BENORI

Understanding the Controlled Environment Agriculture (CEA) Seeds Genetics Market in NA

Benori Sample

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Market definition

The CEA seeds market in the USA and Canada is consolidated in the high-tech greenhouses by end-use

Market Definition

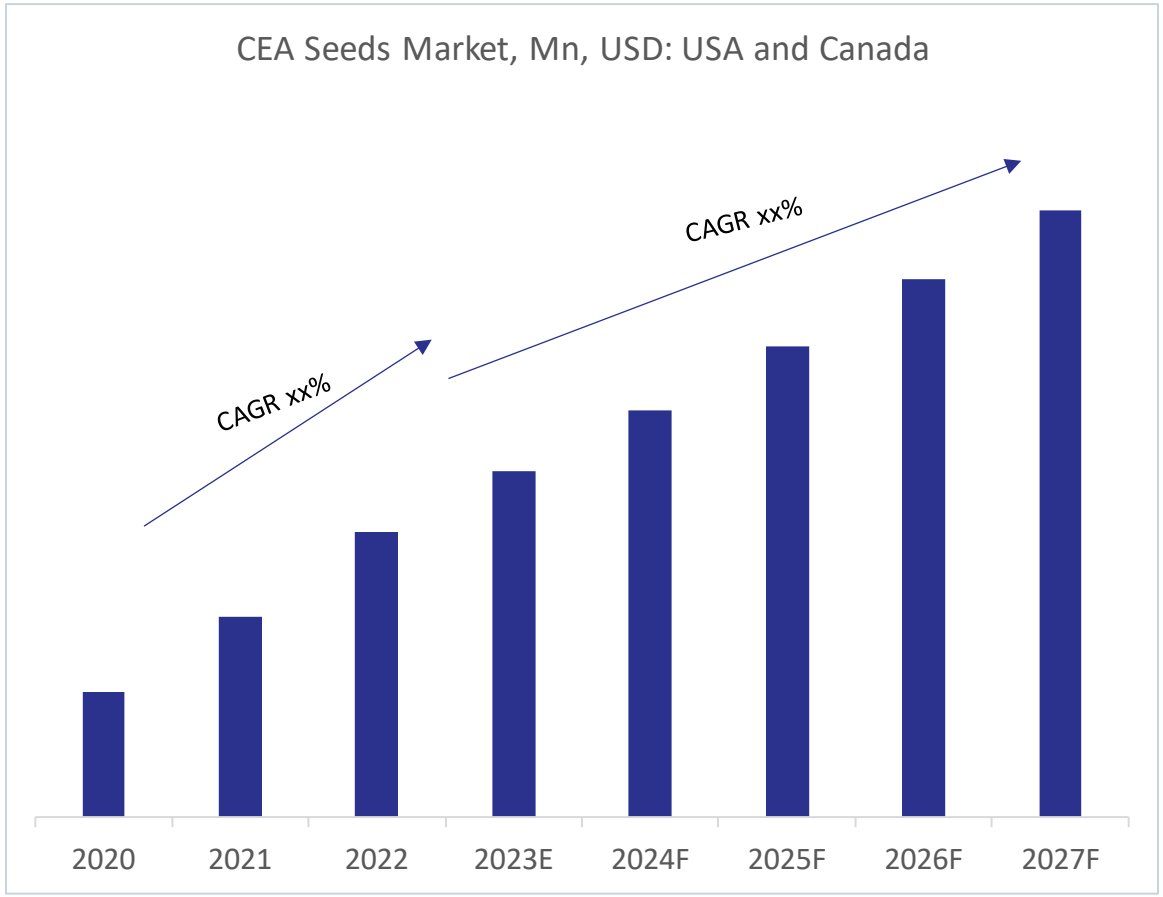
Controlled environment agriculture involves cultivating crops with regulated environmental conditions to minimize pests or diseases, enhance efficiency, promote sustainability, and boost yield.

