



 EMERGING TECH RESEARCH

Agtech Report

VC trends and emerging opportunities

Q4
2023





Contents

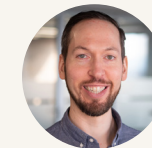
Vertical update	3
Q4 2023 timeline	5
Agtech landscape	6
Agtech VC ecosystem market map	7
VC activity	8
Emerging opportunities	26
Digital twins	27
Select company highlights	29
Apha.Bio	30
Halter	32

What else would you like to see in this report?

Send your ideas to alex.frederick@pitchbook.com. We look forward to hearing from you.

Institutional Research Group

Analysis



Alex Frederick Senior Analyst, Emerging Technology
alex.frederick@pitchbook.com
pbinstitutionalresearch@pitchbook.com

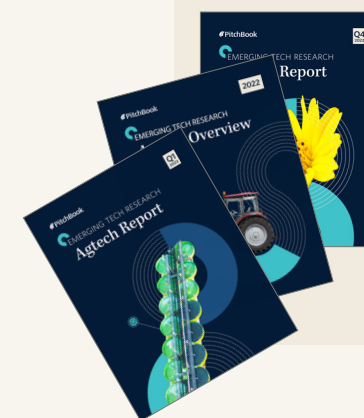
Data

TJ Mei Data Analyst

Publishing

Report designed by **Chloe Ladwig & Julia Midkiff**

Published on January 26, 2024



For previous updates as well as our complete agtech research, please see the designated [analyst workspace](#) on the PitchBook Platform.



Vertical update

Agricultural technology (agtech) venture activity ended 2023 on a sour note, with quarterly deal counts decelerating to the lowest point since Q3 2019. The agtech vertical was not immune to broader challenges impacting the VC asset class. Despite a Q4 rally in most global public indexes, private markets continue to face a challenging exit environment. The IPO window has not yet reopened despite a few scant tech IPOs. Interest rates remain elevated, discouraging M&A. However, in the near term, we expect agtech to outperform the broader VC asset class. Maintaining food security and food sovereignty are critical global issues made more challenging by climate change, geopolitical conflict, supply chain disruptions, growing populations, and labor shortages. Agtech will continue to play a critical role in addressing these challenges.

Venture capital activity

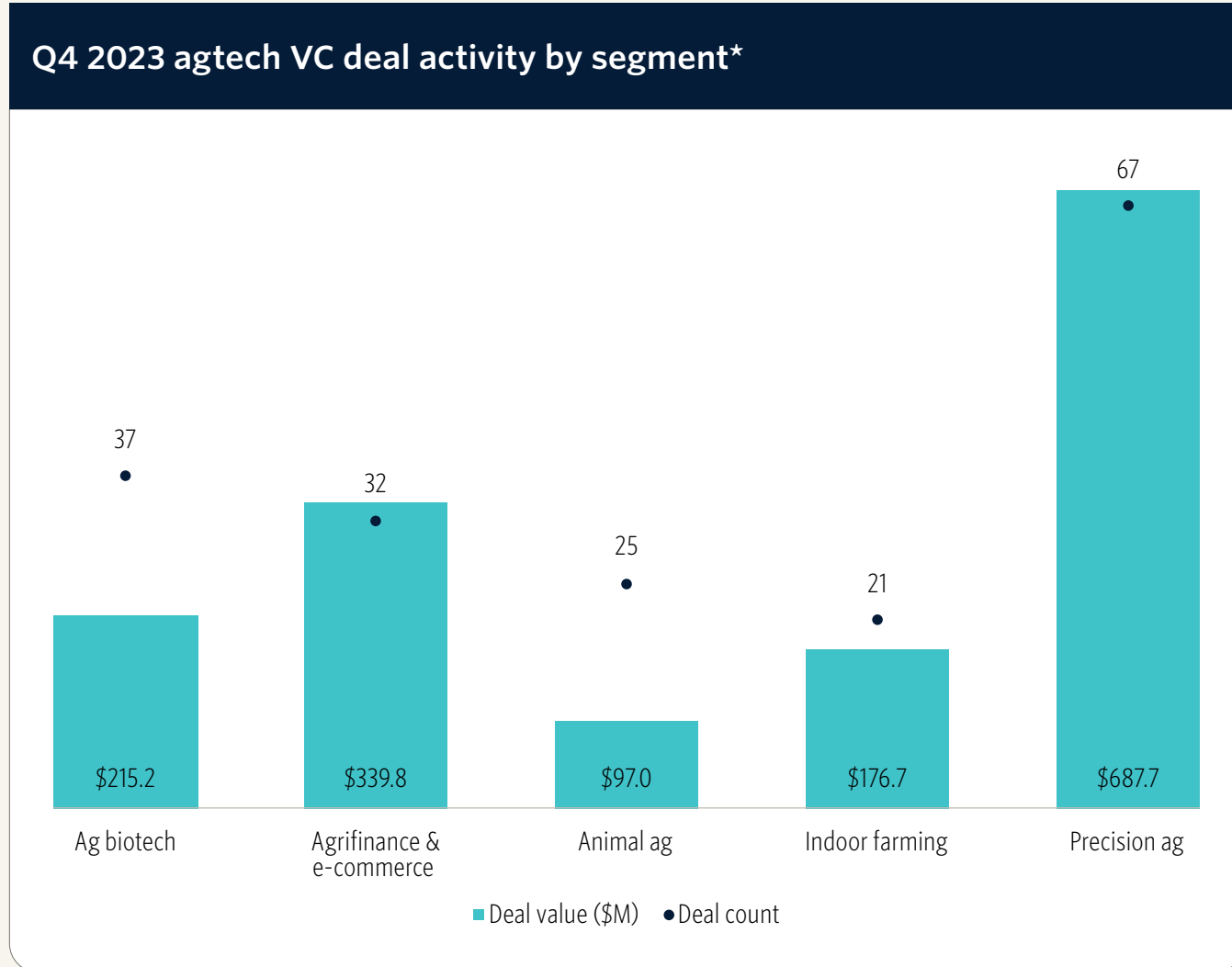
- **Overall funding:** Q4 was in line with the downward trend of investment activity. Deal values totaled \$1.4 billion, down 34.7% QoQ. Deal counts reached 181, down 17.4% QoQ.
- **Notable VC deals:** [Farmers Business Network](#) (FBN) raised the largest deal of the quarter with a \$154.9 million late-stage round. Other notable rounds include imagery analytics provider [Quantum Systems](#)' \$67.2 million Series B, and AI-breeding monitoring provider [Orbem](#)'s \$31.8 million Series A.
- **Notable VC exits:** Top exits this quarter include the acquisition of ag robotics provider [Clearpath Robotics](#) by [Rockwell Automation](#) for \$454.5 million. Additionally, decision support platform provider [ITK](#) was acquired by [Innoval](#) for €45.0 million, and bio-fungicide producer [Peptyde Bio](#) was acquired by [Invaio](#).
- **Investment focus areas:** Agribusiness marketplaces saw the greatest total deal value in Q4 2023. Led by [FBN](#)'s \$154.9 million round, we recorded \$313.6 million invested across 21 deals. The drones & imagery analytics category saw the greatest deal count with \$271.6 million invested across 22 deals.

Notable events and emerging trends

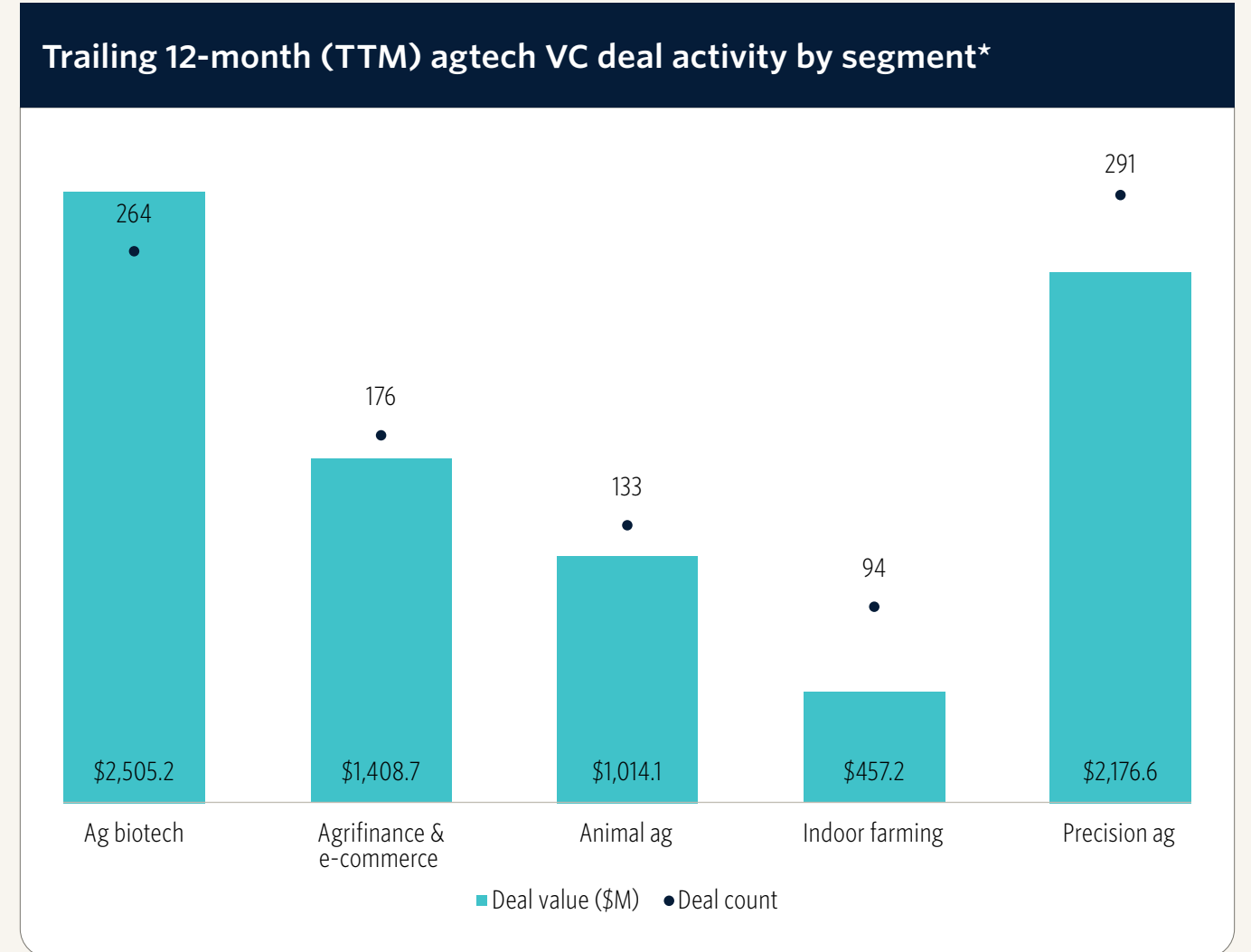
- **Generative AI (GenAI):** One of the biggest tech trends of 2023 has applicability in agriculture as well. Farm management platforms like [FBN](#) are beginning to implement GenAI tools to make data more accessible and insights more actionable. Indoor farm intelligence provider [Gardin](#) is using GenAI to develop synthetic images of crops to train its own AI model. Many other agricultural applications for GenAI likely exist and have not yet been discovered or disclosed.
- **Regenerative agriculture:** The term is gaining traction in the agrifood industry. Several large food companies including [JBS](#), [Pepsico](#), [Nestlé](#), and [Sodexo](#) have pledged funds to encourage farmers to adopt regenerative ag practices. Agtech software platforms, biologicals, drones, and robotics are enablement technologies critical to adoption at scale.
- **Livestock methane reduction:** Companies like [Mootral](#), [Blue Ocean Barns](#), and [CH4 Global](#) are utilizing synthetic biology and precision fermentation to cultivate methane inhibitors from red seaweed, presenting a promising avenue for mitigating methane emissions from livestock. VC funding to scale production further underscores the growing interest in this sustainable solution.



