of *Coffea arabica* to lay eggs. Larvae and young adults consume the endosperm during development. Most of the life cycle occurs inside the fruit. This gallery protects the insect from adverse environmental

conditions and from some biological control agents.

Small ants, however, are able to enter these channels. Previous studies have already indicated the removal of adult and immature forms of the fruit borer by small species. The new observation shows another use for the attacked fruits. The cavities also function as shelter and breeding sites for some ants.

Green fruits

Morris collected hundreds of green fruits showing signs of infestation in September and October 2016. The material was used to extract borers for a laboratory experiment. During the opening of the fruits, the researcher found ants in some

samples.

The recorded species included *Nesomyrmex echinatinodis*, *Procryptocerus hylaeus*, *Pseudomyrmex elongatus*, and *Wasmannia auropunctata*. Representatives of the genera *Azteca*, *Pheidole*, and *Tapinoma* also appeared, but were not identified to the species level.

Reproductive use of the cavity

Five groups presented eggs, larvae, pupae, queens, or winged reproductive individuals. The records involved *Nesomyrmex echinatinodis*, *Procryptocerus hylaeus*, *Pseudomyrmex elongatus*, *Wasmannia auropunctata*, and

one species of *Tapinoma*. This presence indicates reproductive use of the cavity, not just occasional passage.

Some of these ants already have a known role in controlling the fruit borer.

Procryptocerus hylaeus reduces fruit colonization. *Wasmannia auropunctata* also decreases infestation and preys on immature forms of *Hypothenemus hampei*. Ants of the genus *Pseudomyrmex* can reduce the number of borers inside the fruits and limit new colonizations.

The study did not confirm whether all the ants found consumed the pest. Some of them may remove individuals and debris to free up space. However, evidence from other studies points to predation of eggs, larvae, pupae, and adults by ants capable

of entering the galleries.

Partially cleaned cavities

The researcher observed partially cleaned cavities in the occupied fruits. This pattern does not usually appear when only the borer remains inside. The ants can remove insect debris and deteriorated portions of the endosperm. This cleaning expands the area available for the nest. Some also appear to widen the entrance opened by the borer.

Morris classified the process as "indirect bottom-up niche construction." In this mechanism, prey alters the environment and creates an advantage for the predator.

The borer opens the cavity. Ants take advantage of the space, make further modifications, and can establish colonies within the fruit itself.

The interaction does not occur at any time. Its use depends on the size of the fruits and the time required for the formation of the galleries. Even so, the reproduction of various species within the cavities indicates a recurring phenomenon, not an isolated event.

The establishment of nests in the fruit can keep ants directly on the coffee plants. This proximity tends to increase contact with new coffee berry borer infestations. The effect can reach neighboring fruits and contribute to the control of future infestations.

Ecological management

The study also raises implications for ecological management. Complete elimination of the pest does not always favor the stability of natural enemies. Low populations of *Hypothenemus hampei* can provide food and shelter for predatory ants. This availability helps sustain communities responsible for natural control over time.

The proposal does not recommend accepting economic damage. The result reinforces the importance of assessing infestation levels, ant dynamics, and habitat conservation. Shaded systems with greater vegetation complexity may offer conditions for the maintenance of these agents. In this context, management can

seek a balance between reducing the borer population and maintaining ecological interactions linked to biological control.

TABLE 1 List of ant species documented inside coffee fruits in this study and their role in coffee berry borer (*Hypothenemus hampei*) control.

Ant species	Life stage/caste found in fruits	Role in coffee berry borer pest control	Literature with experimental evidence
<i>Azteca</i> sp.	Workers, majors	Unknown for this species, but congeneric <i>A. sericeasur</i> attacks adult borers and reduces colonization	Perfecto and Vandermeer (2006), Pardee and Philpott (2011), Philpott et al. (2012), Gonthier et al. (2013), Jiménez-Soto et al. (2013, 2019), Morris et al. (2015), Rivera-Salinas et al. (2018), Morris and Perfecto (2022), Cowal et al. (2023)
<i>Nesomyrmex echinatoides</i>	Brood, workers, alates, queen	Unknown	NA
<i>Pheidole</i> sp.	Workers, majors	Unknown for this species, but other <i>Pheidole</i> spp. attack adult borers and reduce colonization	Varón et al. (2004), Gonthier et al. (2013), Jiménez-Soto et al. (2013)
<i>Procryptocerus hylaeus</i>	Brood, workers	Known to reduce borer colonization	Philpott et al. (2012)
<i>Pseudomyrmex elongatus</i>	Brood, workers, alates	<i>Pseudomyrmex</i> ants in general are known to reduce the densities of borers inside fruits and overall borer colonization	Larsen and Philpott (2010), Philpott et al. (2012), Gonthier et al. (2013)
<i>Tapinoma</i> sp.	Brood, workers, queen	Some <i>Tapinoma</i> ants are known to reduce borer colonization	Gonthier et al. (2013), Onishi et al. (2017)
<i>Wasmannia auropunctata</i>	Brood, workers	Known to reduce borer colonization and predate immature borer life stages	Gonthier et al. (2013), Morris and Perfecto (2016), Morris and Perfecto (2022)

Note: Ant life stages and castes are listed as well as the known role of each species in coffee berry borer biological control with supporting literature references.

DOI 10.1002/ecy.70463

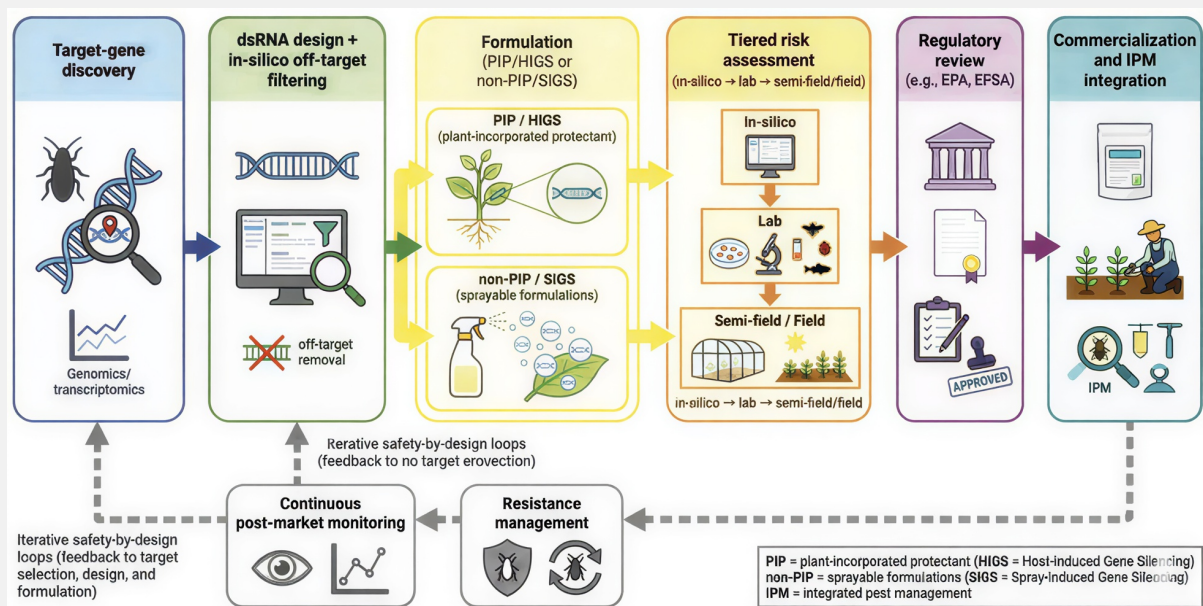
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Researchers highlight the advances and risks of RNAi biopesticides

They highlight specificity, rapid degradation, and challenges related to formulation and resistance

28.07.2026 | 15:22 (UTC -3)

Schubert Peter, Cultivar Magazine



DOI 10.1127/entomologia/3821

RNA interference-based biopesticides are advancing as a third-generation technology for pest management. These products combine specific gene silencing,

rapid environmental degradation, and low potential toxicity to non-target organisms, explain researchers Wei Zhang, Umut Toprak, Amr Mohamed, George Joseph Chakkalakkal, Ioannis Eleftherianos, and Guy Smagghe. The team emphasizes, however, the need for individualized evaluations for each sequence, formulation, target species, and condition of use (DOI 10.1127/entomologia/3821).

According to the researchers, the technology uses double-stranded RNA to interrupt the expression of essential genes in insects. Inside the cell, the Dicer-2 enzyme fragments the molecule into small interfering RNAs. These fragments integrate into the RNA-induced silencing complex. The complex recognizes the

complementary messenger RNA and promotes its degradation.