The industry can be categorized based on different types of growing environments, such as:

Relevance	Categories		Definition
	High tech greenhouse	Greenhouse	Glass or polycarbonate structures utilizing sunlight.
	Mid tech greenhouse		
	Low tech greenhouse		
	Indoor farming including vertical farms		Crop production utilizing supplemental lighting.
	Protected cropping		Crops that are grown outdoors with some protection against the elements like rain.

CEA seeds market in the USA and Canada is likely to see a steady growth

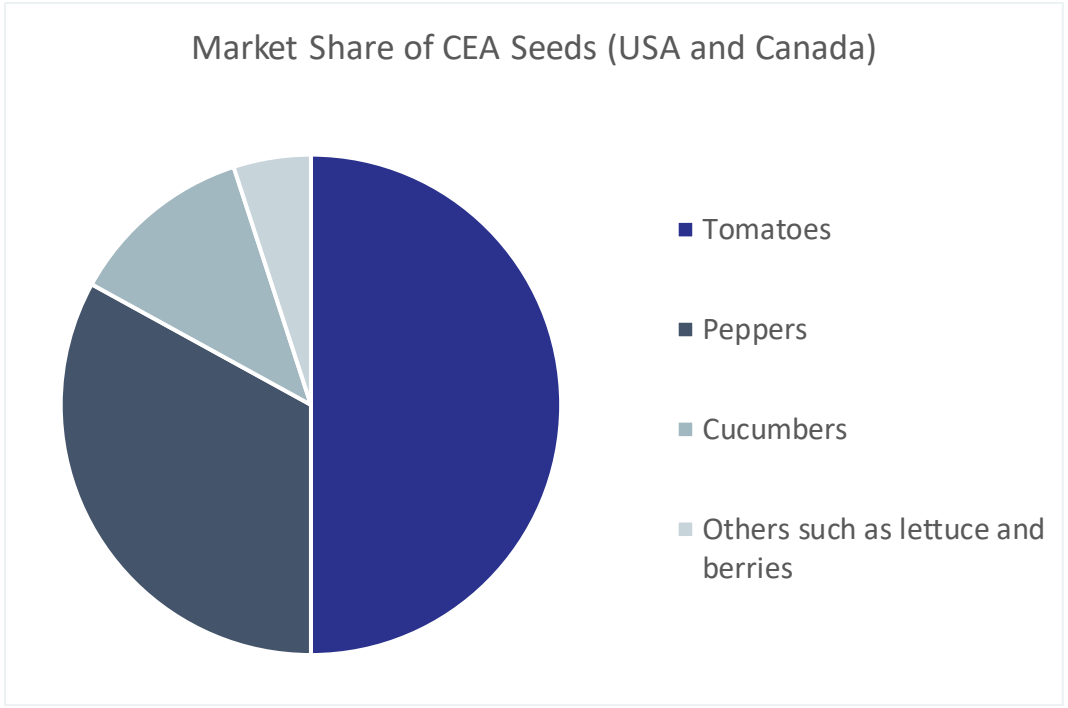
While the growth rate has slowed compared to previous years, increasing investments and the rising interest of growers in increasing yield per hectare will generate increased demand for the CEA seeds market



- *An increase in per capita consumption, support from the government, investments in the market, and rising interest of growers in increasing their yield per hectare are some factors that will drive this market*
- *In the USA and Canada, the majority of the CEA seeds market is driven by growers with high-tech greenhouse solutions. Completely vertical farms only account for ~xx% of the overall CEA farming*
- *The slow growth owes to the ToBRFV virus which is impacting the tomato seed market*

Tomatoes and peppers collectively constitute over xx% of the CEA seeds market

The USA vegetable market is mostly import-oriented and get their vegetables from Canada during the summers and from Mexico during the winters



- *The cucumber is anticipated to grow the fastest in the coming years followed by tomatoes and peppers*
- *In the pepper segment, sweet pepper will be the slowest growing category*

Some of the challenges leading to slower rate of growth are

Determining and prioritizing the traits and qualities that hold greater significance for indoor cultivators, consistently incorporating feedback to meet the requirements and decrease in lucrativeness for the growers' segment due to a rise in electricity cost