VERTICAL UPDATE



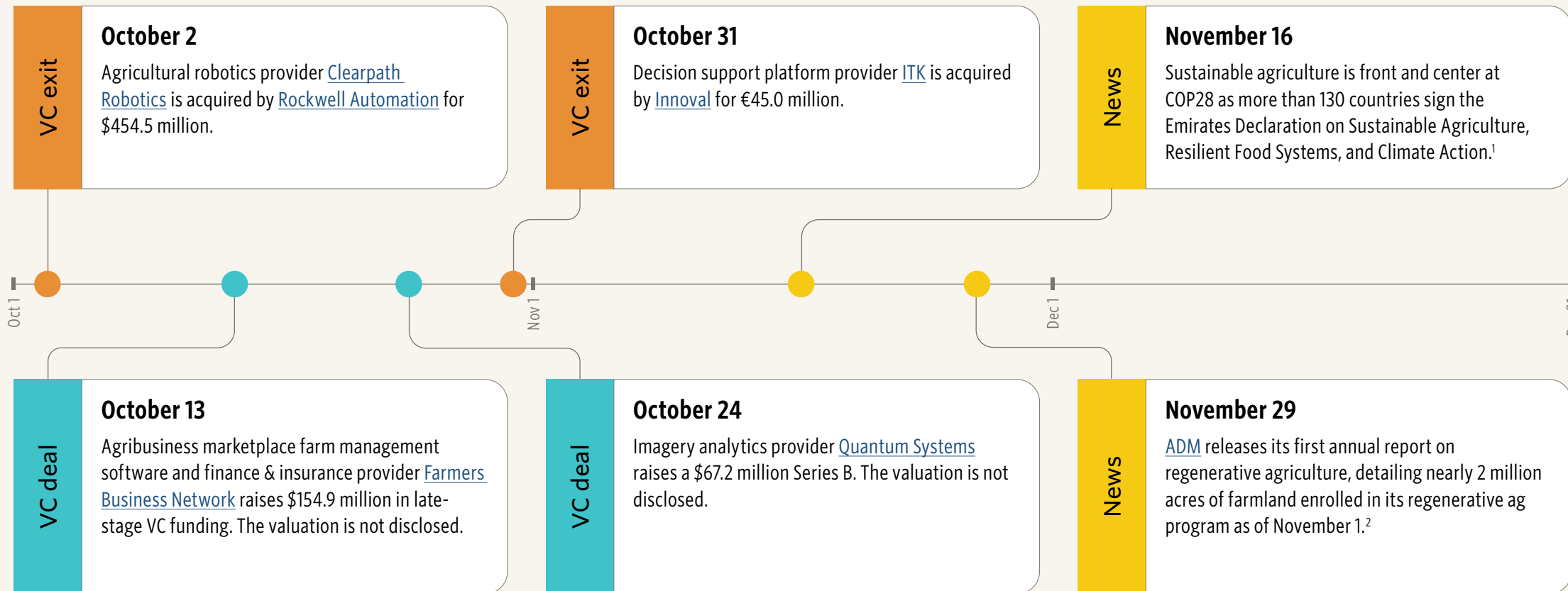
Source: PitchBook • Geography: Global • *As of December 31, 2023



Source: PitchBook • Geography: Global • *As of December 31, 2023



Q4 2023 timeline



1: "COP28 Presidency Puts Food Systems Transformation on Global Climate Agenda as More Than 130 World Leaders Endorse Food and Agriculture Declaration," COP28, December 1, 2023.
2: "As Sustainability Work Accelerates, ADM Issues First Annual Report on Regenerative Agriculture," ADM, November 29, 2023.

Q4 VC summary

181
total deals

-17.4%
QoQ growth

\$1.4B
total VC raised

-34.7%
QoQ deal value growth

2023 summary

952
total deals

-39.2%
YoY deal value growth

\$7.1B
total VC raised

-39.5%
YTD growth



Agtech landscape

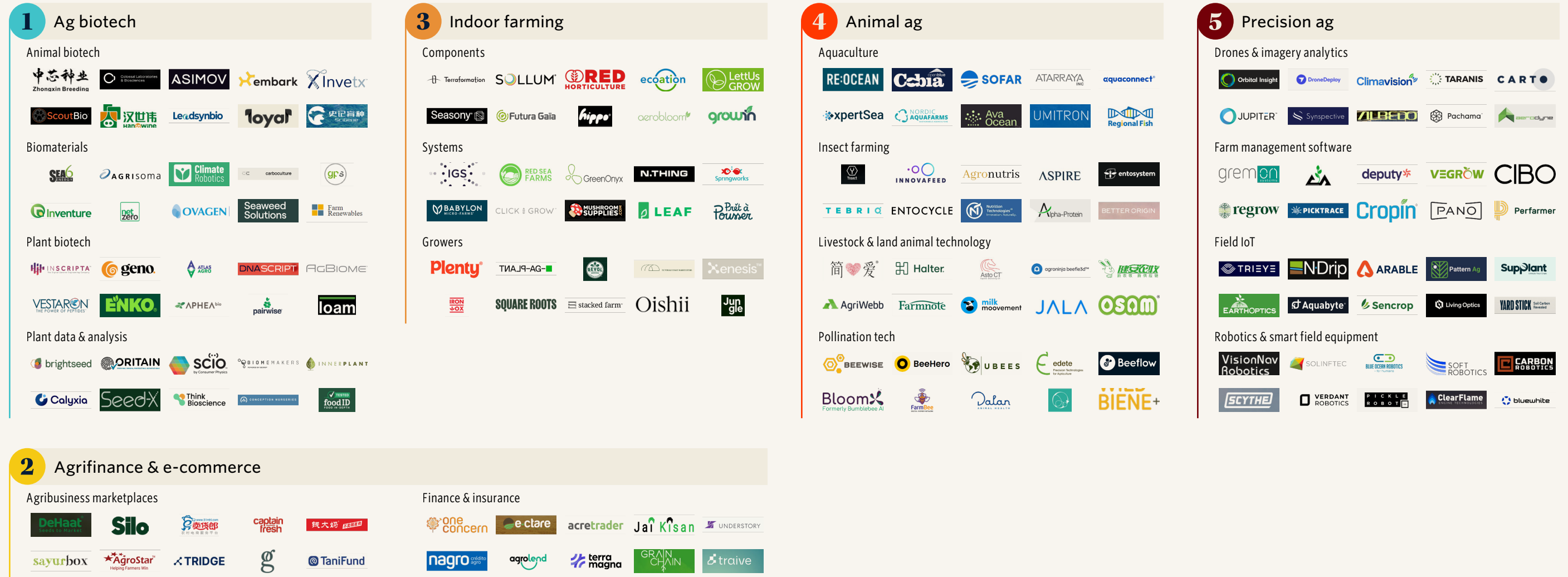
- 1** Ag biotech
- 2** Agrifinance & e-commerce
- 3** Indoor farming
- 4** Animal ag
- 5** Precision ag





Agtech VC ecosystem market map

This market map is an overview of venture-backed or growth-stage companies that have received venture capital or other notable private investments. [Click to view the full map on the Pitchbook Platform.](#)





VC activity

The agtech ecosystem experienced a decline in VC deal value and count in Q4, totaling \$1.4 billion across 181 deals. These declines, -34.7% and -17.4% QoQ, respectively, were a reversion to a trend that was bucked in Q3 when we logged a 24% increase in deal value. In total, the quarterly deal activity declines in 2023 have added up to nearly a 40% reduction in deal values and deal counts YoY. We logged \$7.1 billion invested across 952 deals in 2023, down 39.5% and 39.2% YoY, respectively.

Despite dismal venture activity, there were notable deals to be had. [FBN](#) closed a \$154.9 million late-stage VC round in the form of a convertible note. [FBN](#) has evolved significantly from its founding as a farmer-to-farmer sharing network to a comprehensive platform offering an input marketplace, marketing support, insurance programs, and credit to farmers. It was an early adopter of GenAI tools and recently partnered with [ADM](#) to enroll farmers in its regenerative ag program. Indoor farm operator [Bowery](#) raised the second largest deal of the quarter with a \$93.8 million Series D. The deal valued the company at \$941.8 million post-money, a considerable down round from its Series C1 in 2021 that valued the company at \$2.3 billion. Indoor ag companies have faced significant headwinds over the past two years, including high startup costs, rising energy costs, and dwindling investor support. Although struggles are likely to continue in the near term, in the long term we expect business models and technology to continue to evolve and investors to become increasingly savvy to the complexities, challenges, and opportunities of the indoor farming industry.

Agtech VC deal activity by quarter



Source: PitchBook • Geography: Global • *As of December 31, 2023

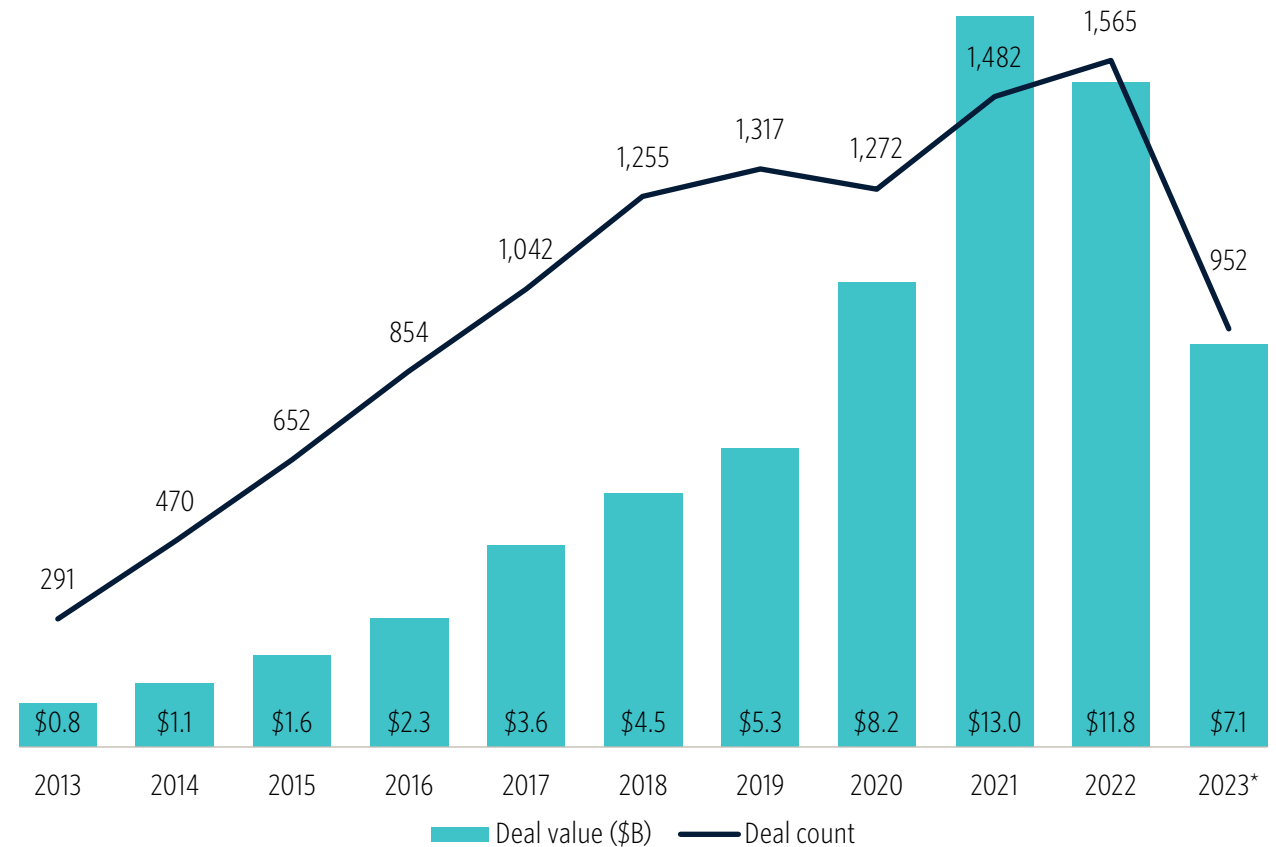


VC ACTIVITY

Median deal sizes and valuations saw positive growth in 2023. The median deal size was \$2.6 million, up 41.6% YoY, while the median pre-money valuation totaled \$15.7 million, up 33.0% YoY. The median valuation may be overinflated due to data omissions to obscure flat or down rounds; in 2020, 35% of agtech deals disclosed valuations, but by 2023, that number had declined to 23%. Additionally, many investors have adopted a more conservative approach by strengthening support of existing positions and reserving new investments for the most high-confidence deals.