Protein production

The process reduces the production of proteins associated with vital functions in pests. Efficiency depends on gene selection and sequence design.

Researchers note that RNAi often causes a partial reduction in gene expression.

Therefore, selection should prioritize genes sensitive to small drops in activity.

The specificity of the sequence represents one of the main advantages of the technology. According to scientists, the method can target the effect to a specific species or a restricted group. This

characteristic reduces impacts on other organisms compared to broad-spectrum products.

Off-target effects

The team warns of the possibility of off-target effects. The risk increases when non-target organisms have genetic regions similar to the applied sequence.

Continuous stretches with high identity can allow silencing in closely related species.

The researchers recommend avoiding conserved regions and applying bioinformatics screenings before RNA synthesis.

Computational tools already support this stage. Scientists cite platforms designed to

compare sequences with genomes and transcriptomes of different organisms. These systems identify unwanted matches and guide the design of molecules with greater selectivity. For researchers, bioinformatics should be integrated into risk assessment from the beginning of development.

Main routes

RNAi biopesticides follow two main application routes. One uses plants modified to produce double-stranded RNA in their own tissues. The insect ingests the molecule while feeding. The other route applies the RNA externally, through foliar spraying, seed treatment, soil application, or root contact.

Researchers highlight two commercial milestones. The SmartStax Pro corn, identified as MON 87411, combines the Bt Cry3Bb1 protein with double-stranded RNA targeting the DvSnf7 gene of *Diabrotica virgifera virgifera*. The United States Environmental Protection Agency has approved the technology as the first commercially usable RNAi trait in the country.

The agency also approved Calantha, a sprayable product intended for the control of *Leptinotarsa decemlineata*. According to scientists, this decision marked the entry of foliar-applied RNA insecticides into the market.

Reports of degradation

The low stability of RNA in the environment limits its persistence, but also reduces the control period. Researchers report degradation by ultraviolet radiation, microbial nucleases, and physical environmental conditions. In studies cited in the article, unformulated double-stranded RNA disappeared within 14 to 30 hours in different agricultural soils. In aquatic environments, concentrations fell below the detection limit within 96 hours.

Formulations with layered double hydroxide clays, lipid vesicles, chitosan, polymers, and nanogels aim to increase stability. These carriers can also improve adhesion to leaves and absorption by the insect.

Profile of risco

The team emphasizes that greater persistence alters the risk profile. The carrier can modify the exposure of non-target organisms and the behavior of RNA in soil, water, and plant tissues. Some materials may affect soil microorganisms, germination, root growth, or interactions between plants and microbiota.

For this reason, researchers advocate for the evaluation of the entire product. The analysis should not only consider the double-stranded RNA. The composition, particle size, surface charge, biodegradability, and accumulation potential also need to be factored into the regulatory process.

Non-target organisms can come into contact with RNA by consuming treated plants, through contact with residues, or through transfer along the food chain. Predators and parasitoids can ingest the molecule by consuming exposed prey.

Biological barriers

According to the researchers, biological barriers reduce the chance of unwanted silencing. Saliva, digestive nucleases, intestinal epithelium, and cell membranes hinder systemic absorption. Even so, the team recommends testing with species linked to different ecological functions.

Scientists cite *Apis mellifera* for pollination, *Folsomia candida* for soil decomposition,

Eisenia fetida for soil health, and Daphnia magna for aquatic environments. The assessment should begin with computational analyses. Then, it should advance to laboratory, semi-field, and field trials.

Researchers also point to a low dietary risk for humans and animals. Double-stranded RNA occurs naturally in food and undergoes rapid degradation in the digestive system. Ribonucleases, gastric acidity, and intestinal barriers limit absorption.

Studies cited by the team did not identify adverse effects after administering high doses of DvSnf7 RNA to mice.

Assessments included food consumption, body weight, organ histology, and clinical

parameters. Regulatory bodies also concluded that the molecules evaluated did not exhibit toxicity, allergenicity, or bioaccumulation.

Resistance evolution

The evolution of resistance emerges as another challenge. According to researchers, insects can develop alterations in intestinal absorption of RNA or increase the degradation of the molecule by nucleases. Microorganisms associated with the gut can also reduce efficiency.

Scientists report identifying *Bacillus* strains capable of degrading double-stranded RNA in the gut of *Helicoverpa armigera*.

The microbial activity reduced the accumulation of the molecule and limited gene silencing.

The team notes that using multiple RNAs against different genes may fail when resistance affects a common step, such as uptake or degradation. The researchers recommend combining RNAi with other modes of action, cultural practices, refuges, rotation, and monitoring.

For scientists, commercial advancement will depend on the integration of molecular design, formulation, environmental assessment, resistance management, and post-registration follow-up. Sustainable use requires continuous adjustments based on results obtained in the laboratory and in the field.

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Sequential release expands control of the green aphid

A predator applied eight days before the parasitoid reduced the *Myzus persicae* population by 89,1%

28.07.2026 | 14:41 (UTC -3)

Cultivar Magazine



Photo: Whitney Cranshaw / Colorado State University - Bugwood - BY CC 3.0

Releasing *Aphidoletes aphidimyza* eight days before *Aphidius gifuensis* resulted in the greatest reduction of *Myzus persicae* in a protected environment. This strategy decreased the aphid population by 89,1% and outperformed treatments with only one natural enemy or with the reverse order of release (DOI <https://doi.org/10.1002/ps.71133>).

Researchers evaluated oviposition site selection, prey preference, and different release strategies. The trials included isolated, simultaneous, and sequential applications, with an eight-day interval.

Female *Aphidoletes aphidimyza* laid 33,9 eggs on plants with unparasitized aphids. The number dropped to 21,3 eggs in the presence of aphids that had been

parasitized for three days and to 7,9 eggs on plants that had been parasitized for six days. The females avoided plants with mummies.

Larvae of all stages of *Aphidoletes aphidimyza* preferred first instar aphids over third instar aphids. Second and third instar larvae also prioritized non-parasitized prey.

The parasitoid *Aphidius gifuensis* showed a preference for first instar aphids. The presence of adult predators intensified this response.

In greenhouse tests, *Aphidoletes aphidimyza* applied alone reduced infestation by 79,1%. *Aphidius gifuensis* achieved 17,5%. Releasing the parasitoid before the predator resulted in 66,7%.

According to the study, differences in prey stage preference reduce intraguild predation. The combination of the two agents promotes synergistic control, with improved performance after the initial introduction of the predator.

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Bayer appoints Mateus Barros to lead supplies in Asia

Executive takes over Product Supply area after leading the company's commercial operations in the region

28.07.2026 | 10:29 (UTC -3)

Cultivar Magazine



Bayer has appointed Mateus Barros as CS Head of Product Supply Asia. The executive will lead the company's product supply in Asia, focusing on availability, operational efficiency, and customer service.

Barros has over 20 years of experience in agriculture, supply chain, operations, sales, business transformation, and leadership. Prior to his new role, he held the position of CS Cluster Division Head for East Asia and Pakistan, based in Singapore.

At Bayer, he also led marketing and market development for the Asia-Pacific region. In Latin America, he led digital business and new business models. His work included platforms such as

FieldView, Carbono Pro, open innovation, and initiatives aimed at small producers.

Between 2016 and 2020, she served as Business Digital Lead for Latin America at The Climate Corporation. During this period, she coordinated commercial activities and supported local teams in research, software development, science, and product.

Barros also worked for over 12 years at Monsanto. He held positions in the areas of crop protection, seed treatment, seeds and biotechnology, sales, and business development. Among his roles, he served as director of the crop protection business in Brazil.

The executive graduated in Agronomic Engineering from the University of São

Paulo. He also completed an MBA in Business Administration and Management at the Joseph M. Katz Graduate School of Business, University of Pittsburgh.

