

TECHNOLOGY PROFILE

Orvan™

A microbial inoculant for leguminous crops that couples biological nitrogen fixation and yield gain with rhizosphere *Aspergillus flavus* management — in a single application.

+19.9%

Peanut yield increase

+16.1%

Soybean yield increase

> 80%Soil *A. flavus* reduction**20–40%**

Less nitrogen fertilizer

Averages from multi-site demonstration trials in China (2021–2025) versus untreated controls. Field performance varies with soil, climate, variety, cropping system and management.

Developed by the Oil Crops Research Institute, Chinese Academy of Agricultural Sciences (OCRI-CAAS). Commercialized and supplied by Huasheng Bio Limited.

1 About Orvan™

Orvan™ was developed at the Oil Crops Research Institute (OCRI) of the Chinese Academy of Agricultural Sciences (CAAS) in Wuhan, China. Huasheng Bio Limited is responsible for its commercial production, international supply and technical support.

Orvan™'s science is led by Professor Li Peiwu, a Member (Academician) of the Chinese Academy of Engineering, with the National Agricultural Detection Benchmark Laboratory for Biological Toxins, the Key Laboratory of Biology and Genetic Improvement of Oil Crops (Ministry of Agriculture and Rural Affairs), and the National Oil Crops Improvement Center. The team's research focuses on aflatoxin biocontrol and legume nitrogen fixation.

2 Product Identification

Field	Detail
Product name	Orvan™ Microbial Inoculant — coupled biocontrol & nitrogen fixation.
Category	Multi-strain microbial inoculant for leguminous crops; functions: nodulation enhancement, nutrient mobilization and yield improvement. <i>A. flavus</i> suppression in peanut is a research finding, not a registered function outside China.
Developer	Oil Crops Research Institute, Chinese Academy of Agricultural Sciences (OCRI-CAAS), Wuhan, China.

Commercial partner	Huasheng Bio Limited.
Target crops	Lead crops: peanut (<i>Arachis hypogaea</i>) and soybean (<i>Glycine max</i>). Also applicable to other legumes (common bean, cowpea, pigeon pea, mung bean, black gram and alfalfa) for nodulation and nitrogen-fixation support.
Primary registration	China Ministry of Agriculture and Rural Affairs — microbial fertilizer registration No. 16162 (microbial inoculant, granule; 2026) and No. 16161 (powder); No. 15621 (compound microbial fertilizer, granule; 2025). Valid to 2031 / 2030.
Regulatory class	Biological soil inoculant / biofertilizer. Strains considered Risk Group 1 based on in-house strain characterization. Non-GMO. Compatible with integrated nutrient management.

3 Mode of Action

Orvan™ is a three-strain bacterial consortium that couples two biological outcomes in the legume rhizosphere: (i) suppression of *Aspergillus flavus*, the principal aflatoxin-producing pathogen of peanut; and (ii) potentiation of native and co-inoculated *Rhizobium* / *Bradyrhizobium* symbiosis, leading to elevated nodule number, nodule weight and nitrogenase activity.

The consortium produces antifungal compounds (lipopeptides, polyketides) that substantially reduce *A. flavus* abundance in the rhizosphere and pod zone. Current evidence supports a coupled mode of action in which reduced *A. flavus* pressure improves the nodulation environment for native or co-applied rhizobia, while improved host photosynthetic performance (Pn, Tr, Gs) supports sustained nitrogen fixation through pod fill.

Orvan™ complements rhizobia — it does not replace them

Orvan™ does not contain *Rhizobium* or *Bradyrhizobium*. It is designed to amplify the performance of native soil rhizobia, or of any commercial rhizobial inoculant co-applied at sowing. Orvan™ is therefore fully complementary (not substitutive) to existing peanut and soybean inoculant programs.

4 Microbial Composition

Orvan™ is a consortium of three naturally isolated, spore-forming bacterial strains. Because all three are spore-forming, the product has intrinsic thermotolerance and desiccation tolerance, and is stable across solid, liquid and seed-applied formulations — no refrigeration is required for the dry granular forms (F1, F2, F6). The peat and liquid forms are stored cool (5–25 °C).