Q4 VC-backed exit activity totaled \$2.6 billion across 20 deals—on par with the quarter prior. Annually, exit activity totaled \$3.1 billion across 54 deals, an increase of 22.6% and 12.5% YoY, respectively. 42 (85.7%) of the exits were acquisitions, while five (9.3%) were public listings. Notable exits this quarter include the acquisition of ag robotics provider [Clearpath Robotics](#) by [Rockwell Automation](#) for \$454.5 million and the acquisition of decision support platform provider [ITK](#) by [Innoval](#) for €45.0 million. An increase in exit activity will likely generate optimism regarding a return to a healthy ecosystem in 2024 and the exuberance of venture investing in 2021.

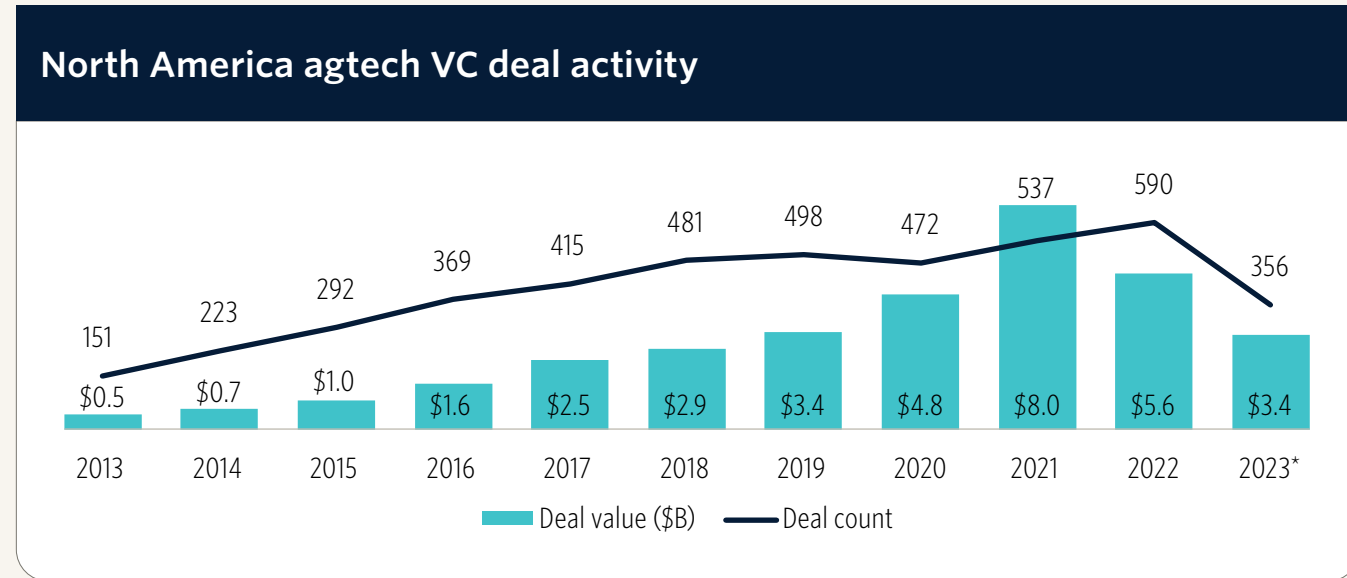
Agtech VC deal activity



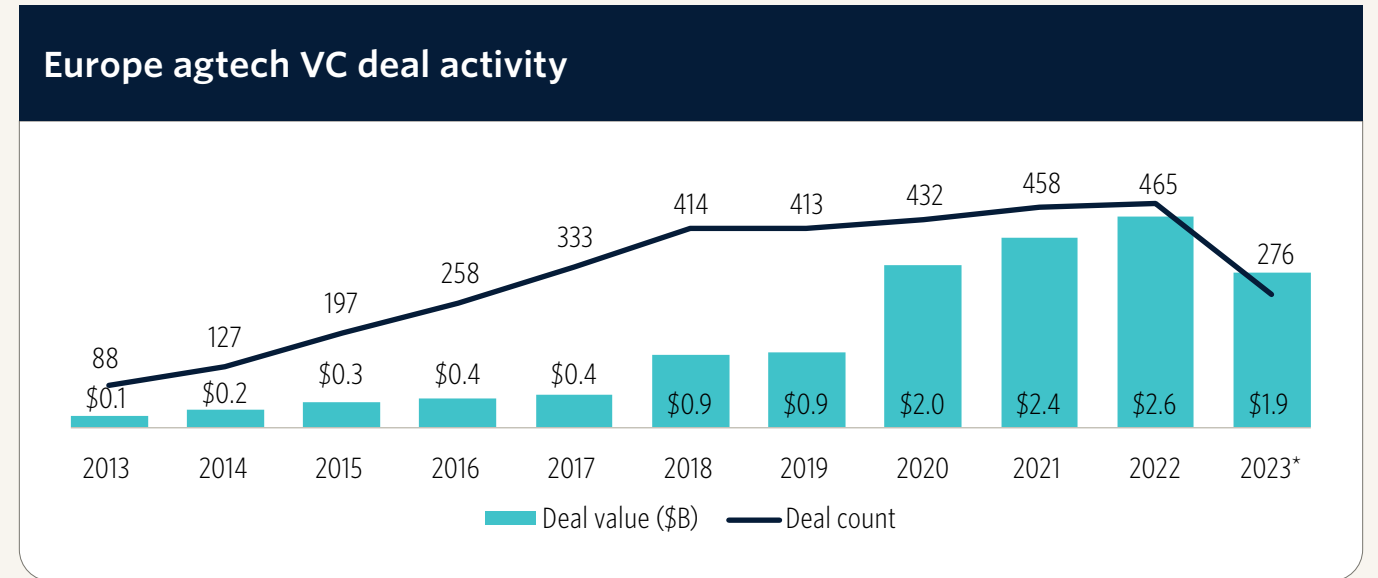
Source: PitchBook • Geography: Global • *As of December 31, 2023



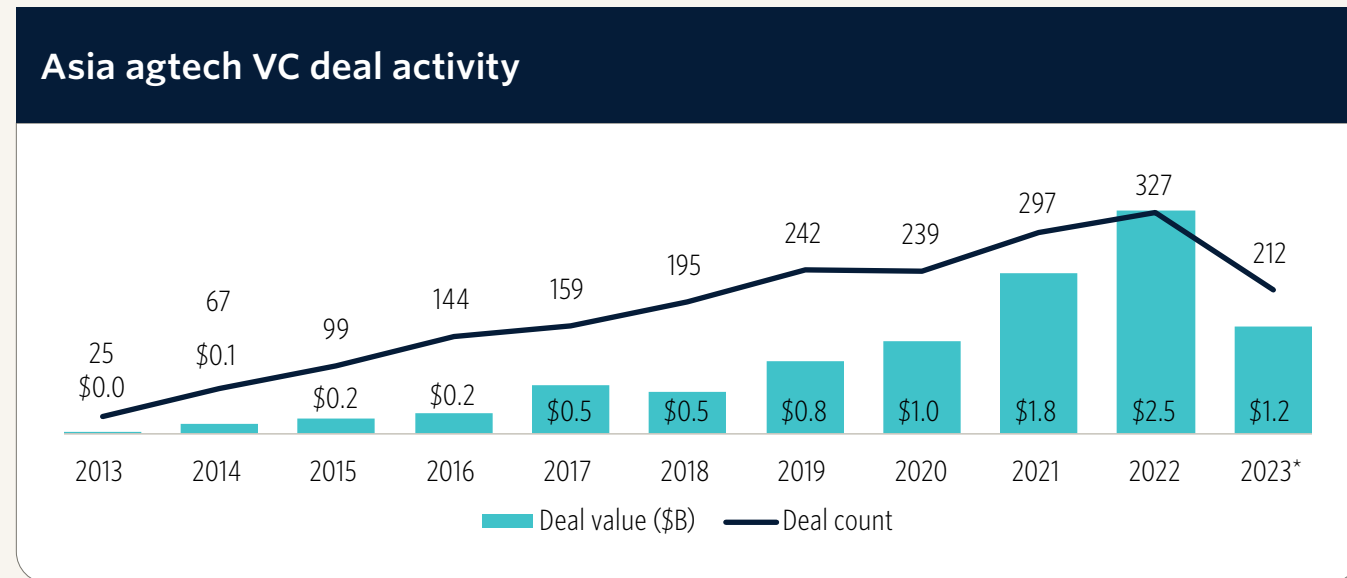
VC ACTIVITY



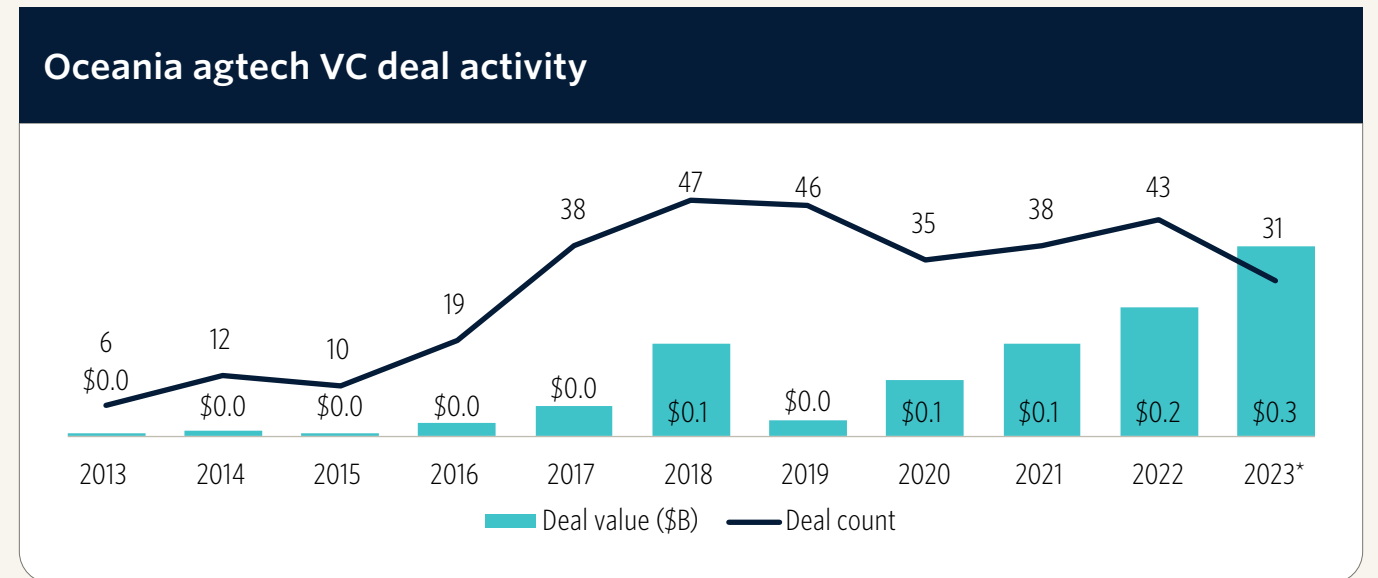
Source: PitchBook • Geography: North America • *As of December 31, 2023