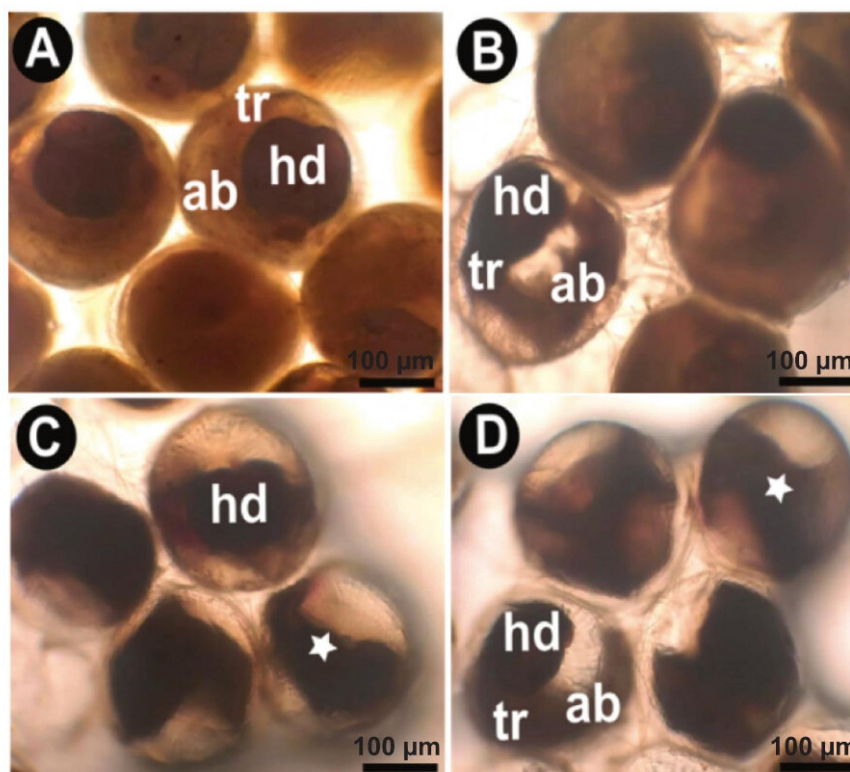
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Bacillus thuringiensis reduces the viability of fall armyworm eggs

Treatments also increased the mortality rate of newborn *Spodoptera frugiperda* caterpillars

28.07.2026 | 10:08 (UTC -3)

Schubert Peter, Cultivar Magazine



Spodoptera frugiperda eggs 72 h after bioassays with *Bacillus thuringiensis*: (A) Control eggs. (B) Eggs treated with a spore suspension of the HD-68 strain of *B. thuringiensis* subsp. *aizawai* at a concentration of 3×10^7 spores/mL. (C) Xentari at a concentration of $3,00 \text{ g} \cdot \text{L}^{-1}$. (D) Xentari at a concentration of $5,00 \text{ g} \cdot \text{L}^{-1}$. In A, the embryo shows normal development of the head (hd), thorax (tr), and abdomen (ab) regions. In the treated eggs (B, C, and D), the embryos exhibited compromised morphological development, characterized by deformed thorax and abdomen. In addition, some eggs did not have discernible embryos, containing only amorphous structures (white stars) with a darkened appearance.

Applications of *Bacillus thuringiensis* reduced the viability of *Spodoptera frugiperda* eggs and caused high mortality in neonate caterpillars originating from treated eggs. The study evaluated the *Bacillus thuringiensis* aizawai HD-68 strain and the bioinsecticide Xentari. The treatments caused embryonic inviability between 27% and 41%. Neonate mortality exceeded 70% in the first evaluations and surpassed 85% at the end of seven days (DOI 10.1016/j.jip.2026.108711).

The researchers tested three concentrations of Xentari: 3,00 grams per liter, 4,25 grams per liter, and 5,00 grams per liter. The team also evaluated the HD-68 strain at a concentration of $3 \times 10^?$ spores per milliliter. The concentrations of

the commercial product followed the manufacturer's recommendations for the control of *Spodoptera frugiperda* caterpillars.

Ten repetitions

Egg masses of 20 eggs, collected between zero and 24 hours after laying, remained immersed in the suspensions for 30 seconds. Each treatment consisted of ten replicates, with a total of 200 eggs. The researchers maintained the material at 25 degrees Celsius, 70% relative humidity, and a photoperiod of 12 hours of light and 12 hours of darkness.

After 72 hours, Xentari caused 27% egg inviability at a concentration of 3,00 grams

per liter. The rate rose to 35% at 4,25 grams per liter and reached 41% at 5,00 grams per liter. The HD-68 strain caused 31% inviability.

The control with autoclaved deionized water showed 10,5% inviability. The treatment with water and 0,05% Tween 80 showed 9%. The treatments with *Bacillus thuringiensis* differed from the two controls. The three concentrations of Xentari and the HD-68 strain did not show statistical differences between them.

Microscopic analyses

Microscopic analyses identified alterations in embryonic development. Treated eggs showed deformities in the thoracic and

abdominal regions. Some contained amorphous and darkened masses, without visible embryos.

Damage was also observed in the intestinal epithelium of the embryos.

Treatment with 5,00 grams per liter of Xentari caused degenerated columnar cells and tissue ruptures after 48 hours.

After 72 hours, all treatments with the bacteria caused cytoplasmic vacuolization and cellular degeneration in the intestine.

Electron microscopy showed spores near the micropyle and aeropyles of the eggs.

The spores measured between 1,050 and 1,850 micrometers. The micropyle had a diameter close to 6 micrometers. The aeropyles measured between 1,670 and 2,294 micrometers in the treated eggs.

These dimensions support the hypothesis of spore and insecticidal protein entry through these structures. However, the study did not demonstrate the presence of spores or Cry proteins inside the eggs. The researchers indicate the need for further studies to confirm the entry routes and the mechanisms involved in the embryonic effects.

Newborn caterpillars

Newborn caterpillars hatched from treated eggs showed low survival rates. In the first 24 hours of evaluation, the probability of survival was below 30% in the treatments with Xentari and HD-68. The controls maintained survival rates above 90% during the same period.

After seven days, the cumulative mortality rate in the *Bacillus thuringiensis* treatments exceeded 85%. The final probability of survival was below 15%. The control group did not reach 50% mortality during the experimental period.

contaminated chorion

Contact with the contaminated chorion may explain part of the mortality. During hatching, the neonates break the outer layer of the egg with their mouthparts and consume some of this material. This behavior may favor the ingestion of spores and insecticidal proteins. The caterpillars remained in the egg masses until the daily observations. Therefore, the study did not separate the effects of embryonic

exposure from the effects caused by chorion ingestion.

The results expand our understanding of the action of *Bacillus thuringiensis* in the early stages of *Spodoptera frugiperda*. The use of this microbial agent usually prioritizes the larval stage. This work suggests a possible additional contribution regarding eggs and neonates.

Field application still requires validation. Different insect stages coexist in crops, and environmental factors can alter the effectiveness of treatments. Researchers emphasize the importance of monitoring oviposition, crop phenology, and application technology to integrate bioinsecticides into the management of the fall armyworm.

The work was carried out by scientists Fabiana Santana Machado, Bruno Vinícius Daquila, Edimar Peterlini, Helio Conte, and Ricardo Antonio Polanczyk.

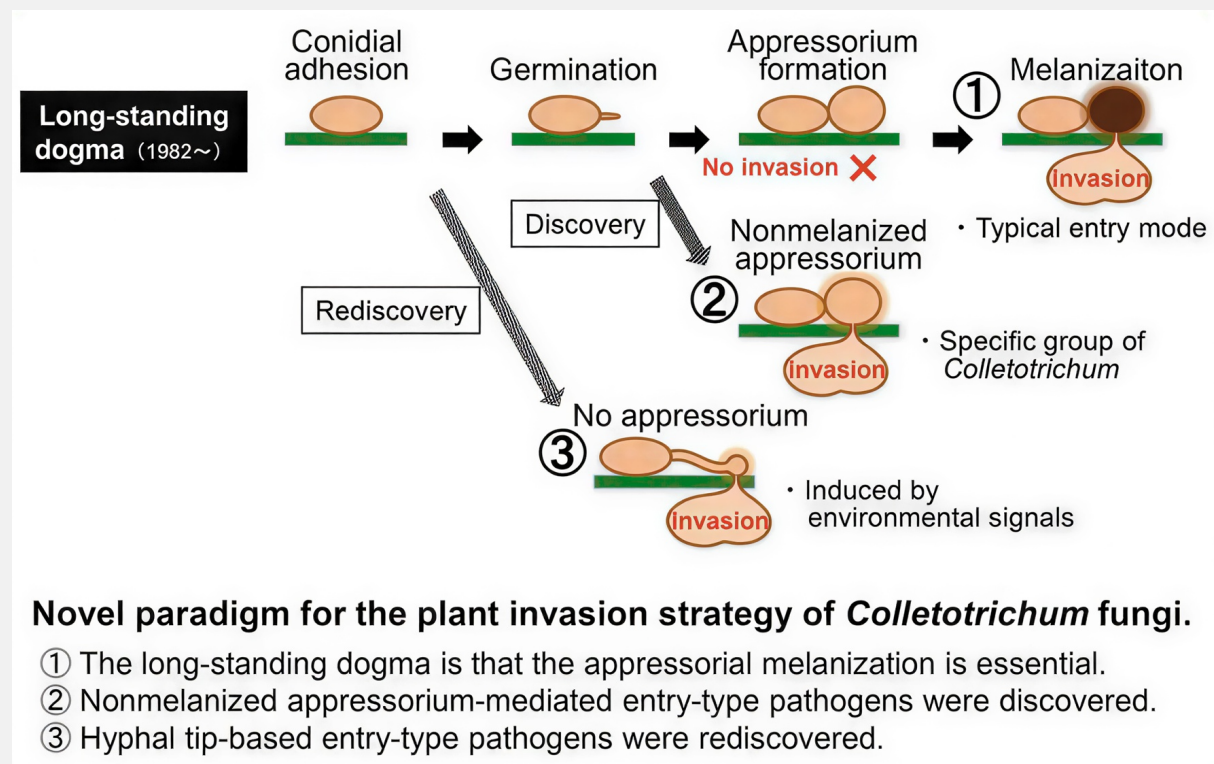
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Fungi break their dependence on melanin to invade plants