Strain	Primary function	Form
<i>Bacillus velezensis</i>	Antifungal lipopeptide production; suppression of <i>A. flavus</i> in the rhizosphere and geocarposphere.	Spore-forming
<i>Brevibacillus laterosporus</i>	Rhizosphere competitive colonization; broad-spectrum biocontrol.	Spore-forming
<i>Paenibacillus mucilaginosus</i>	Phosphate and potassium solubilization; rhizosphere nutrient mobilization.	Spore-forming

All three strains are spore-forming, conferring thermotolerance, desiccation tolerance and formulation flexibility. Strain names follow the current Chinese fertilizer registration; *Paenibacillus mucilaginosus* is listed under its synonym *Bacillus mucilaginosus* on registration No. 16162.

5 Formulation Portfolio

Orvan™ is manufactured in six formats designed to match different sowing interfaces and mechanization levels. All formats deliver the same three-strain consortium, each dosed to deliver an agronomically effective CFU load to its target interface (seed, furrow or root zone). Deployment in any market is determined jointly with local agronomic and regulatory input.

Format	Primary use	Rate
F1 Orvan™ Ground	Standard granule, broadcast or banded with base fertilizer at sowing. Reference format for smallholder and medium-scale farms.	60 kg/ha
F2 Orvan™ Precision	High-concentration microgranule, bulk-blend-ready for fertilizer blenders and large mechanized operations.	5–10 kg/ha
F3 Orvan™ Flow	Ready-to-use liquid in-furrow suspension for planter liquid systems (in-furrow, T-band, 2×2).	1–3 L/ha
F4 Orvan™ Seed	Peat-based seed inoculant, a widely used seed-application format. Sow within 72 h of treatment.	3–6 g/kg seed
F5 Orvan™ Coat	Liquid concentrate for commercial seed-treatment lines; diluted with clean water immediately before coating. Polymer-compatible.	2–4 mL/kg seed (concentrate)
F6 Orvan™ Integra / Duo	Integra: Orvan™ co-formulated with NPK compound fertilizer. Duo: dual-chamber pack pairing Orvan™ with a companion (micronutrient or Rhizobium/Bradyrhizobium), mixed on-farm at sowing.	300–450 kg/ha (as compound)

Precise per-format viable-count guarantees, carrier chemistry and stabilizer systems are provided to qualified partners under NDA.

Standard granule (F1 Orvan™ Ground): full single-format specifications, packaging and dosing are given in the separate Orvan™ Granule Technical Data Sheet.

6 Application Rate Matrix

Formulation	Peanut	Soybean	Application interface
F1 Orvan™ Ground (granule)	60 kg/ha	45–60 kg/ha	Co-applied with base fertilizer, in-soil at sowing
F2 Orvan™ Precision (microgranule)	5–10 kg/ha	5–10 kg/ha	Bulk blend or micro-dose metering box
F3 Orvan™ Flow (liquid)	2–3 L/ha	1–2 L/ha	Planter liquid system, in-furrow or 2×2
F4 Orvan™ Seed (peat)	3–5 g/kg seed	4–6 g/kg seed	On-seed, pre-sowing slurry or drum
F5 Orvan™ Coat (liquid concentrate)	2–3 mL/kg seed	3–4 mL/kg seed	Commercial seed-treatment line
F6 Orvan™ Integra (compound)	300–450 kg/ha	300–450 kg/ha	Base fertilizer application at sowing

Unit reference: the standard granule rate of 60 kg/ha equals 24 kg/acre ($\approx$ 53 lb/acre). Rates are published reference rates from the five-year multi-site China program; site-specific optimization is recommended during in-country bridging trials.

Across crops: for the other target legumes, the peanut and soybean rates serve as a starting reference only; the exact dose depends on the crop, its seeding rate and local conditions, and should be confirmed before large-scale use.