Source: PitchBook • Geography: Europe • *As of December 31, 2023



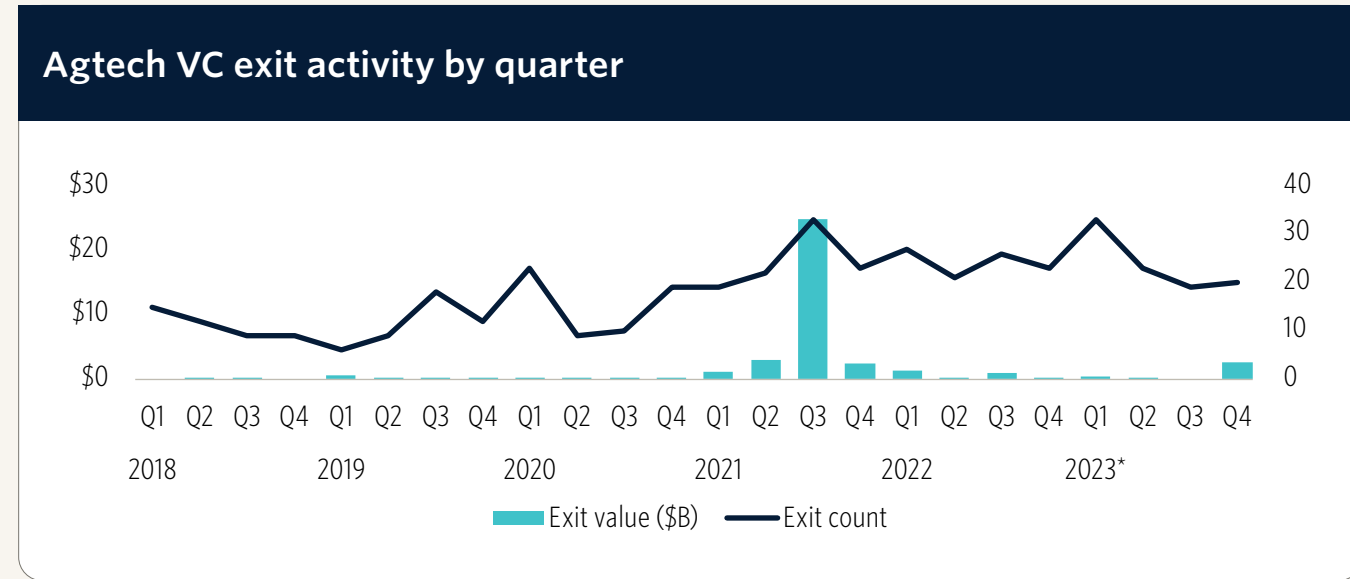
Source: PitchBook • Geography: Asia • *As of December 31, 2023



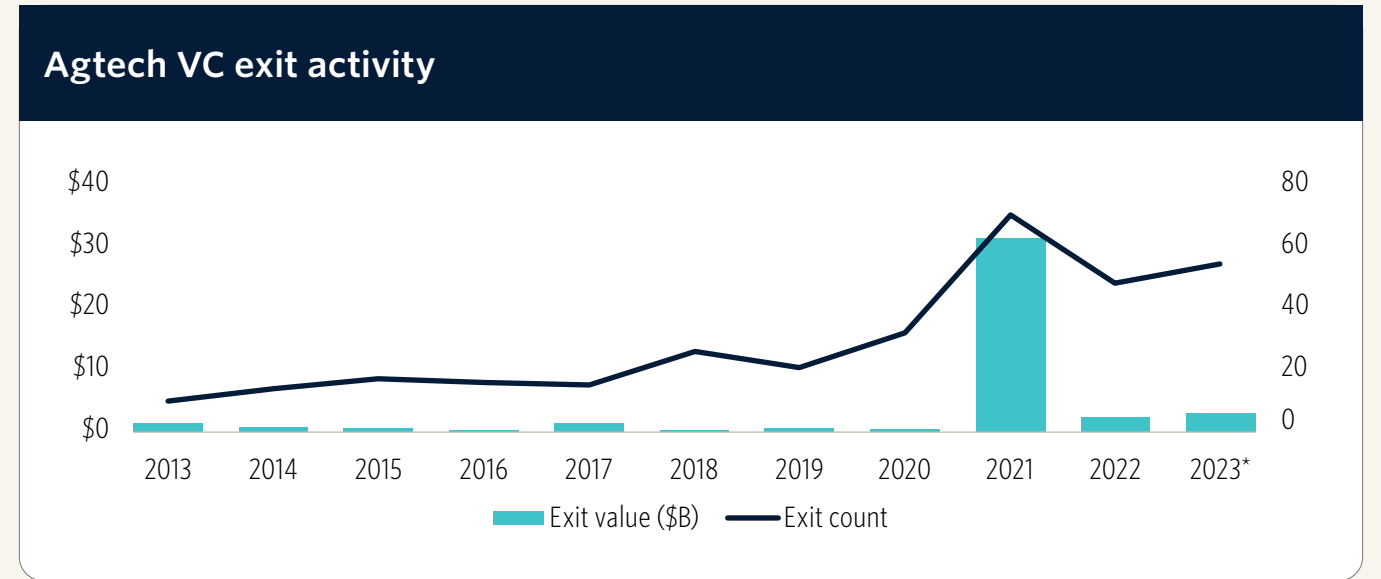
Source: PitchBook • Geography: Oceania • *As of December 31, 2023



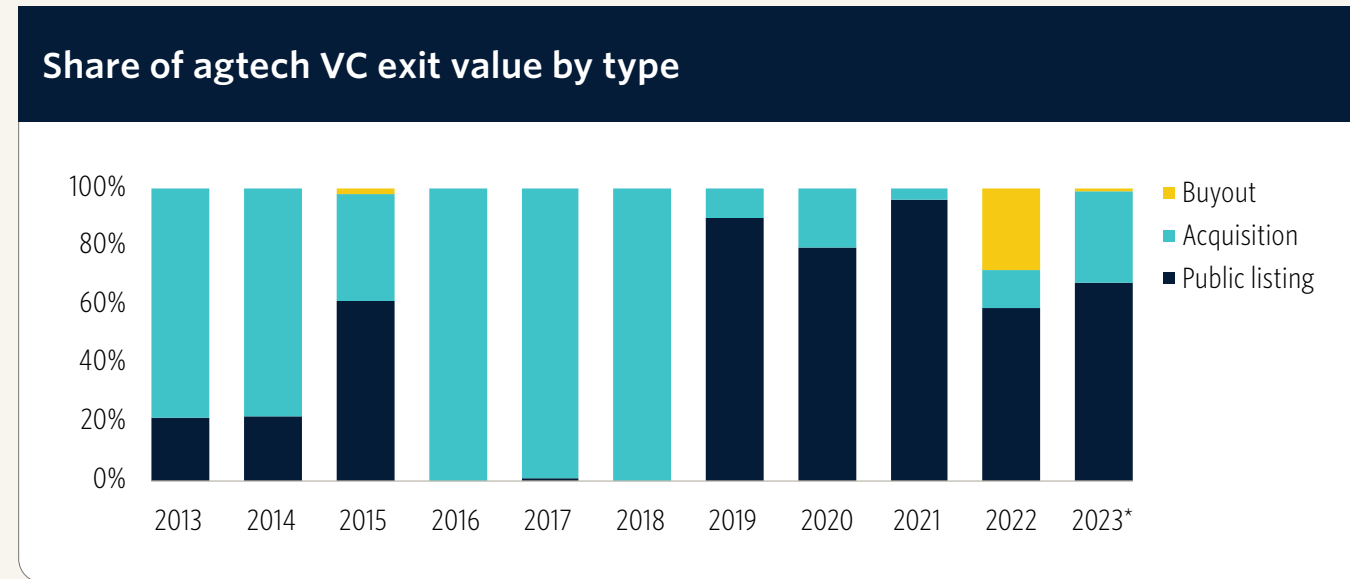
VC ACTIVITY



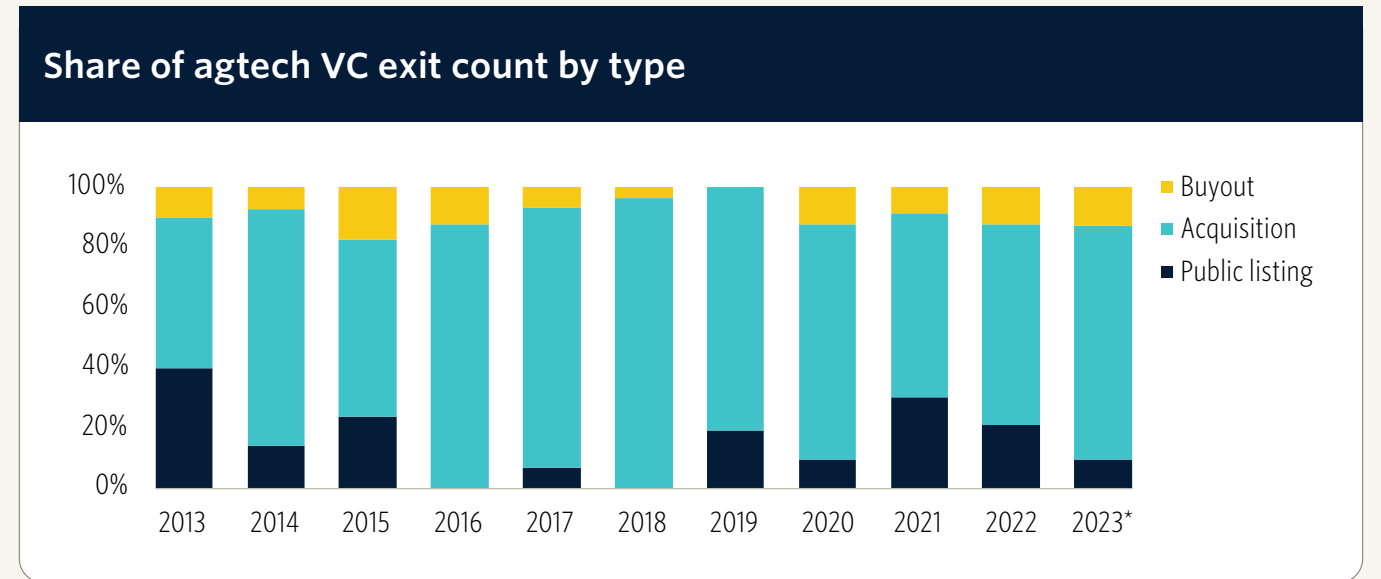
Source: PitchBook • Geography: Global • *As of December 31, 2023