Study identifies *Colletotrichum* strains with new penetration routes and reduced sensitivity to fungicides

28.07.2026 | 08:25 (UTC -3)

Schubert Peter, Cultivar Magazine



Researchers at Shinshu University in Japan have identified strains of

Colletotrichum capable of penetrating plant tissues without appressorium melanization. This discovery expands knowledge about anthracnose-causing fungal infections and highlights potential limitations in control based on melanin biosynthesis inhibitors. The study also confirmed strains that enter through the ends of hyphae, without the participation of a conventional appressorium (DOI 10.1038/s41467-026-74937-6).

Species of Colletotrichum and Pyricularia oryzae typically form a single-celled appressorium with a thick, pigmented wall. This structure adheres to the plant surface and provides the necessary force for penetration. Melanin contributes to the rigidity of the wall, solute retention, and resistance against enzymes capable of

degrading fungal cellular components.

This mechanism formed the basis for the development of fungicides that inhibit melanin biosynthesis. These products target different enzymes in the metabolic pathway and prevent the proper formation of the pigment. This management strategy has a well-established use, especially against rice blast caused by *Pyricularia oryzae*.

Greater diversity

The new study showed greater diversity among species and lineages of *Colletotrichum*. Scientists classified the strategies into three groups. The first includes fungi dependent on melanized

appressoria. The second includes lineages with entry mediated by non-melanized appressoria. The third encompasses fungi capable of penetrating through the tips of hyphae.

The CC1 strain of *Colletotrichum fioriniae* retained its invasive capacity even after the application of carpropamide, pyroquilone, and tolprocarb. These compounds blocked appressorium pigmentation but did not prevent the formation of invasive hyphae within the epidermis. The pathogen also caused lesions in cosmos treated with all three inhibitors.

Colletotrichum fioriniae mutants lacking an enzyme involved in melanization showed similar results. The appressoria remained

unpigmented, but penetrated the host and formed lesions. In other species evaluated, the same alteration eliminated or reduced pathogenicity.

Differences between functions

Analyses indicated differences in the functions performed by melanin. In some lineages, the pigment participated in generating pressure or maintaining the rigidity of the appressorium. In others, the internal pressure remained high even without melanization. Dihydroxyhexanoic acid polymers contributed to reducing wall porosity and retaining osmotic substances.

Degrading enzymes

Resistance to degrading enzymes also varied. Non-melanized appressoria from some lineages suffered rupture or collapse. Structures produced by *Colletotrichum fioriniae* CC1 and *Colletotrichum siamense* MAF1 maintained greater integrity. The result indicates a specific dependence for each species or lineage, without a universal pattern within the genus.

The screening included 24 strains capable of forming lesions through melanized appressoria. Nine showed insensitivity to the inhibitors and penetrated the epidermis through non-pigmented appressoria. The group included strains of *Colletotrichum*

nymphaeae, *Colletotrichum fioriniae*,
Colletotrichum godetiae, and
Colletotrichum scovillei.

Lineages with this characteristic were concentrated in the *acutatum* species complex. The phylogenetic distribution suggests the acquisition of the ability to invade without melanin by a common ancestor of this group. Melanization-dependent lineages appeared in several other species complexes.

Spontaneous infection

The study also recorded spontaneous infection without melanization in the absence of fungicides. The PL1-1-b strain of *Colletotrichum nymphaeae*, associated

with anthracnose of Japanese ornamental cherry, formed melanized and non-melanized appressoria in the same tissue. Both gave rise to invasive hyphae and necrotic lesions.

Another strain, HF3 of *Colletotrichum fioriniae*, produced mature appressoria with little or no pigmentation. The fungus infected hyacinth and *Arabidopsis thaliana* plants with deficient defense mechanisms. The strain also utilized entry through the ends of hyphae.

Fungi with non-melanized appressoria began penetration earlier. *Colletotrichum fioriniae* CC1 and *Colletotrichum nymphaeae* PL1-1-b invaded the epidermis within one day of inoculation. Conventional strains of *Colletotrichum*

higginsianum, *Colletotrichum siamense*, and *Colletotrichum orbiculare* did not yet exhibit invasive hyphae at this time.

The results do not demonstrate an immediate loss of fungicide efficacy in the field. The study was conducted under experimental conditions and evaluated specific strains. However, the data indicate the need to monitor *Colletotrichum* populations with strategies independent of melanization. The presence of these strains may alter the response to products targeting only pigment formation and require management programs with different modes of action.

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Anthocyanins in purple corn are resistant to heat and storage

Pericarp pigments maintained color and stability in a model beverage system

28.07.2026 | 07:20 (UTC -3)

Schubert Peter, Cultivar Magazine

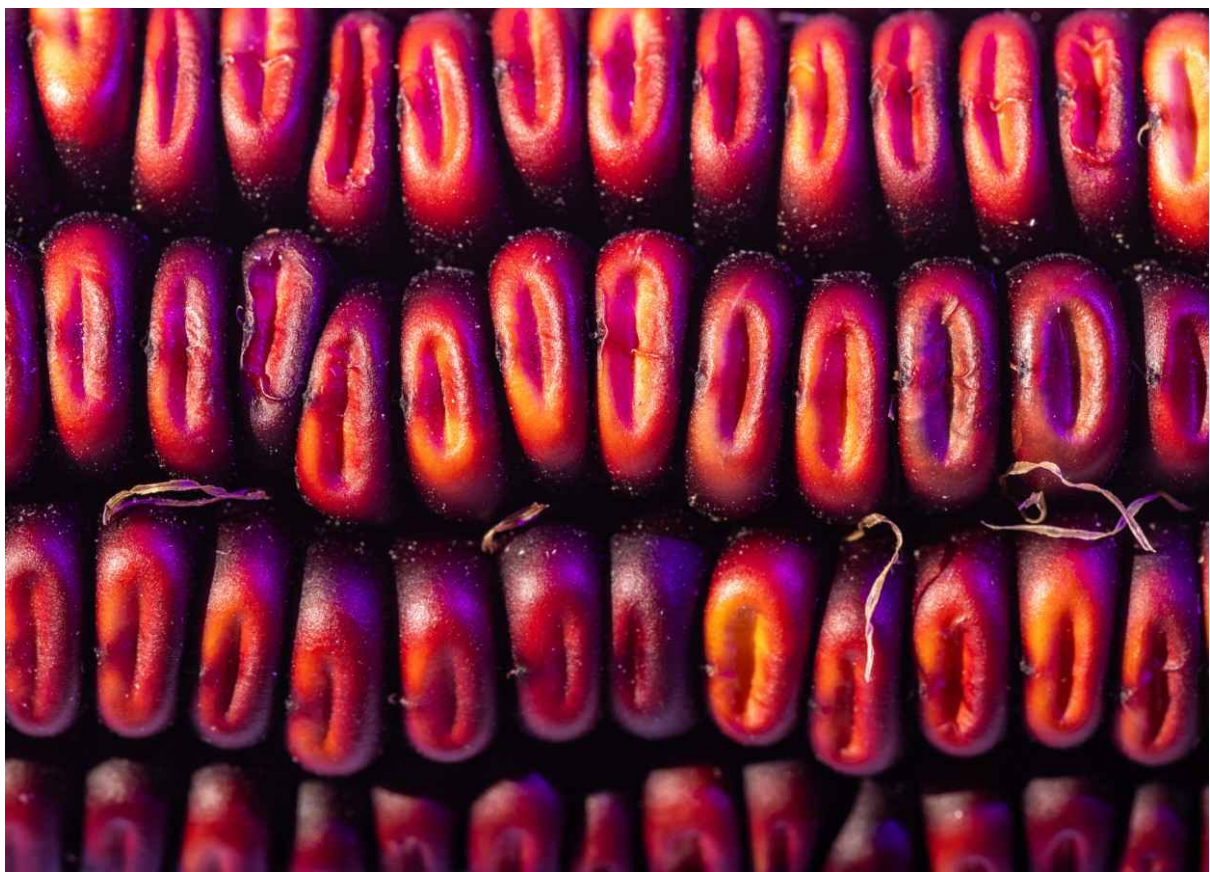


Photo: Abbie Lankitus / University of Missouri

Anthocyanins extracted from purple corn pericarp (*Zea mays*) showed thermal stability and potential to replace synthetic red dyes in beverages. The best result occurred with the spray-dried extract encapsulated with one percent maltodextrin. The half-life of cyanidin-3-glucoside reached 3,43 hours at 121 degrees Celsius (DOI 10.1038/s41538-026-00881-w).