Forecasting requirements

01

- Choosing which traits to breed in CEA is a multifaceted challenge due to the **wide-ranging needs of growers in this diverse landscape**
- [illegible]

Rising cost of electricity

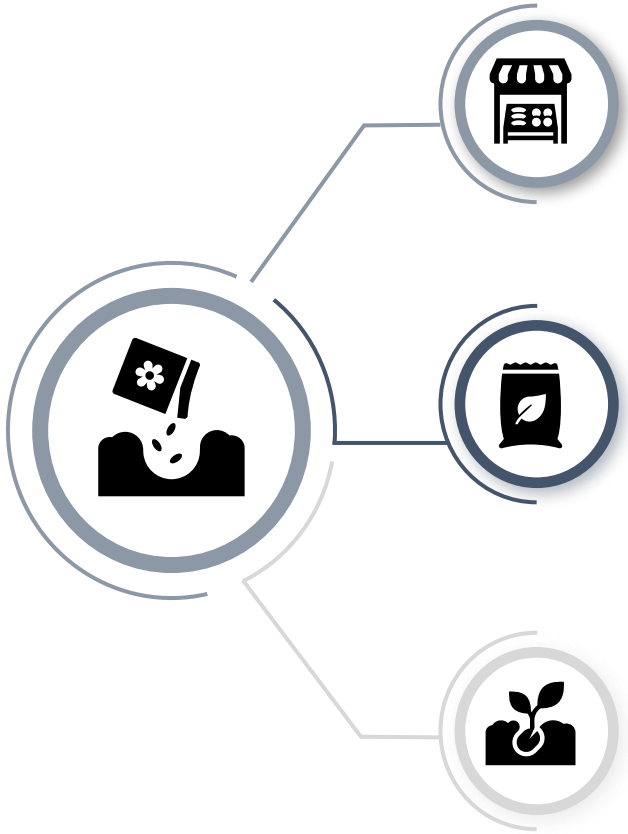
02

- **Rising costs of energy have reduced the lucrativeness of completely indoor farms in the USA and Canada**
- [illegible]

Sources: Challenge, Data Sharing, Expert Inputs

Technologies used in CEA seeds market majorly focus on yield, taste, and size enhancements

Different technologies include nano-priming and CRISPR



Yield

- **Nano-priming** is an emerging technology that holds great potential as a seed-priming technique, effectively enhancing seeds germination, yield, and plant growth through the utilization of nanoparticles
- It achieves this by facilitating **increased water absorption** and triggering the formation of **nanopores** on the shoot, which **activates reactive oxygen species**

Taste

- **CRISPR** is a gene-editing technology, which can be used to modify different parts of a genome to bring changes to yield, quality etc. but is currently being used to by a company called Pairwise to modify tastes in tomatoes to make them tastier
- **Sound Agriculture**, a company based in the United States, employs **epigenetics** to enhance the flavor of tomatoes by manipulating gene expression rather than altering the genes themselves
- **Epigenetic modifications** provide valuable markers that enhance the breeding process, consider the diversity of the epigenome to predict plant performance, and ultimately **boost production**

Size

- Researchers utilize a method known as **genetic screening** to pinpoint various controllers of seed size
- They have employed technologies like **genome-wide association** and **RNA** sequencing to explore variations in seed size

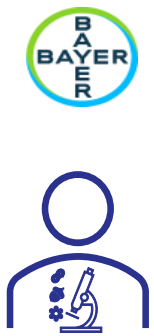
Sources: Scientific American, Frontiers, NCBI, Jnanobiotechnology

Major competitors in the market include

Large diversified entities, exclusive seed players, and various smaller participants. All these stakeholders are expanding their presence in the sector through collaborative efforts

Diversified Players

Players engaged in various industries along with seed development and production.

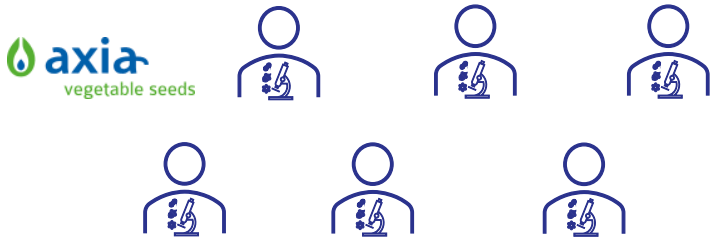


Pure Play Seed Players

Players concentrated on the seed industry and engaged in activities like production, breeding, and seed distribution.