Source: PitchBook • Geography: Global • *As of December 31, 2023



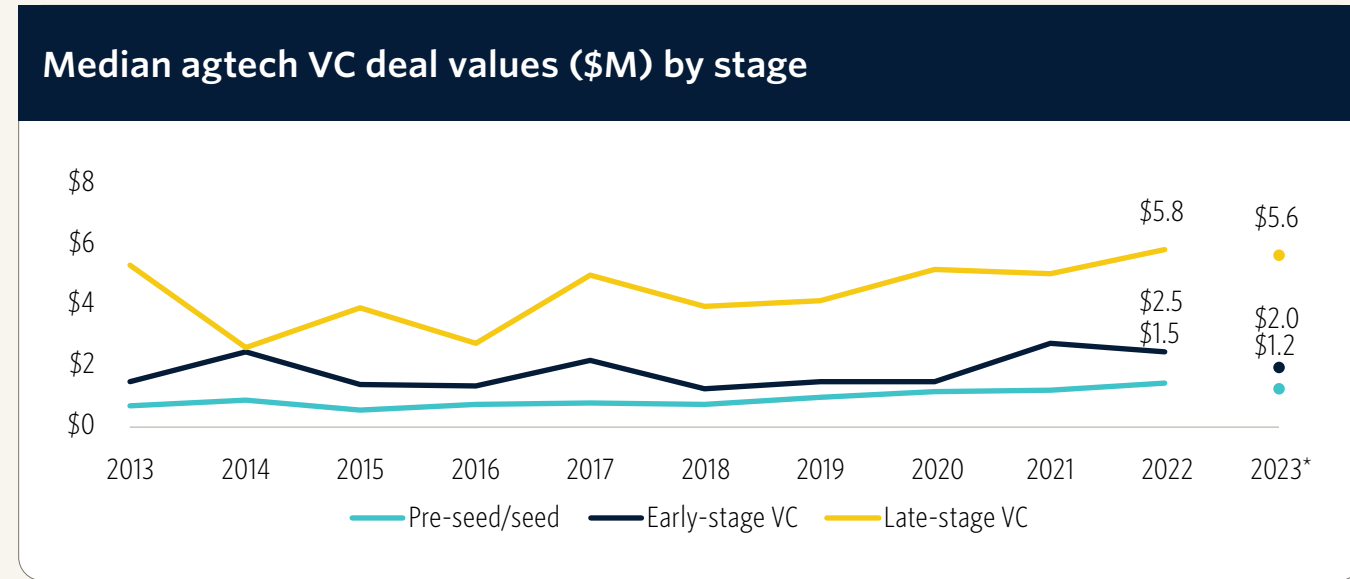
Source: PitchBook • Geography: Global • *As of December 31, 2023



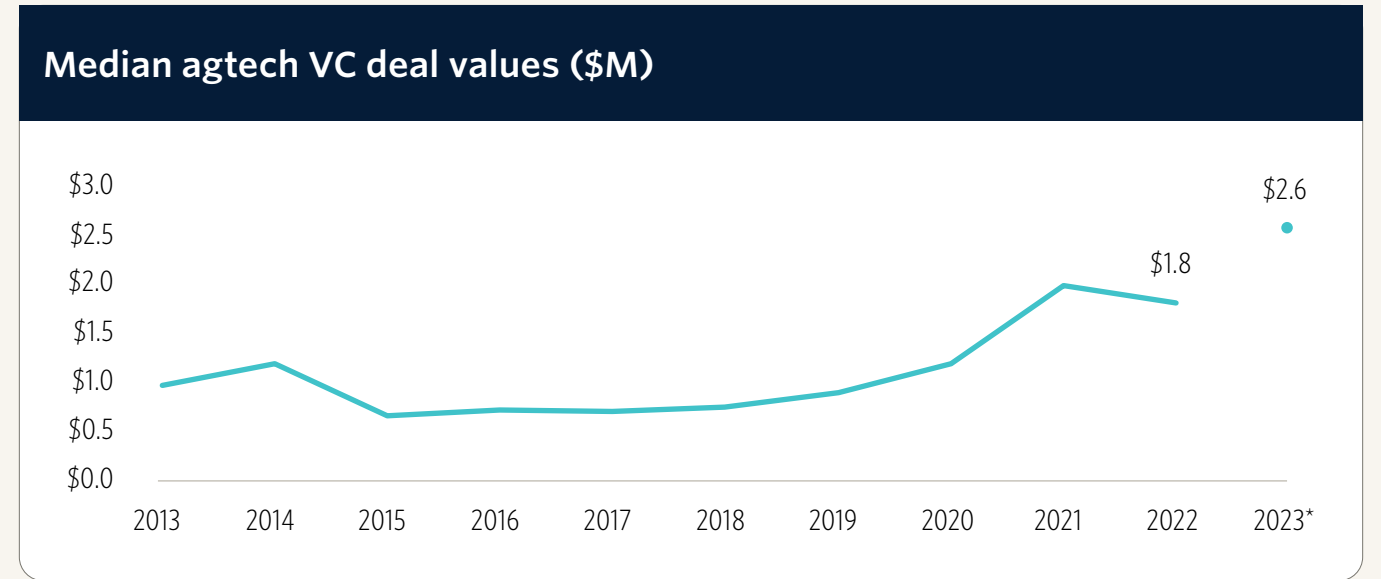
Source: PitchBook • Geography: Global • *As of December 31, 2023



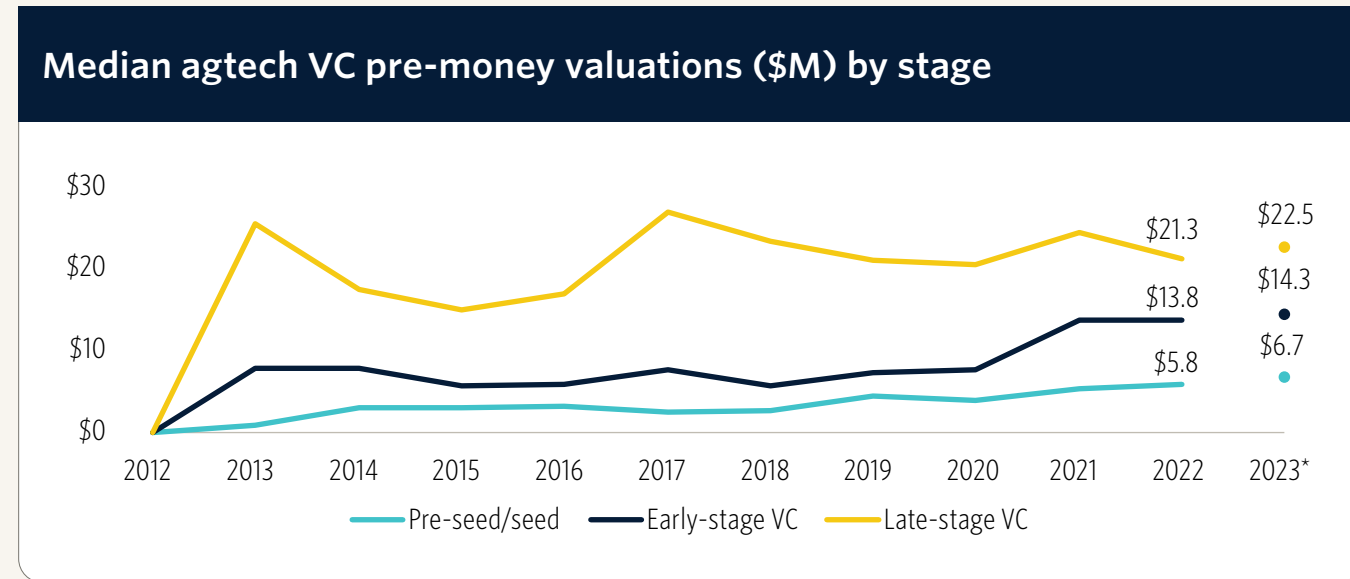
VC ACTIVITY



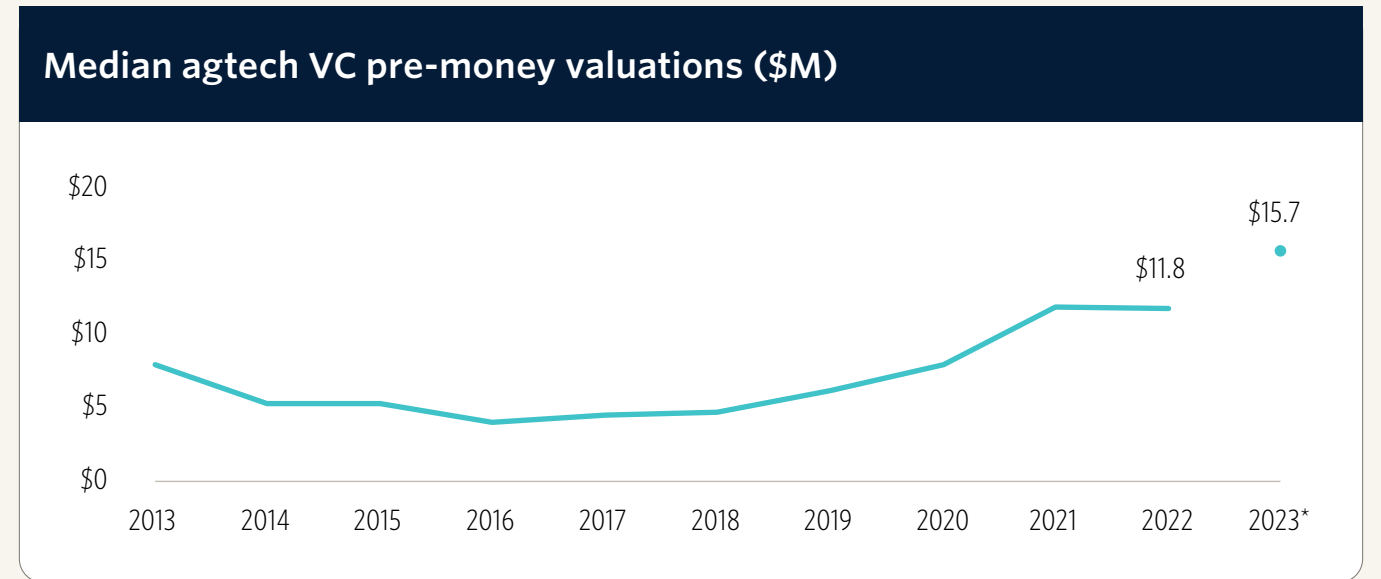
Source: PitchBook • Geography: Global • *As of December 31, 2023