Researchers from the University of Missouri and the U.S. Department of Agriculture produced three formulations. The study evaluated an uncoated extract, a freeze-dried powder with maltodextrin, and a spray-dried powder with the same encapsulant.

After 60 minutes at 121 degrees Celsius, the formulations retained approximately 75 percent of the initial cyanidin-3-glucoside. The spray-dried powder showed the least degradation, with a loss of 17,94 percent. The encapsulated samples also preserved more than 94 percent of the delphinidin.

Scientists tested the powders for seven weeks in a model beverage. Storage occurred at temperatures of 4, 25, and 40 degrees Celsius, as well as different pH levels and ascorbic acid concentrations. Refrigeration reduced losses. The acidic environment also favored the preservation of the pigments.

At pH 2, the samples retained between 84,64 percent and 93,38 percent of the anthocyanins. At higher temperatures and

near-neutral conditions, degradation increased. Maltodextrin enhanced protection during storage, especially under thermal stress.

Gastrointestinal simulation indicated a reduction in anthocyanins during the oral phase, an increase during the gastric phase, and a further decrease during the intestinal phase. According to the study, the results support the use of purple corn pericarp as a source of natural red dye for food and beverages.

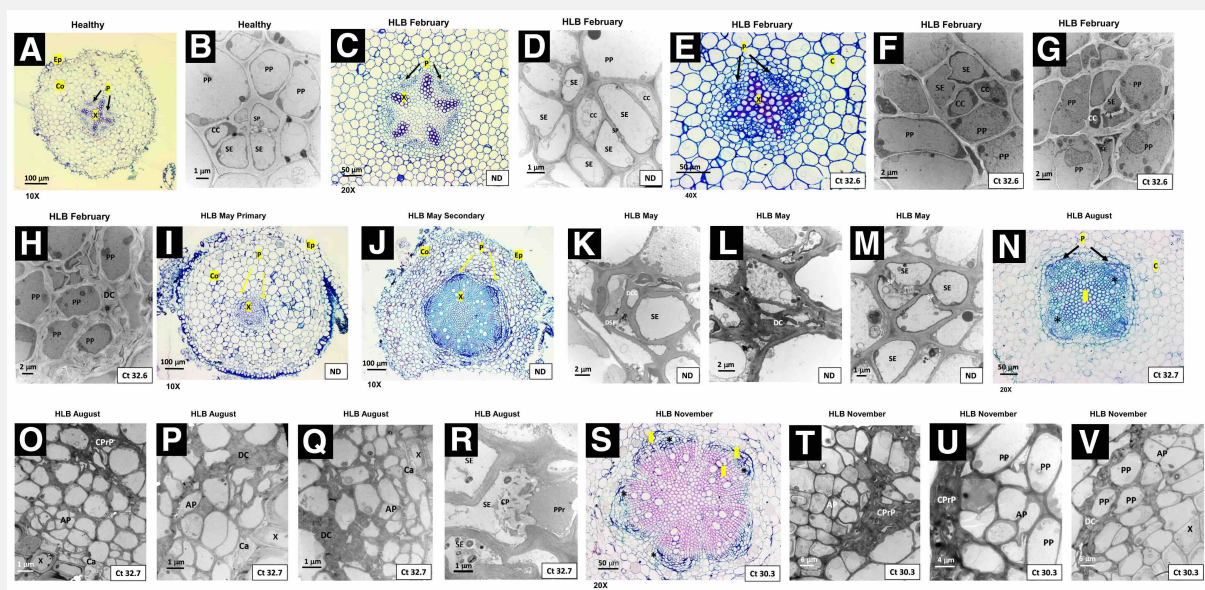
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Microscopic atlas reveals damage sequence of citrus greening

Study links phloem cell death, vascular blockage, starch accumulation, and root degradation

28.07.2026 | 06:38 (UTC -3)

Schubert Peter, Cultivar Magazine



Light microscopy and transmission electron microscopy (TEM) analyses of root tissues of *Citrus sinensis*, cultivar Valencia.

A study by researchers at the University of Florida identified the sequence of cellular

changes associated with citrus huanglongbing (HLB). The results indicate distinct mechanisms in photosynthetic and non-photosynthetic tissues. The bacterium *Candidatus Liberibacter asiaticus* causes phloem cell death and callose deposition in leaves, branches, trunk, and parts of the fruit. In the roots, degradation is mainly due to a lack of carbon, according to the scientists (DOI 10.1094/PHYTO-01-26-0019-R).

The team analyzed sweet orange trees (*Citrus sinensis*) of the Hamlin and Valencia cultivars. The work included plants kept in an orchard, a protected environment, and a growth chamber. Collections took place in February, May, August, and November. The scientists

examined young leaves, mature leaves, branch bark, trunk bark, fibrous roots, albedo, pedicel, columella, and seed coat.

Microscopic Atlas

The analyses combined transmission electron microscopy, light microscopy, and quantitative PCR. The comparison involved infected tissues and healthy controls. The data together formed a microscopic atlas of HLB progression over one year.

The photosynthetic tissues showed the most direct damage. The infection increased the deposition of callose around the pores of the sieve plates. This material reduced or blocked passage through the

phloem. The researchers also recorded death of sieve tube elements and companion cells. In several samples, companion cell death appeared before the loss of sieve elements.

The blockage interrupted the transport of photoassimilates. This process favored the accumulation of starch in mature leaves and branch bark. In the leaves, the starch grains occupied the chloroplasts. The excess promoted the degeneration of these organelles. This sequence explains the irregular mottling and yellowing typical of HLB.

Mature leaves

Mature leaves showed the most intense signs. Infected samples exhibited phloem cell death during all four periods evaluated. They also showed increased callose deposition and starch accumulation. The cambium showed disorganized growth, an increased number of cells, and irregular formation of new phloem.

Young leaves showed a less uniform response. Some samples showed callose deposition, but cell death remained rare. Starch accumulation occurred in some materials collected in the orchard, especially in May and November. The data suggest that the damage progressed after leaf maturation.

Bark and trunk

The bark of branches and trunks also showed callus formation, narrowing of sieve pores, and death of phloem cells. The intensity of the infection, in several samples, corresponded to the bacterial concentration. Tissues with a higher titer of *Candidatus Liberibacter asiaticus* exhibited more extensive damage. The infected cambium produced thicker and more disorganized phloem layers.

In the fruits, the study detected cell death and callose deposition in the albedo, pedicel, and columella. This damage increased with maturation. In November, some samples showed extensive cell loss. Starch accumulation played a minor role in these organs, unlike what was observed in mature leaves.

Roots: another pattern

The roots followed a different pattern. Callose deposition and direct death of phloem cells occurred to a lesser extent. Infected roots lost starch reserves. Scientists attribute root degradation to reduced carbon transport from the canopy. The lack of photoassimilates compromises the maintenance of underground tissues. This result places root deterioration after phloem damage in the aerial part of the plant. The bacteria infect the vascular system, but the drop in available carbon accounts for most of the root loss. Root degradation reduces water and nutrient absorption. Subsequently, nutritional deficiencies, leaf and fruit drop, branch

dieback, decline, and plant death occur.

The seed coat also showed a limited response. Even in the presence of the bacteria, scientists did not observe a clear increase in cell death or a consistent change in callose deposition. The hypothesis points to seed abortion caused by restriction in carbon supply, not by intense direct destruction of the phloem.

Proposed model

The proposed model begins with systemic infection by *Candidatus Liberibacter asiaticus*. The plant activates chronic immune responses, producing reactive oxygen species and depositing callose in tissues capable of photosynthesis.

Subsequently, cell death occurs in the phloem. Vascular blockage leads to starch accumulation in the leaves. Chloroplasts lose their structure, resulting in mottling and yellowing. Reduced carbon export causes energy starvation in the roots. Root degradation amplifies the symptoms and accelerates decline.

Researchers point to two fronts for future management strategies. One involves reducing secondary damage to roots. The other seeks to control the production of reactive oxygen species and protect chloroplast components. The work does not present a ready-to-use measure for the field, but it defines relevant cellular steps for new approaches against HLB.