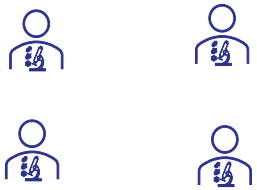
Large Players

Entities that have a substantial portion of the seed industry and possess a significant global presence.



Small Players

Emerging or small companies with a focus on specific regions.



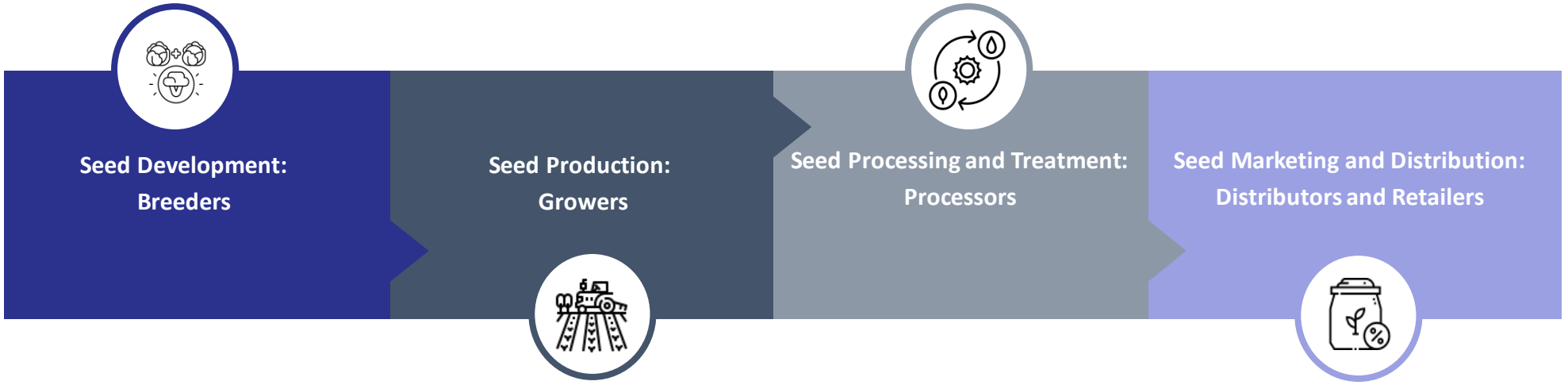
Majority of players catering to the CEA seeds segment are

- Big players like **Bayer are utilizing their extensive networks** around the world to grow their indoor seed segment
- Startups like Vindara and public-private partnerships like Precision Indoor Plants (PIP) Consortium are launched to focus on breeding specifically for indoor farming
- Smaller seed companies such as Johnny's Selected Seeds are acting in the market as **they focus on certain niche crop varieties including snack varieties of tomatoes and cucumbers** that are not the focus of large companies along with other categories such as leafy greens and berries
- Johnny's Selected Seeds has their own retail function in the company

Sources: Benori Analysis, Expert Inputs

Seeds value chain

A company may focus on one or multiple aspects of this value chain, selling or licensing its products and services to or from other firms in the chain



Share of attribute in seed cost	**xx%**	**xx%**	**xx%**

- **Breeders supply foundation seeds** (parent seeds stock derived from the original seeds created by plant breeders) to growers. These foundation seeds are used to generate additional foundation seeds for ongoing R&D or registered seeds for large-scale production. The registered seeds are then contracted to produce certified seeds