Source: PitchBook • Geography: Global • *As of December 31, 2023



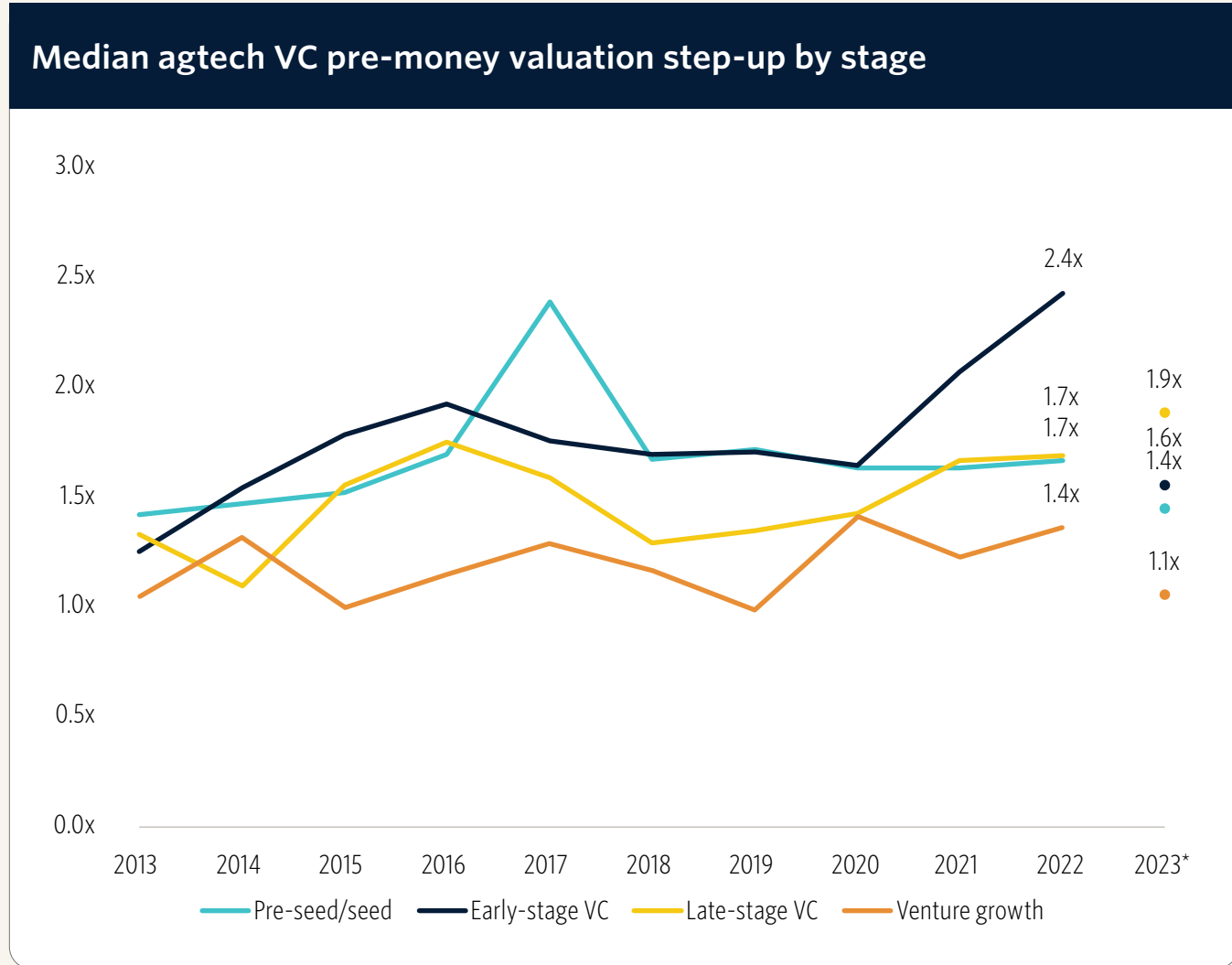
Source: PitchBook • Geography: Global • *As of December 31, 2023



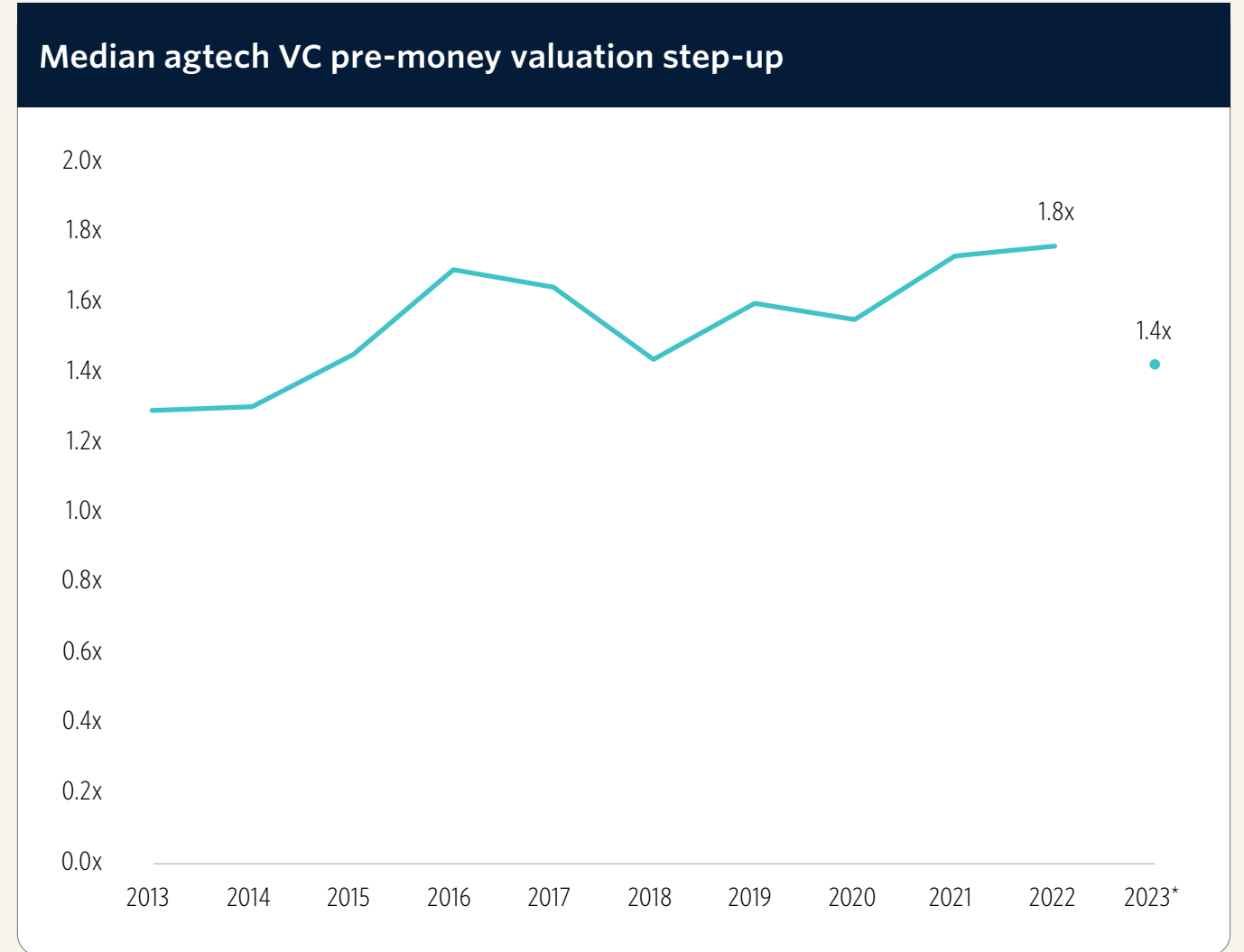
Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY



Source: PitchBook • Geography: Global • *As of December 31, 2023



Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Key agtech pre-seed/seed VC deals in Q4 2023*

Company	Close date	Subsegment	Stage	Deal value (\$M)	Post-money valuation (\$M)	Lead investor(s)
Bonsai	October 2	Robotics & smart field equipment	Seed	\$13.5	N/A	Acre Venture Partners
Bloomix	October 30	Plant biotech	Early-stage VC	\$7.1	N/A	West Hill Capital
InPlanet	October 1	Plant biotech	Seed	\$5.0	N/A	Foodlabs, Salvia
Croptide	December 15	Field IoT	Seed	\$4.3	N/A	N/A
VVF AgTech	December 21	Agribusiness marketplaces	Seed	\$4.2	\$9.2	N/A
Traction	December 13	Farm management software	Seed	\$3.5	N/A	N/A
Soiltech Wireless	November 1	Field IoT	Seed	\$3.0	\$17.1	N/A
PES Technologies	October 30	Field IoT	Seed	\$2.9	N/A	TSP Ventures
Osiris Agriculture	October 18	Robotics & smart field equipment	Seed	\$2.3	N/A	N/A
Inalve	December 14	Animal biotech	Seed	\$2.2	\$4.2	N/A

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Key agtech early-stage VC deals in Q4 2023*

Company	Close date	Subsegment	Stage	Deal value (\$M)	Lead investor(s)	Valuation step-up
Albedo	October 31	Drones & imagery analytics	Series A	\$29.4	N/A	1.2x
Retailo	November 29	Agribusiness marketplaces	Early-stage VC	\$15.0	N/A	N/A
Overstory	October 19	Drones & imagery analytics	Series A	\$14.0	B Capital Group	N/A
Aigen	October 12	Robotics & smart field equipment	Series A2	\$11.2	ReGen Ventures	1.2x
FarmInsect	October 23	Insect farming	Series A	\$8.5	Sandwater	N/A
Poppy	November 1	Agribusiness marketplaces	Series A	\$6.5	Michigan Capital Network Ventures	N/A
Digivridhi Technologies	December 5	Finance & insurance	Early-stage VC	\$6.0	Omidyar Network	N/A
Growcoms	November 2	Agribusiness marketplaces	Early-stage VC	\$3.5	Arali Ventures, JSW Ventures	N/A
IYOTAH Solutions	December 20	Livestock & land animal technology	Series A	\$3.1	N/A	N/A
tokuiten	October 26	Robotics & smart field equipment	Early-stage VC	\$2.5	United Co.	1.8x

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Key agtech late-stage VC deals in Q4 2023*

Company	Close date	Subsegment	Stage	Deal value (\$M)	Lead investor(s)	Valuation step-up
Quantum Systems	October 24	Drones & imagery analytics	Series B	\$67.2	DTCP, HV Capital	N/A
Pachama	December 5	Drones & imagery analytics	Series B	\$64.0	Future Positive	3.7x
Oritain	November 28	Plant data & analysis	Series C	\$57.0	Highland Europe	N/A
VeGrow	December 13	Farm management software	Series C	\$46.0	GIC, Prosus Ventures	N/A
Carbon Robotics	December 1	Robotics & smart field equipment	Series C	\$43.0	S28 Capital, Sozo Ventures	1.6x
Planet Farms	November 16	Indoor farming components	Late-stage VC	\$40.0	N/A	N/A
Orbem	October 11	Livestock & land animal technology	Series A	\$31.8	83North	N/A
AFEX	November 2	Agribusiness marketplaces	Late-stage VC	\$26.5	N/A	N/A
Burro	December 27	Robotics & smart field equipment	Series B	\$24.0	Catalyst Investors, TransLink Capital	1.3x
LiveEO	November 28	Drones & imagery analytics	Late-stage VC	\$19.5	N/A	N/A

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Key agtech venture-growth deals in Q4 2023*

Company	Close date	Subsegment	Stage	Deal value (\$M)	Lead investor(s)	Valuation step-up
Farmers Business Network	October 13	Agribusiness marketplaces, farm management software, finance & insurance	Late-stage VC	\$154.9	N/A	N/A
Bowery	November 9	Indoor growers	Series D	\$93.8	N/A	0.4x
FarMart	October 17	Agribusiness marketplaces	Late-stage VC	\$65.0	N/A	N/A
NewLeaf Symbiotics	December 19	Plant biotech	Series D	\$47.0	Gullspang Re:food	1.0x
Mootral	December 15	Animal biotech	Series B	\$20.0	King Philanthropies	N/A
EAVision Robot	November 16	Drones & imagery analytics	Late-stage VC	\$13.7	N/A	N/A
Hazel Technologies	December 1	Plant biotech	Series D	\$11.5	N/A	0.2x
Solena	October 25	Plant biotech	Series A	\$6.0	N/A	N/A
Garuda Aerospace	October 25	Drones & imagery analytics	Late-stage VC	\$3.0	Venture Catalysts, We Founder Circle	N/A
Hello Tractor	December 27	Agribusiness marketplaces	Late-stage VC	\$3.0	N/A	N/A

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Key agtech VC exits in Q4 2023*