7 Compatibility

Compatibility refers to short-window operational co-application (tank-mix or on-seed combination) under the specified handling conditions, based on laboratory challenge and on-seed survival assays. It does not imply long-term co-storage or universal compatibility across all commercial brands; product-specific review is recommended before large-scale deployment.

General guidance: Orvan™ is compatible with neutral-pH fertilizers, starter fertilizers, rhizobial inoculants and common insecticide seed treatments under short-window co-application. Apply it last with fungicide seed treatments — sequential, never premixed — and apply any rhizobial inoculant after Orvan™.

Not compatible — products with antibacterial activity. Copper compounds, agricultural antibiotics and chemical bactericides act on bacterial targets and will inactivate Orvan™; they must not be combined with it, nor may strong oxidizers, products above pH 9 or water containing more than 2 ppm free chlorine. Full positions, including the fungicide and insecticide groups assessed as compatible by FRAC and IRAC group, are set out in the Orvan™ compatibility technical reference, ORVAN-COMPAT-2026-01.

8 Physicochemical & Quality Specifications

Summary: Orvan™ solid forms are brown granules or dark-brown moist powder; liquid forms are light- to dark-brown suspensions, pH 6.0–7.5. All forms meet the heavy-metal limits of GB 38400-2019, are screened free of Salmonella, and are held to defined contaminant-microbe limits. Full physicochemical and quality specifications are provided to qualified partners under NDA.

9 Field Performance

Reference formulation across reported work: granule (F1) mixed with NPK 15-15-15 at 60 kg/ha, applied at sowing.

Applicability across legumes: Orvan™'s application method is the same across the target legumes, but the rate should be adapted to each crop's seeding rate and local conditions. Quantified multi-year field data is most extensive for peanut and soybean (below); crop-specific rates and data for the other legumes are available on request.



Figure 1. Peanut whole-plant comparison — untreated control (CK, left) vs. Orvan™-treated (right). Peanut var. Huayu 23, same sowing date; Zhangwu, Liaoning, China, 2024 season. Example field result; performance varies with soil, variety, season and management.



Figure 2. Soybean whole-plant comparison — untreated control (left) vs. Orvan™-treated (right). Example field result; performance varies with soil, variety, season and management.

9.1 Controlled-condition studies

- Across highly susceptible and moderately resistant peanut varieties, Orvan™ produced statistically significant increases in nodule number, nodule weight and nitrogenase activity relative to untreated controls, with the largest effects on the more susceptible variety.
- Orvan™ measurably improved host photosynthetic performance (Pn, Tr, Gs, Ci), consistent with a systemic effect beyond the rhizosphere.
- Rhizosphere *A. flavus* abundance was substantially reduced under Orvan™ treatment relative to untreated controls.

- Pod number, pod weight, full-peanut count and yield were significantly increased under Orvan™ treatment.

9.2 Multi-site demonstration evidence (China)

Under a national demonstration program led by the National Agricultural Technology Extension Service Center, Orvan™ was evaluated at 658 demonstration sites across 22 provinces over five consecutive seasons (2021–2025):

Indicator	Peanut	Soybean
Average yield increase over untreated control	+19.9%	+16.1%
Nodule number increase	8.5×	3.7×
Nitrogenase activity increase	10.7×	4.8×
A. flavus field control rate	> 63%	—
Soil A. flavus abundance reduction	> 80%	—
Nitrogen-fertilizer reduction (yield maintained)	20–40%	20–40%
Quality improvement	Elevated protein, resveratrol	Elevated protein, isoflavones
Demonstration scale	405 sites	253 sites

Aflatoxin (A. flavus) suppression is a peanut-specific benefit: soybean is not an aflatoxin-susceptible crop, so it is not evaluated as an aflatoxin endpoint. Orvan™'s contribution in soybean is nodulation, nitrogen fixation and yield.

Fold-changes are increases over untreated controls in the cited trials; the largest responses occur where the native rhizobial population is limited.

Findings derive from OCRI-CAAS research and the national multi-site demonstration program (2021–2025) coordinated with the National Agricultural Technology Extension Service Center. Site-specific performance may vary and should be validated through local bridging trials.