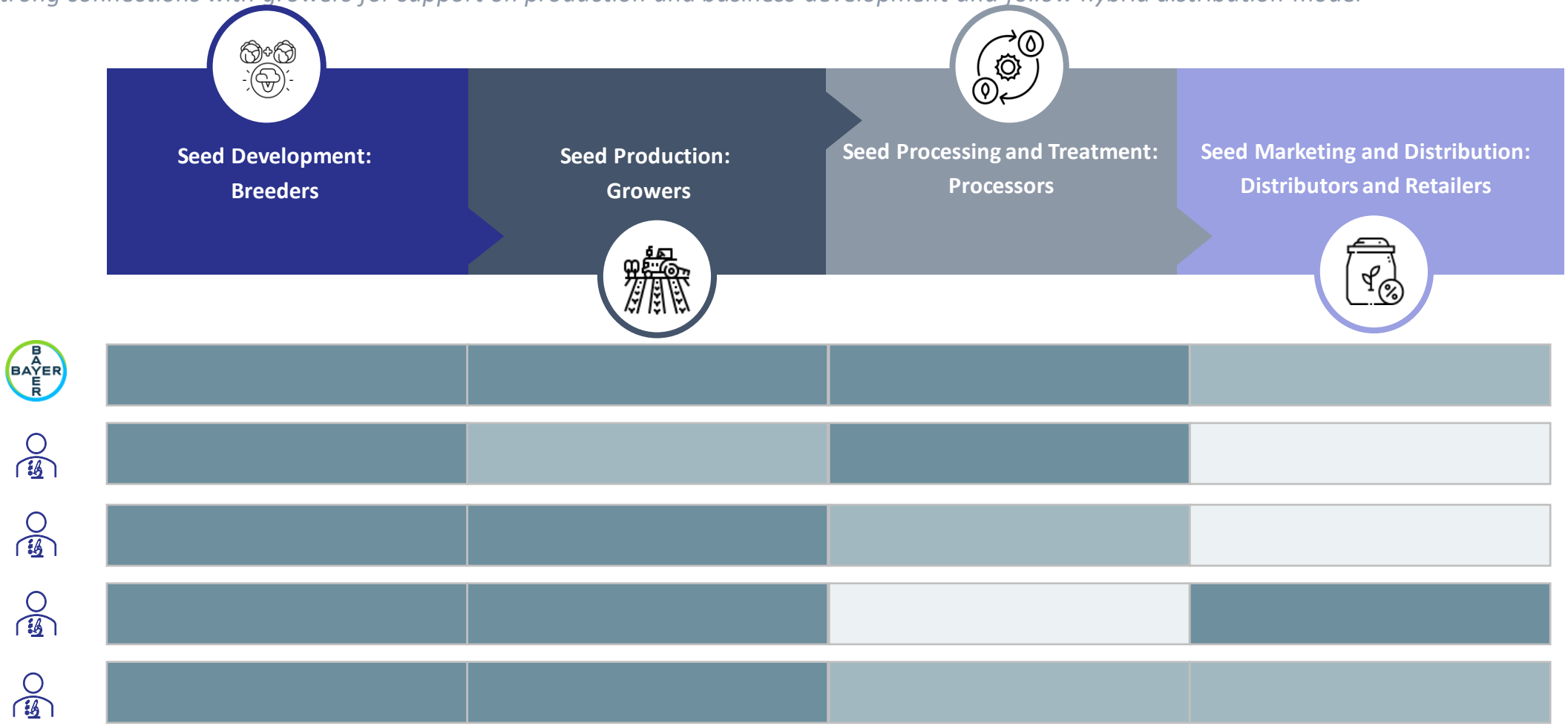
- **Seed firms oversee contract growers** during the production of both registered and certified seeds to guarantee the transmission of desirable plant characteristics to future generations
- A portion of the seeds is redirected to the seed companies for resale

- **Seed processing and treatment:** It includes sorting, drying, treatment, etc.. The seeds are further processed in-house by the seed companies or outsourced as needed

- **Seed marketing and distribution**: Major vegetable breeding companies frequently take an active role in marketing and distributing their final products in regional, national, and global markets. Some firms might license or outsource these activities to private firms and individuals to improve access to local markets