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Ultrafine limestone improves soil microbiology, study says

Research shows an increase in soybean nodulation and greater activity of enzymes linked to nutrient cycling

27.07.2026 | 14:59 (UTC -3)

Otávio Costa



Research conducted by Andrios
Assessoria, under the supervision of

Professor Fernando Andreote from the Luiz de Queiroz Higher School of Agriculture (Esalq/USP), evaluated the behavior of soybeans in clay soil with high natural fertility after the surface application of filler limestone, an ultrafine-grained, highly reactive soil amendment. The research was carried out using Viter's Itaú Ultrafino Limestone, an ultrafine-grained, highly reactive agricultural amendment developed to meet the demands of modern soil fertility management.

The results showed significant gains in Biological Nitrogen Fixation (BNF), a process responsible for supplying a large part of the crop's nitrogen needs.

Compared to the area without corrective application, the plants showed a 13% increase in the number of nodules and a

38% increase in the mass of these structures, indicating more favorable conditions for the development of bacteria responsible for nutrient fixation.

The study also found increased activity of enzymes related to nutrient cycling and the decomposition of organic matter, indicating a more active microbiota. Among the indicators evaluated, noteworthy increases include a 27% increase in arylsulfatase activity, linked to the sulfur cycle; a 12% increase in acid phosphatase, responsible for promoting phosphorus utilization; a 6% increase in β -glucosidase, related to the decomposition of organic matter; and a 5% increase in glomalin, a protein associated with mycorrhizal fungi that contributes to nutrient absorption and water retention in the soil.

“The results are strongly linked to the most appropriate system for plant development, which results in greater soybean nodulation, and also in greater root exudation, a major promoter of microbial activity in the soil,” says Professor Fernando Andreote, from Andrios Assessoria and Luiz de Queiroz Higher School of Agriculture (Esalq/USP).

"The results of this research show that the choice of soil amendment influences not only the chemical correction of the soil, but also its biological activity. Highly reactive amendments, such as limestone filler, promote a faster and more uniform reaction on the soil surface. This creates a more favorable environment for the development of beneficial microorganisms, which play essential roles in nutrient

cycling and strengthening the root system," says Taciana Seixas, Technical Development Manager at Viter, the agricultural solutions unit of Votorantim Cimentos.

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Proper storage reduces costs associated with agricultural tractors.

Massey Ferguson expert provides guidance on how to preserve machinery and prevent breakdowns during the off-season.

27.07.2026 | 14:46 (UTC -3)

Flavia Amarante



Tractors are present in virtually all stages of agricultural production and require attention even during periods of lower

usage. Proper storage during the off-season or during periods of inactivity is essential to preserve components, prevent premature wear, and reduce maintenance costs.

Although many producers are attentive to periodic check-ups and inspections, the care taken when the machine remains idle for weeks or months also has a direct impact on its performance and lifespan. Prolonged exposure to sun, rain, and humidity, for example, can accelerate corrosion processes, compromise electrical systems, and reduce the durability of parts and components.

According to Eder Pinheiro, Tractor Product Marketing Coordinator at Massey Ferguson, some simple measures help

preserve the equipment and ensure it is ready to operate when needed, reducing the risk of breakdowns and unexpected expenses. Among the main recommendations is a thorough cleaning of the machine before periods of inactivity. "Removing soil, straw, fertilizer, and pesticide residue prevents moisture buildup and reduces the risk of corrosion in metal parts," he explains.

Another important consideration is choosing a suitable storage location. "Covered, ventilated environments protected from the elements help preserve the paint, electronic components, and rubber parts. When possible, the machine should be protected from direct sunlight and rain," says the expert.

Maintaining the machine during the off-season also involves taking care of tires and fluids. Correct tire pressure helps prevent deformation caused by the weight of the equipment during prolonged periods of inactivity, while inspecting the engine oil, hydraulic fluid, and coolant allows for the identification of any maintenance needs before they turn into operational problems.

Another suggested measure is to start the tractor every 15 days for approximately 20 minutes. This procedure promotes the circulation of lubricant through the internal components, helping to protect the parts and preserve the operating conditions of the equipment.

Periodic inspections during storage periods are also recommended. Checking for possible leaks, signs of corrosion, or

the presence of animals in machine components can prevent problems that would often only be identified when resuming operations. “Small precautions can generate significant gains for the producer. In addition to contributing to the operational availability of the machine, they help reduce maintenance costs and preserve the value of the equipment over the years,” emphasizes Pinheiro.

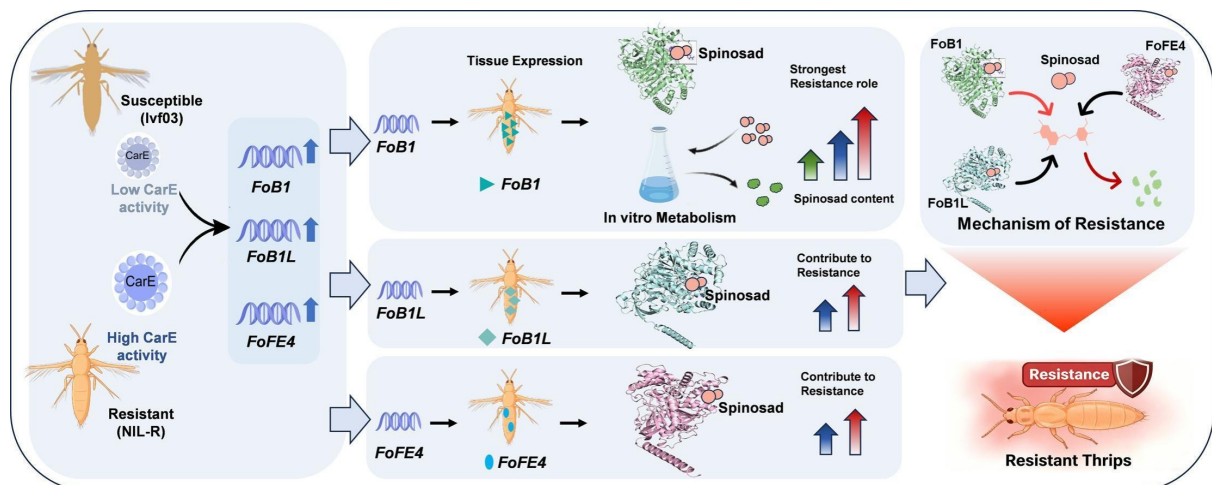
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Three genes extend thrips resistance to spinosad

Carboxylesterases metabolize the insecticide and reduce its effect on *Frankliniella occidentalis*

27.07.2026 | 13:30 (UTC -3)

Schubert Peter, Cultivar Magazine



DOI 10.1016/j.pestbp.2026.107280

Three carboxylesterase genes are involved in the resistance of *Frankliniella occidentalis* to spinosad. Silencing FoB1, FoB1L, and FoFE4 increased the insect's susceptibility to the product. Among them,

FoB1 showed the greatest response to exposure, greater molecular affinity, and direct ability to metabolize the insecticide. The results are from a study by Chinese researchers and indicate possible targets for resistance monitoring and integrated pest management (DOI 10.1016/j.pestbp.2026.107280).

The study compared the susceptible strain Ivf03 with the resistant strain NIL-R. Carboxylesterase activity remained above the values ??of the susceptible population in all phases and sexes evaluated. The greatest difference occurred in adult females. In this group, the enzymatic activity of the resistant strain reached a value 1,62 times higher.

Enzyme activity

Exposure to spinosad also stimulated enzyme activity. In the susceptible strain, a concentration of 0,02 milligrams per liter increased activity by 1,42 times. In the resistant strain, 80 milligrams per liter promoted a 2,19-fold increase.

Researchers tested triphenyl phosphate, a compound used as an esterase inhibitor. Combined application with spinosad increased toxicity in the NIL-R strain. The synergism index reached 2,995. The same combination did not cause significant changes in the susceptible strain. The result reinforces the role of carboxylesterases in the resistance mechanism.

Candidate genes

Gene expression analysis identified five candidate genes: FoB1, FoB1L, FoFE4, FoFE4L, and FoJHE. In resistant adults, FoB1 showed 2,21 times higher expression compared to susceptible adults. FoB1L showed a 1,56-fold increase. FoFE4 reached 1,46 times. FoJHE showed a value 1,50 times higher. FoFE4L showed no significant difference between the strains.

Spinosad induced the expression of all five genes in adults of the resistant strain. FoB1 responded at all concentrations evaluated, from 50 to 400 milligrams per liter. Expression increased between 6,26 and 9,24 times. FoB1L and FoFE4

required concentrations starting at 100 milligrams per liter to show significant induction.