Company	Close date	Subsegment	Exit value (\$M)	Exit type	Acquirer(s)/index
Shiyue Daotian	October 10	Plant biotech	\$2,048.2	Public listing	Hong Kong Stock Exchange
Clearpath Robotics	October 2	Robotics & smart field equipment	\$454.5	Acquisition	Rockwell Automation
ITK	October 31	Farm management software	\$47.5	Acquisition	Innoval
Clinical Microbiomics	October 11	Animal biotech	N/A	Acquisition	CosmosID
QualySense	December 1	Robotics & smart field equipment	N/A	Acquisition	Ferrum
Peptide Bio	December 4	Plant biotech	N/A	Acquisition	Invaio
Barrix	December 16	Plant biotech	N/A	Acquisition	Sumitomo Chemical India
Orion Space Solutions	November 29	Drones & imagery analytics	N/A	Buyout	Arcfield, Veritas Capital
Merci Raymond	October 18	Indoor farming systems	N/A	Buyout	Groupe Chevrillon, Myrium
Dekon Farming	December 6	Livestock & land animal technology	N/A	Public listing	Guiyang Agricultural Investment Group, Xiushan Huayu Logistics Investment
Ame Kaze Taiyo	December 18	Agribusiness marketplaces	N/A	Public listing	Tokyo Stock Exchange

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Key agtech incumbents in Q4 2023*

Company	Category	Key products	EV/NTM revenue	EV/NTM EBITDA
CNH Industrial	Robotics & smart field equipment	Tractors	1.8x	15.9x
John Deere	Robotics & smart field equipment	Tractors, sprayers, planters	3.3x	14.8x
Archer Daniels Midland	Livestock & land animal tech	Feed, feed additives, premix, macroingredients	0.7x	11.3x
Zoetis	Animal biotech	Vaccines, parasite control products, antibiotics	10.1x	23.4x
Hydrofarm	Indoor farming components	Nutrients, grow media, containers, lighting, atmospheric control	1.0x	10.1x
Benson Hill	Plant biotech	Phenotyping, predictive breeding, environmental modeling	2.0x	N/A
Corteva	Plant biotech	Seeds & traits, crop protection, biologicals, digital tools	2.7x	15.6x
Nutrien	Plant biotech	Fertilizer, feed	1.6x	4.3x
Flying Spark	Insect farming	Protein powder, aquaculture feed	N/A	N/A
Bioceres Crop Solutions	Plant biotech	Crop protection, crop nutrition, seed & integrated products	2.3x	10.2x
Ekobot	Robotics & smart field equipment	Autonomous weeding robot	N/A	N/A

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Top pre-seed/seed VC-backed agtech companies by total VC raised to date*

Company	Category	VC (\$M) raised to date	Post-money valuation (\$M)	IPO probability	M&A probability	No exit probability
constellr	Drones & imagery analytics	\$33.6	N/A	10%	72%	18%
Iterro.	Aquaculture	\$25.0	N/A	1%	16%	83%
Downforce Technologies	Drones & imagery analytics	\$0.6	N/A	2%	67%	31%
SPREAD	Indoor growers	\$29.3	\$72.1	N/A	N/A	N/A
SemiosBio Technologies	Field IoT, plant biotech	\$16.0	N/A	59%	35%	6%
Pursell	Plant biotech	\$25.2	N/A	4%	41%	55%
PredaSAR	Drones & imagery analytics	\$25.0	\$90.0	N/A	N/A	N/A
Greeneye Technology	Robotics & smart field equipment	\$1.0	N/A	22%	70%	8%
Agtonomy	Robotics & smart field equipment	\$22.5	N/A	15%	61%	24%
IrriGreen	Robotics & smart field equipment	\$5.8	\$5.7	3%	86%	11%

Source: PitchBook • Geography: Global • *As of December 31, 2023
 Note: Probability data based on [PitchBook VC Exit Predictor methodology](#).



VC ACTIVITY

Top early-stage VC-backed agtech companies by total VC raised to date*

Company	Category	VC (\$M) raised to date	Post-money valuation (\$M)	IPO probability	M&A probability	No exit probability
Plant-Ag	Indoor growers	\$900.0	N/A	N/A	N/A	N/A
Zhongxin Breeding	Animal biotech	\$338.7	\$1,230.8	N/A	N/A	N/A
Atlas Agro	Plant biotech	\$333.0	N/A	40%	46%	14%
Colossal Laboratories & Biosciences	Animal biotech	\$80.0	\$245.0	55%	37%	8%
Re:Ocean	Aquaculture	\$222.3	N/A	17%	36%	47%
Maihuolang Information Technology	Agribusiness marketplaces	\$150.0	N/A	N/A	N/A	N/A
FJ Dynamics	Robotics & smart field equipment	\$130.9	N/A	N/A	N/A	N/A
Synspective	Drones & imagery analytics	\$32.3	\$87.8	7%	76%	17%
Pairwise	Plant biotech	\$25.0	N/A	34%	14%	52%
E-ctare	Finance & insurance	\$114.6	N/A	N/A	N/A	N/A

Source: PitchBook • Geography: Global • *As of December 31, 2023
 Note: Probability data based on [PitchBook VC Exit Predictor methodology](#).



VC ACTIVITY

Top late-stage VC-backed agtech companies by total VC raised to date*

Company	Category	VC (\$M) raised to date	Post-money valuation (\$M)	IPO probability	M&A probability	No exit probability
Solugen	Biomaterials	\$50.7	\$90.0	50%	43%	7%
Pivot Bio	Plant biotech	\$87.4	\$200.0	15%	51%	34%
Bowery	Indoor growers	\$137.5	\$341.0	52%	39%	9%
InnovaFeed	Insect farming	\$0.1	N/A	75%	23%	2%
Little Leaf Farms	Indoor growers	\$20.0	N/A	19%	70%	11%
Ninjacart	Agribusiness marketplaces	\$362.8	\$756.8	16%	73%	11%
Frubana	Agribusiness marketplaces	\$102.0	N/A	8%	54%	38%
Pure Harvest Smart Farms	Indoor growers	\$89.3	N/A	38%	47%	15%
DNA Script	Plant biotech	N/A	N/A	83%	11%	6%
Capella Space	Drones & imagery analytics	\$254.0	\$320.0	12%	83%	5%

Source: PitchBook • Geography: Global • *As of December 31, 2023
 Note: Probability data based on [PitchBook VC Exit Predictor methodology](#).



VC ACTIVITY

Top venture-growth VC-backed agtech companies by total VC raised to date*

Company	Category	VC (\$M) raised to date	Post-money valuation (\$M)	IPO probability	M&A probability	No exit probability
Indigo	Plant biotech, agribusiness marketplaces	\$163.6	\$609.1	97%	1%	2%
Farmers Business Network	Agribusiness marketplaces, farm management software, finance & insurance	\$369.3	\$1,075.0	79%	19%	2%
Plenty	Indoor growers	\$226.0	\$500.0	64%	34%	2%
Apeel Sciences	Plant biotech	\$110.0	\$420.0	93%	5%	2%
Ynsect	Insect farming	\$9.7	\$19.3	68%	30%	2%
Inscripta	Plant biotech	\$134.5	\$270.0	92%	6%	2%
Inari	Plant biotech	\$55.0	\$165.0	90%	8%	2%
Synthego	Plant biotech	\$159.5	\$310.0	97%	1%	2%
eFishery	Aquaculture	\$23.8	\$89.3	86%	10%	4%
Gotham Greens	Indoor growers	\$129.9	\$262.0	70%	21%	9%

Source: PitchBook • Geography: Global • *As of December 31, 2023
 Note: Probability data based on [PitchBook VC Exit Predictor methodology](#).



VC ACTIVITY

Most active investors in agtech accelerator deals in 2023*

Investor	Deal count
Thrive - SVG Ventures	26
Cultivator	12
EIT Food	11
RootCamp	6
gener8tor	6
Tech Incubator Program for Startups	5
National Science Foundation	5
Google for Startups Accelerator	5
VentureWell	4
Remove	4
European Innovation Council Fund	4

Source: PitchBook • Geography: Global • *As of December 31, 2023

Top VC investors in agtech companies in 2023*

Investor	Deal count	Pre-seed/seed	Early-stage VC	Late-stage VC
European Innovation Council Fund	14	1	2	6
SOSV	12	7	0	3
Yield Lab	10	0	2	7
AgFunder	10	5	2	2
Conexus Venture Capital Fund	9	3	1	3
Ag Ventures Alliance	8	2	4	1
Serra Ventures	8	2	0	5
Grit Road Partners	7	4	2	1
Lowercarbon Capital	7	1	2	3
Techstars	7	2	1	0

Source: PitchBook • Geography: Global • *As of December 31, 2023



VC ACTIVITY

Top PE investors in agtech companies since 2021*

Investor	Deal count	Primary investor type
Unigrains	7	PE/buyout
Sofiproteol	6	PE/buyout
HarbourVest Partners	6	PE/buyout
Sofina	5	Growth/expansion
Altas Partners	4	PE/buyout
Hellman & Friedman	4	PE/buyout
AlpInvest Partners	4	PE/buyout
Cibus Capital	3	Growth/expansion
Mérieux Equity Partners	3	PE/buyout
Forage Capital Partners	3	PE/buyout
The Carlyle Group	3	PE/buyout

Source: PitchBook • Geography: Global • *As of December 31, 2023

Top strategic acquirers of agtech companies since 2021*

Investor	Deal count	Investor type
CNH Industrial	5	Corporation
Hydrofarm	5	Corporation
Deveron	5	Corporation
De Sangosse	4	PE-backed company
GrowGeneration	4	Corporation
Zoetis	4	Corporation
John Deere	4	Corporation
Biobest Group	4	PE-backed company
Hub International	4	PE-backed company

Source: PitchBook • Geography: Global • *As of December 31, 2023



Emerging opportunities

Digital twins

The transformative potential of digital twins in modern agriculture.



Digital twins

Overview

In the rapidly evolving landscape of modern agriculture, digital twins are an emerging opportunity that may revolutionize the industry. At the core of this innovation lies the concept of creating virtual replicas of tangible elements within the agricultural ecosystem, ranging from fields and crops to machinery and livestock. Digital twins in agriculture function as dynamic and data-driven simulations, providing farmers with unprecedented insights into the intricacies of their operations.

Digital twins in agriculture transcend mere representations; they are living, evolving simulations that mirror the real-time conditions of the farm. These virtual models incorporate a plethora of data, ranging from soil quality and weather patterns to the health status of crops and the operational efficiency of machinery. This dynamic representation empowers farmers with a holistic view of their agricultural landscape, facilitating informed decision-making and precision management strategies.

Use cases

- **Precision farming:** The application of digital twins in precision farming involves a granular analysis of the farming environment. Real-time insights into soil attributes, weather conditions, and crop health enable farmers to fine-tune their practices, optimizing resource utilization and ultimately enhancing productivity.
- **Crop monitoring & management:** Digital twins provide farmers with a virtual observatory for monitoring crop development, identifying potential issues, and strategizing management interventions. From predicting growth patterns to assessing disease risks, this application aids in maximizing crop yields and quality.
- **Climate resilience & risk management:** By simulating diverse climate scenarios, digital twins empower farmers to proactively manage risks associated with weather fluctuations, pests, and diseases. This forward-looking approach enhances the resilience of agricultural operations in the face of unpredictable challenges.
- **Machinery optimization:** Integrating digital twins into agricultural machinery allows farmers to simulate and optimize equipment performance. This includes monitoring machinery health, predicting maintenance needs, and ensuring the efficient operation of farm equipment.
- **Supply chain optimization:** Digital twins extend their influence beyond the farm gate, offering a comprehensive view of the entire supply chain. Farmers can optimize inventory management, track the journey of crops from cultivation to market, and streamline logistics for enhanced efficiency.