10 Regulatory, Biosafety & Environmental Status

The information below reflects in-house strain characterization and the registration status of Orvan™ in its primary market. Final regulatory classification, labelling and permitted claims are jurisdiction-specific and must be determined under the applicable national or regional framework.

- **Biosafety:** based on in-house strain characterization and available safety data, Orvan™ strains are handled as low-risk, non-GMO microorganisms under controlled agricultural use.
- **GMO status:** Non-GMO. All three strains are naturally isolated; no genetic modification has been performed.
- **Strain safety:** none of the three strains belongs to the *Bacillus cereus* group associated with emetic or diarrhoeal toxins. *Bacillus velezensis* is included on the EFSA Qualified Presumption of Safety (QPS) list.
- **Environmental status:** the three strains are naturally occurring soil bacteria that are part of the native soil microbial community. No crop phytotoxicity was observed across five years of multi-site agronomic demonstration in China. Region-specific environmental risk assessment remains the responsibility of the local registrant.
- **Regulatory support:** regulatory route, labelling and permitted claims are jurisdiction-specific; territory-specific regulatory dossiers and regulatory-grade strain documentation can be made available to qualified partners under NDA to support registration in their market.

- **Organic acceptability:** formulations are designed without GMOs, synthetic pesticides or animal-derived carriers; organic acceptability is jurisdiction-specific and subject to third-party review (e.g. NOP, EU 2018/848, IBD).

11 Storage & Handling

- **Solid forms (F1, F2, F6):** store in a cool, dry, ventilated warehouse at $\leq 30^{\circ}\text{C}$ (short excursions $\leq 35^{\circ}\text{C}$), RH $< 65\%$, out of direct sunlight. Do not over-stack pallets. Do not store adjacent to pesticides, fuels or strong oxidizers.
- **Peat and liquid forms (F3, F4, F5):** store at $5\text{--}25^{\circ}\text{C}$. Do not freeze. Protect from direct sunlight. Gently invert before use if settling has occurred.
- **Opened-pack window:** use within 30 days (solids) or 14 days (liquids).
- **Transportation:** not classified as a dangerous good under UN/ADR/IMDG. However, as a live microbial product, import may require a biosecurity, quarantine or phytosanitary permit in the destination country; confirm import requirements before shipment.

12 Registration & Recognition

- 2019 — First registered as a microbial fertilizer by China's Ministry of Agriculture and Rural Affairs; registrations subsequently renewed. Current registrations: 15621 (compound microbial fertilizer, granule; valid to 2030), 16161 (microbial inoculant, powder) and 16162 (microbial inoculant, granule; valid to 2031).
- 2023 — Selected as a National Recommended Agricultural Technology and recognized as an Agricultural Spark Technology.
- 2024 — Designated one of China's Top 10 Major Leading Agricultural Technologies by the Ministry of Agriculture and Rural Affairs.
- 2024 — Independent expert-panel review confirmed Orvan™ as a major original technology for large-scale yield improvement in soybean and peanut.
- Commercial deployment in China since 2019 through multiple technology-transfer agreements, with established compound-fertilizer production capacity and a large-scale multi-province field demonstration program.

Contact & Support

Huasheng Bio Limited

Huasheng Bio Limited brings Orvan™ technology to growers internationally; Orvan™ is developed by the Oil Crops Research Institute, Chinese Academy of Agricultural Sciences (OCRI-CAAS).

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For trial materials, samples, formulation selection, and regulatory dossiers, contact us by email or WhatsApp. Technical dossiers, safety data sheets, and regulatory-grade strain documentation are available to qualified partners under a mutual non-disclosure agreement.

Disclaimer, Trademarks & Copyright

Performance disclaimer. Field performance data derive from multi-site demonstration trials coordinated by OCRI-CAAS in China and from supporting research studies. Actual field performance may vary with soil, climate, variety, cropping system, water regime and management. Users are responsible for ensuring the product is registered, permitted and applied in accordance with all applicable laws, and for verifying compatibility with their own seed treatments, fertilizers and rhizobial inoculants prior to commercial deployment.

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