FoB1 silencing

Double-stranded RNA reduced the expression of candidate genes by approximately 60%. After silencing FoB1, mortality at 50 milligrams per liter of spinosad increased from 17,87% to 47,39%. At 100 milligrams per liter, it rose from 32,54% to 61,35%. At a concentration of 200 milligrams per liter, it increased from 43,77% to 76,67%. At 400 milligrams per liter, it increased from 71,33% to 92,44%.

Silencing FoB1 also reduced the median lethal concentration from 229,188 to 100,517 milligrams per liter. The synergism index reached 2,280.

Suppression of FoB1L reduced the median lethal concentration to 155,825 milligrams per liter. Silencing FoFE4 brought the value to 152,037 milligrams per liter.

Reducing FoFE4L and FoJHE did not significantly alter susceptibility.

FoB1 concentrated its expression in the abdomen. The level was 2,68 times higher than that recorded in the head and 2,98 times higher than that observed in the thorax. In the midgut, FoB1 expression reached values 1,92 times higher than FoB1L and 2,69 times higher than FoFE4.

Molecular simulations

Molecular simulations indicated a greater affinity of spinosad for the catalytic regions of FoB1. The predicted binding energy reached -11,0 kilocalories per mole for spinosad A and -11,9 kilocalories per mole for spinosad D. FoB1L and FoFE4 showed weaker interactions.

Assays with recombinant protein confirmed the direct metabolization of the insecticide. FoB1 reduced the concentration of spinosad A from 0,632 to 0,341 micrograms per milliliter. The concentration of spinosad D fell from 0,088 to 0,048 micrograms per milliliter. The protein metabolized approximately 47% of the spinosad present in the experimental system.

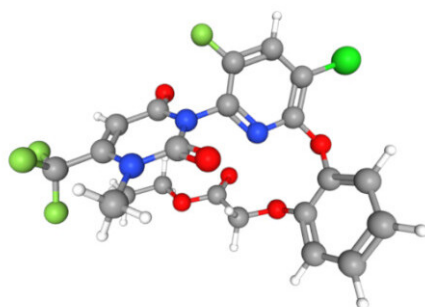
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BASF initiates registration for the herbicide Replexor Active

New active ingredient controls broadleaf weeds and grasses and could reach the market around 2030

27.07.2026 | 10:49 (UTC -3)

Cultivar Magazine, based on information from Julian Prade



We create chemistry

BASF has announced the start of the registration process for the molecule Replexor Active (fendioxypyracil). The company has submitted its first regulatory applications in Brazil and Australia. The United States and Argentina are expected to receive their applications in 2027. Initial sales could occur around 2030, after approvals.

The active ingredient inhibits the protoporphyrinogen oxidase enzyme, known by the acronym PPO. The product is effective against broadleaf weeds and annual grasses. The spectrum includes *Eleusine indica*, species of the genus *Echinochloa*, and species of the genus *Setaria*.

BASF estimates potential use in management programs covering more than 50 million hectares worldwide during the period of greatest adoption. The technology aims to expand options for soybeans, corn, and cotton, crops affected by the spread of resistant weeds.

According to the company, grass resistance to PPO herbicides still occurs infrequently. Replexor Active complements the portfolio formed by the active ingredients Kixor (saflufenacil) and Tirexor (trifludimoxazin).

BASF also reports rapid action and efficiency at low doses per hectare. The technology allows applications in no-till farming systems, a practice associated with reduced soil erosion.

The company is also developing genetic traits that provide tolerance to PPO herbicides. The strategy aims to increase the flexibility of applying the new active ingredient in resistance management programs.

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Bacterial symbionts support whiteflies

Alterations in the microbiome compromise insect development and change responses related to jasmonic and salicylic acids

27.07.2026 | 10:28 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: W Billen / Pflanzenbeschaustelle - Weil am Rhein - Bugwood - CC BY 30

Symbiotic bacteria play a decisive role in the survival of *Bemisia tabaci* and

Trialeurodes vaporariorum. These microorganisms also participate in suppressing the tomato plant's defenses. This conclusion results from a study conducted by researchers from Iranian universities, using experimental methods such as rifampicin and tetracycline to alter the bacterial community of the two whitefly species (DOI doi.org/10.3390/insects17080775).

The treatments reduced insect survival, prolonged nymphal development, and caused total mortality in the treated groups. In *Bemisia tabaci*, no individual exposed to antibiotics remained alive after 40 days. In *Trialeurodes vaporariorum*, complete mortality occurred before 50 days.

Greater vulnerability

The final stages of development showed greater vulnerability. In *Bemisia tabaci*, the most pronounced differences appeared in the third instar, the pupal stage, and in adults. Rifampicin had the greatest impact on the species' survival. In *Trialeurodes vaporariorum*, the effects were concentrated in the second and third instars and in the pupae. In this species, tetracycline caused greater losses than those observed with rifampicin, except in the second instar.

The research evaluated populations collected in February 2023 in tomato greenhouses located in Isfahan, Iran. The insects remained for two generations

under a temperature of 25 degrees Celsius, with a variation of two degrees Celsius, relative humidity of 60%, with a variation of five percentage points, and a photoperiod of 14 hours of light and ten hours of darkness.

Four genres

Researchers identified four genera of symbionts in the two species: *Portiera*, *Hamiltonella*, *Arsenophonus*, and *Rickettsia*. The study did not identify these bacteria at the species level. *Portiera* acts as an obligate symbiont and provides amino acids absent in the phloem sap. The other microorganisms perform complementary functions related to

nutrition, development, and adaptation of the host.

Different answers

Exposure to antibiotics produced distinct responses between the two whiteflies. In *Bemisia tabaci*, rifampicin reduced the abundance of *Portiera*. Tetracycline, on the other hand, increased the population of this symbiont. Both treatments decreased *Rickettsia*. The populations of *Hamiltonella* and *Arsenophonus* remained stable.

In *Trialeurodes vaporariorum*, the abundance of *Portiera* did not undergo significant alteration. Rifampicin reduced *Arsenophonus*. Both antibiotics increased populations of *Hamiltonella* and *Rickettsia*.

The increases ranged from 1,5 to 2,3 times compared to the control.

The results indicate specific host-bacteria relationships. The stability of *Portiera* in *Trialeurodes vaporariorum* contrasts with the sensitivity observed in *Bemisia tabaci*. According to the researchers, this difference may reflect distinct co-evolutionary trajectories. The increase in some symbionts after the treatments may result from reduced competition within bacteriocytes, specialized cells that harbor these bacteria.

Tomato plant's response

Altering the microbiome also changed the tomato plant's response to the attack.

Plants infested with treated *Bemisia tabaci* showed increased expression of genes linked to the jasmonic and salicylic acid pathways. Rifampicin increased the expression of the AOS gene, a marker of the jasmonic acid pathway, by 2,97 times, and the expression of PR-1, associated with salicylic acid, by 14,94 times.

Tetracycline produced increases of 5,51 times in AOS and 54,32 times in PR-1.

This behavior suggests the involvement of intact symbionts in reducing the tomato plant's defenses during feeding on *Bemisia tabaci*. After the alteration of the bacterial community, the plant responded with greater activation of both defense pathways.

The pattern differed in *Trialeurodes vaporariorum*. Rifampicin reduced AOS expression. Tetracycline caused a slight increase in this marker. Both treatments reduced PR-1 expression, with a more intense effect after exposure to rifampicin. The growth of *Hamiltonella* and *Rickettsia* populations may have contributed to the maintenance of suppressed defenses in this species.

Core components

Scientists consider symbionts to be central components of the interaction between plant, insect, and microorganism. In addition to supplying nutrients, these bacteria help *Bemisia tabaci* and *Trialeurodes vaporariorum* to navigate

critical developmental stages and interfere with the host plant's defense responses.

The study points to the insect microbiome as a potential target for new management strategies. Practical application still requires field validation, identification of the mechanisms involved, and analysis of ecological risks. Antibiotics served as an experimental tool to alter symbionts and do not, in themselves, represent a recommendation for agricultural control.

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Climate could expand by 91,8% the area favorable to the fall armyworm

Model projects *Spodoptera frugiperda* expanding to higher latitudes under a scenario of high greenhouse gas emissions

27.07.2026 | 08:06 (UTC -3)

Schubert Peter, Cultivar Magazine



Photo: Phil Sloderbeck / Kansas State University - Bugwood CC BY 3.0

Climate change could expand the global area with conditions favorable to the fall armyworm (*Spodoptera frugiperda*) by up to 91,8% by the end of the century. The greatest expansion appears in the SSP5-8.5 scenario, marked by high greenhouse gas emissions. The advance occurs towards higher latitudes, with shifts to the north and west (DOI 10.3390/insects17080772).