Startups leading the disruption

- **AGERpoint:** An agtech company that specializes in providing innovative solutions for precision agriculture. Its Capture app creates digital twins of crops using cameras, LiDAR, and GPS data to enable users to understand plant health, yield, and biodiversity.
- **MentorMate:** A subsidiary of [TietoEVRY](#), [MentorMate](#) is a global digital consultancy that develops digital solutions for a variety of industries, including agriculture. It develops digital twins to create solutions to complex agricultural challenges and answer, “how might we” and “what if” questions.
- **Native AI:** A market intelligence platform that incorporates agricultural, consumer, and market data. It uses digital twins, GenAI, and other tools to provide market insights.
- **Digital Twin Corporation:** A software platform using Internet of Things (IoT) technology and digital twins to help agricultural producers and exporters identify waste generating failure



DIGITAL TWINS

points along a supply chain and use predictive analytics to reduce future waste.

- **NatureDots:** A platform that applies deep data analytics to fish farms to create digital twins of fisheries. Use cases include aquaculture, freshwater, coastal, and marine.
- **Taranis:** An agtech startup that focuses on precision agriculture through aerial imagery, AI, and data analytics. It uses digital twin concepts to optimize farm management practices and improve yields.

Challenges and opportunities

- **Data integration and interoperability:** Integrating diverse data sources into a unified digital twin platform can be challenging. Achieving interoperability between different systems and ensuring seamless data flow remains a hurdle.
- **Data security and privacy:** As digital twins involve handling sensitive farm data, ensuring robust cybersecurity measures and addressing privacy concerns are critical challenges that need to be addressed.
- **Innovation in farming practices:** Digital twins pave the way for innovative farming practices, allowing farmers to experiment with new techniques and technologies in a virtual environment before implementing them on the field.
- **Enhanced decision-making:** The data-driven insights provided by digital twins empower farmers to make informed decisions, leading to improved productivity, resource efficiency, and sustainable agricultural practices.

Outlook

The outlook for digital twins in agriculture is undeniably promising. As the technology matures, overcoming challenges related to data integration and security, digital twins are poised to become indispensable tools for modern farming. Ongoing advancements in AI, machine learning, and IoT technologies will further amplify the capabilities of digital twins, providing farmers with powerful and adaptive solutions to navigate the complexities of contemporary agriculture. In essence, digital twins are not merely technological innovations; they represent a fundamental shift in how we perceive, understand, and cultivate the future of farming.



Select company highlights



SELECT COMPANY HIGHLIGHTS: APHEA.BIO



Overview

[Apeha.Bio](#) is a spin-off of [Ghent University](#), the [Vlaams Instituut voor Biotechnologie](#), and [KU Leuven](#). It is an agricultural biotechnology company that specializes in developing and commercializing biological products to enhance crop yield and quality. [Apeha.Bio](#) has a focus on leveraging microbiome research to develop sustainable solutions for agriculture. The company's core offerings include biopesticides, biostimulants, and other biological products designed to improve crop health, yield, and resilience to environmental stressors. It has over 30 products in its pipeline.

Leadership

The leadership team at [Apeha.Bio](#) is uniquely positioned to steer the company forward, leveraging their diverse backgrounds and expertise in biotechnology and sustainable chemistry. Isabel Vercauteren, the co-founder and CEO, brings a strong background in research & development (R&D), technology licensing, and new venture management, thus enabling her to effectively navigate the complexities of the industry and drive strategic growth initiatives. Her leadership is complemented by Steven Vandenabeele, the co-founder and chief technology officer, whose extensive background in molecular biology and plant biotechnology showcases his capability to lead the company's R&D efforts. With their combined expertise, the leadership team at [Apeha.Bio](#) demonstrates a capacity to pioneer groundbreaking solutions in the agricultural sector, placing the company at the forefront of sustainable innovation in the industry.

Key company information

Founded
2017

Total raised
\$122.5M over five deals

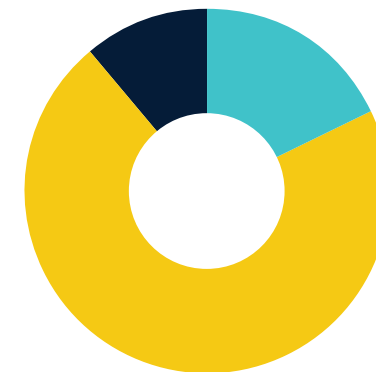
Last disclosed financing
Raised \$76.4M of Series C funding, valuation undisclosed (July 2023)

Employees
55+

First disclosed institutional round
Raised \$10.1M in Series A funding, valuation undisclosed (June 2017)

Lead investor(s)
Innovation Industries and Korys Investments

Exit Predictor



■ **IPO:** 18% probability ■ **M&A:** 71% probability ■ **No exit:** 11% probability
Success: 89% probability

Note: Probability data based on [PitchBook VC Exit Predictor methodology](#).



SELECT COMPANY HIGHLIGHTS: APHEA.BIO

Competitors

[Apha.Bio](#) operates in a congested field of ag biologicals. We have logged over 430 companies producing biostimulants or biopesticides. Many of these companies are pre-commercialized, making comparisons challenging. Key VC-backed biostimulant producers include [Indigo](#), [Sound](#), and [NewLeaf Symbiotics](#). Key VC-backed biopesticide producers include [AgBiome](#), [Invaio](#), and [Vestaron](#). Major incumbents in the space include [BASF](#) and [Bayer](#). These agrochemical companies have expanded into biologicals through acquisition and organic growth.

Financing history

Series A	Early-stage VC	Series B	Series B	Series C
June 16, 2017	March 28, 2019	April 14, 2021	January 12, 2022	July 11, 2023
Total raised \$10.1M	Total raised \$3.4M	Total raised \$21.3M	Total raised \$12.8M	Total raised \$76.4M
Pre-money valuation \$N/A	Pre-money valuation \$6.9M	Pre-money valuation N/A	Pre-money valuation \$22.0M	Pre-money valuation N/A
Investor(s) V-Bio Ventures	Investor(s) N/A	Investor(s) Astanor Ventures	Investor(s) N/A	Investor(s) Astanor Ventures



SELECT COMPANY HIGHLIGHTS: HALTER



Overview

[Halter](#) is focused on precision livestock farming to improve efficiency, sustainability, and animal welfare. The company was founded with a vision to revolutionize the way beef and dairy farming is conducted, leveraging cutting-edge technologies to transform traditional practices.

[Halter's](#) flagship offering is a unique collar system equipped with advanced technologies designed to provide farmers with unprecedented control and insights into their livestock. The collar, worn by each animal, is equipped with GPS, motion sensors, and audio cues, allowing for virtual fencing and the remote and automated management of cattle.

Leadership

[Halter's](#) leadership team is strategically composed of young professionals with diverse expertise, driving the company's success in livestock management technology. It is led by CEO Craig Piggott, who founded the company after spending nine months getting a taste for startup life at [Rocket Lab](#)—his first role upon graduation from university. Working alongside Piggott, Chief Operating Officer Mark MacLeod-Smith leverages his experience in leadership roles at startup accelerators including [The IceHouse](#), [Lightning Labs](#), and [Flux Accelerator](#).

Key company information

Founded
2016

Total raised
\$103.4M over four deals

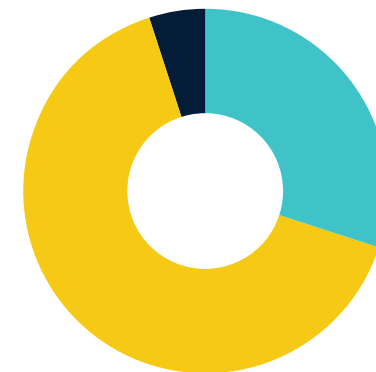
Last financing
Raised \$50.0M in Series C funding at a \$235.0M pre-money valuation (March 2023)

Employees
160+

First institutional round
Raised \$5.4M of Series A funding at a \$21.0M pre-money valuation (July 2018)

Lead investor(s)
Battery Ventures and Bessemer Venture Partners

Exit Predictor



■ **IPO:** 30% probability ■ **M&A:** 65% probability ■ **No exit:** 5% probability
Success: 95% probability

Note: Probability data based on [PitchBook VC Exit Predictor methodology](#).



SELECT COMPANY HIGHLIGHTS: HALTER

Competitors

[Halter](#) operates in a small but competitive landscape, contending with other virtual fencing and livestock collar companies that employ advanced technologies to monitor and manage cattle. One of the largest competitors [Vence](#) uses a solar-powered base station and smart collars to monitor herd location. The company became an operating subsidiary of [Merck Animal Health](#) after being acquired in September 2022. Rival [Nofence](#) also employs a smart collar. It uses audio cues to keep herds within virtual paddocks. A mobile app allows ranchers to monitor herds and create, edit, and remove pastures. Other key providers include [Ixorigue](#) and [Cowlar](#).

Financing history

Series A	Series B	Series B	Series C
July 2, 2018	April 23, 2021	December 3, 2021	March 29, 2023
Total raised \$5.4M	Total raised \$23.0M	Total raised \$25.0M	Total raised \$50.0M
Pre-money valuation \$21.0M	Pre-money valuation \$60.0M	Pre-money valuation \$144.0M	Pre-money valuation \$235.0M
Investor(s) Promus Ventures	Investor(s) Blackbird Ventures	Investor(s) N/A	Investor(s) Battery Ventures and Bessemer Venture Partners

About PitchBook Industry and Technology Research

Independent, objective, and timely market intel

As the private markets continue to grow in complexity and competition, it's essential for investors to understand the industries, sectors and companies driving the asset class.

Our Industry and Technology Research provides detailed analysis of nascent tech sectors so you can better navigate the changing markets you operate in—and pursue new opportunities with confidence.

©2024 by PitchBook Data, Inc. All rights reserved. No part of this publication may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, and information storage and retrieval systems—without the express written permission of PitchBook Data, Inc. Contents are based on information from sources believed to be reliable, but accuracy and completeness cannot be guaranteed. Nothing herein should be construed as any past, current or future recommendation to buy or sell any security or an offer to sell, or a solicitation of an offer to buy any security. This material does not purport to contain all of the information that a prospective investor may wish to consider and is not to be relied upon as such or used in substitution for the exercise of independent judgment.

PitchBook Data, Inc.

John Gabbert Founder, CEO

Nizar Tarhuni Vice President, Institutional Research and Editorial

Paul Condra Head of Emerging Technology Research

Additional research

Eric Bellomo
eric.bellomo@pitchbook.com
Gaming
E-Commerce

Brendan Burke
brendan.burke@pitchbook.com
Internet of Things
Information Security
Artificial Intelligence & Machine Learning

Aaron DeGagne
aaron.degagne@pitchbook.com
Medtech
Digital Health

Alex Frederick
alex.frederick@pitchbook.com
Agtech
Foodtech

Jonathan Geurkink
jonathan.geurkink@pitchbook.com
Supply Chain Tech
Mobility Tech

Kazi Helal
kazi.helal@pitchbook.com
Biopharma
Pharmatech

Derek Hernandez
derek.hernandez@pitchbook.com
Enterprise SaaS
Infrastructure SaaS

Ali Javaheri
ali.javaheri@pitchbook.com
Emerging Spaces

Robert Le
robert.le@pitchbook.com
Insurtech
Crypto

John MacDonagh
john.macdonagh@pitchbook.com
Carbon & Emissions Tech
Clean Energy Tech

Rebecca Springer
rebecca.springer@pitchbook.com
Healthcare Services
Healthcare IT

Rudy Yang
rudy.yang@pitchbook.com
Enterprise Fintech
Retail Fintech