The projection results from a distribution model developed on the biomod2 platform. Chinese researchers integrated six of the best-performing algorithms: XGBOOST, Maxnet, Maxent, MARS, GBM, and GLM. The combined model achieved a TSS index value of 0,851 and a ROC curve value of 0,977. These indicators point to a

high capacity to discriminate between suitable and unsuitable areas for the pest.

Potentially favorable area

In the current climate, the potentially favorable area reaches approximately 20.260.500 square kilometers. This territory corresponds to almost 10% of the global land surface. The main zones are concentrated in East Asia and the south-central region of North America. Areas also appear in southern South America, southern Africa, Southeast Asia, Europe, and eastern Australia.

Regions with low suitability represent 75,99% of the total favorable area in the

current scenario. They occupy approximately 15.396.800 square kilometers. Areas of moderate suitability total about 3.387.300 square kilometers. Areas of high suitability cover 1.476.300 square kilometers.

Scenarios with growth

The study evaluated three climate trajectories: SSP1-2.6, SSP2-4.5, and SSP5-8.5. Each trajectory included the periods from 2041 to 2060, from 2061 to 2080, and from 2081 to 2100. Under SSP5-8.5, the favorable area reaches 18,12% of the Earth's surface in the last period. All suitability classes show growth in this scenario.

In SSP1-2.6, the overall favorable proportion increases to 14,22% between 2041 and 2060, 14,61% between 2061 and 2080, and 14,84% between 2081 and 2100. The area of low suitability continues to grow. The zones of high suitability show a slight reduction.

In SSP2-4.5, favorable areas occupy 15,03%, 15,14%, and 16,17% of the Earth's surface in the three periods analyzed. The model indicates an increase in low-suitability zones and little variation in the moderate and high suitability classes.

Average temperature for the quarter

The average temperature of the wettest quarter had the greatest influence on the pest's distribution, accounting for 31,66%. Precipitation during the wettest quarter accounted for 21,23%. The average temperature of the driest quarter contributed 13,90%. Isothermal variation, the ratio between daily and annual temperature variation, accounted for 13,59%. These four variables together accounted for 80,4% of the importance calculated by the model.

The greatest suitability associated with temperature during the wettest quarter occurred between 24,38 and 24,86 degrees Celsius. For the driest quarter, the peak appeared between 9,20 and 11,08 degrees Celsius. In terms of precipitation

during the wettest quarter, the range of greatest response was between 437,12 and 457,92 millimeters.

Occurrence of the species

The researchers used 1.763 valid records of the species' occurrence. The data came from the Global Biodiversity Information Facility, scientific publications, and field surveys. The processing retained only one record per 2,5-kilometer cell, a measure adopted to reduce the spatial concentration of observations.

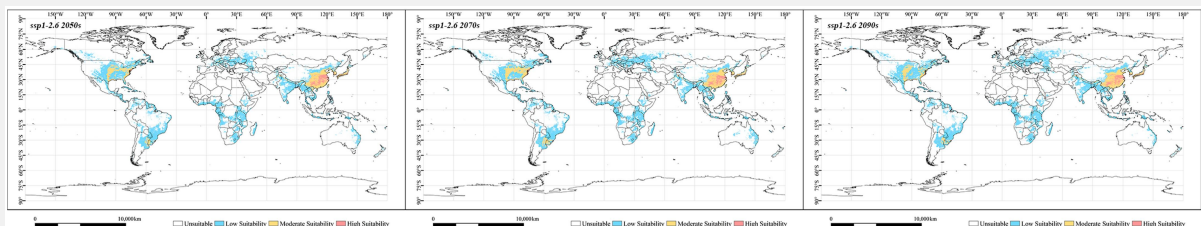
Analysis of the geographic center of favorable climate zones indicated a northward shift in all scenarios. In the

current climate, this center is located in Chad. In SSP5-8.5, the shift ends in Algeria between 2081 and 2100, after projected passages through Niger and Libya.

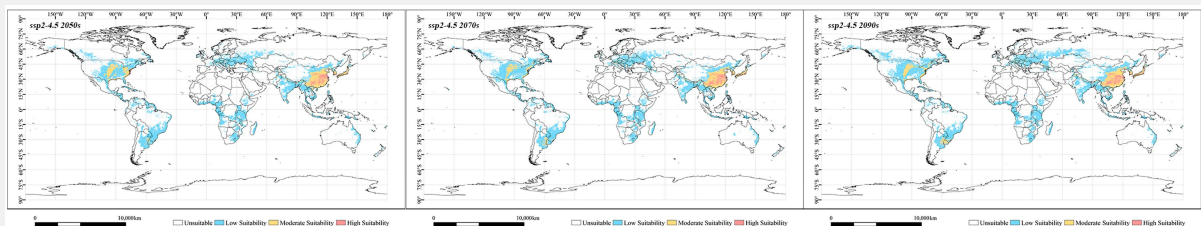
According to the study, the potential expansion stems from the reduction of limitations imposed by cold weather in mid- and high-latitude regions. Warming may also extend the period with favorable accumulated temperatures during the growing season.

The results indicate climatic potential, not actual infestation intensity. The model did not fully incorporate the distribution of host crops, agricultural practices, seasonal migrations, competition, predation, and parasitism. Local adaptation of populations can also alter the regional response. For

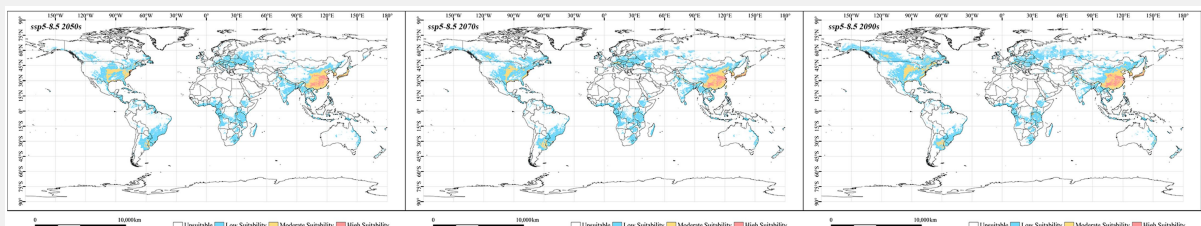
this reason, the projections support monitoring planning, but do not replace field surveys and local early warning systems.



Potentially suitable areas for *Spodoptera frugiperda* in the SSP1-2.6 scenario.



Potentially suitable areas for *Spodoptera frugiperda* in the SSP2-4.5 scenario.



Potentially suitable areas for *Spodoptera frugiperda* in the SSP5-8.5 scenario.

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Helicoverpa armigera resistance to soybean characterized with Cry1Ac

Research identifies polygenic inheritance, cross-resistance, and biological costs associated with the mechanism

27.07.2026 | 06:41 (UTC -3)

Cultivar Magazine



Photo: Gyorgy Csoka / Hungary Forest Research Institute - CC BY 3.0 - adapted

Helicoverpa armigera resistance to the Cry1Ac protein exceeded 300 times in bioassays with diet. A study by Brazilian researchers identified polygenic inheritance, cross-resistance with Cry1A.105, and biological costs in the resistant population. The results reinforce the need for structured refuge and pyramided technologies with proteins without cross-resistance to Cry1Ac (DOI 10.1002/ps.71154).

The researchers evaluated a near-isogenic resistant strain, named Iso-Res. The team obtained this population through backcrosses between a strain resistant to Cry1Ac and another susceptible one.

Reciprocal crosses indicated autosomal inheritance and incomplete dominance at

the tested concentrations. However, Cry1Ac soybean controlled susceptible and heterozygous individuals fed leaf discs. This result points to recessive functional dominance of resistance in plant tissue.

Backcrosses between heterozygotes and susceptible individuals indicated the involvement of several genes. The population resistant to Cry1Ac also showed cross-resistance to the Cry1A.105 protein. The same effect did not occur with Cry2Ab2.

Soybeans containing the proteins Cry1Ac, Cry1A.105, and Cry2Ab2 caused total mortality in all evaluated lines.

The Iso-Res lineage exhibited lower larval and pupal weight, a longer development

period, and lower survival rates on non-Bt soybeans. Females also showed a 30% reduction in fertility.

According to the study, the current low frequency of resistance to Cry1Ac soybeans in Brazil may result from functional recessiveness, biological costs, and incomplete resistance. Management should prioritize structured refuge areas and protein combinations with modes of action that do not cross-resistance.

The work was developed by Thalles Felipe Zambon, Mariana Yuki Iuanami, André Carrascosa Franco Machado, Leonardo Libardi Miraldo, Renato Jun Horikoshi, Graham P Head, and Celso Omoto.

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CONTACT

editor@grupocultivar.com

comercial@grupocultivar.com