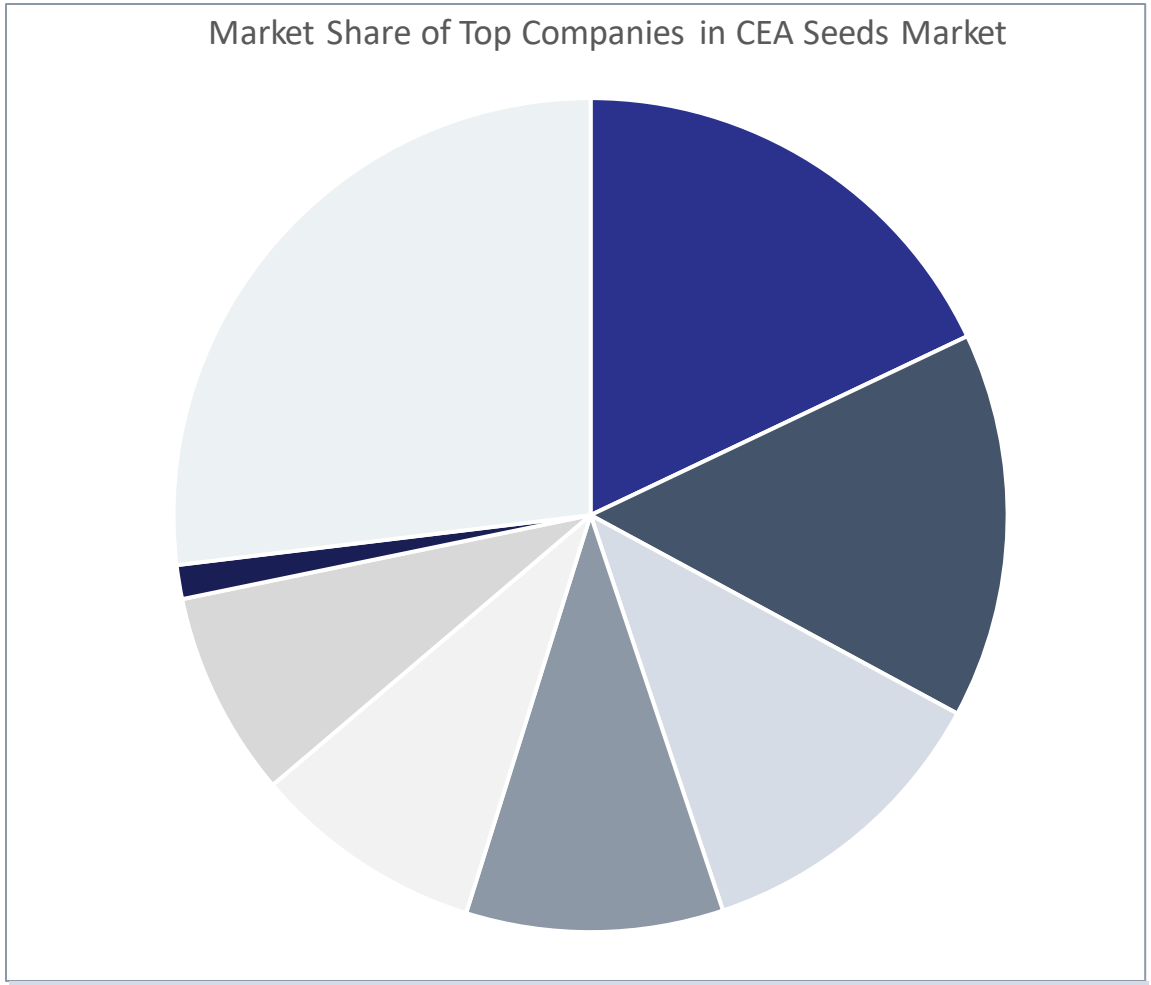
Players’ presence across the value chain

Axia collaborates with seed producers for production and works with local distributors for retail, whereas other companies have comparatively strong connections with growers for support on production and business development and follow hybrid distribution model



Top five players in the market account for xx% of the market share

Bayer Crop Science and XX are two big players in the North American CEA seeds market having more than xx% market share each



North American (USA + Canada) CEA seeds Market

~xx Mn USD

Market share of companies in crop segments:

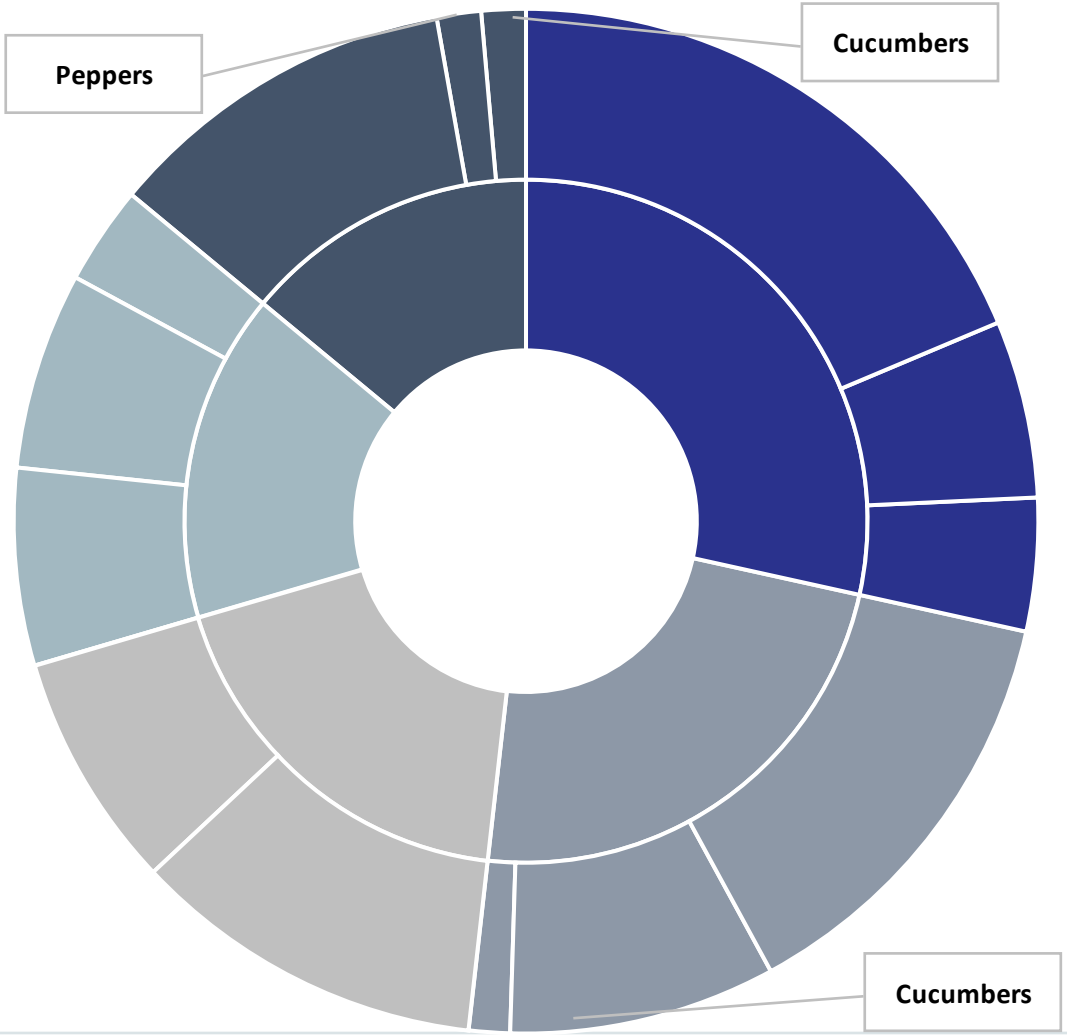
Companies/ Crops	BAYER				
	xx%	xx%	xx%	xx%	xx%
	xx%	xx%	xx%	xx%	xx%
		xx%	-	xx%	xx%

High (above xx%)	Medium (above xx%)	Low (Below xx%)

Bayer Crop Science, XX, and XX have diversified portfolios

Whereas XX's portfolio is consolidated and dependent on the growth of xx

Value of Crop Contribution to Revenue in USD Mn (Top 5 companies)



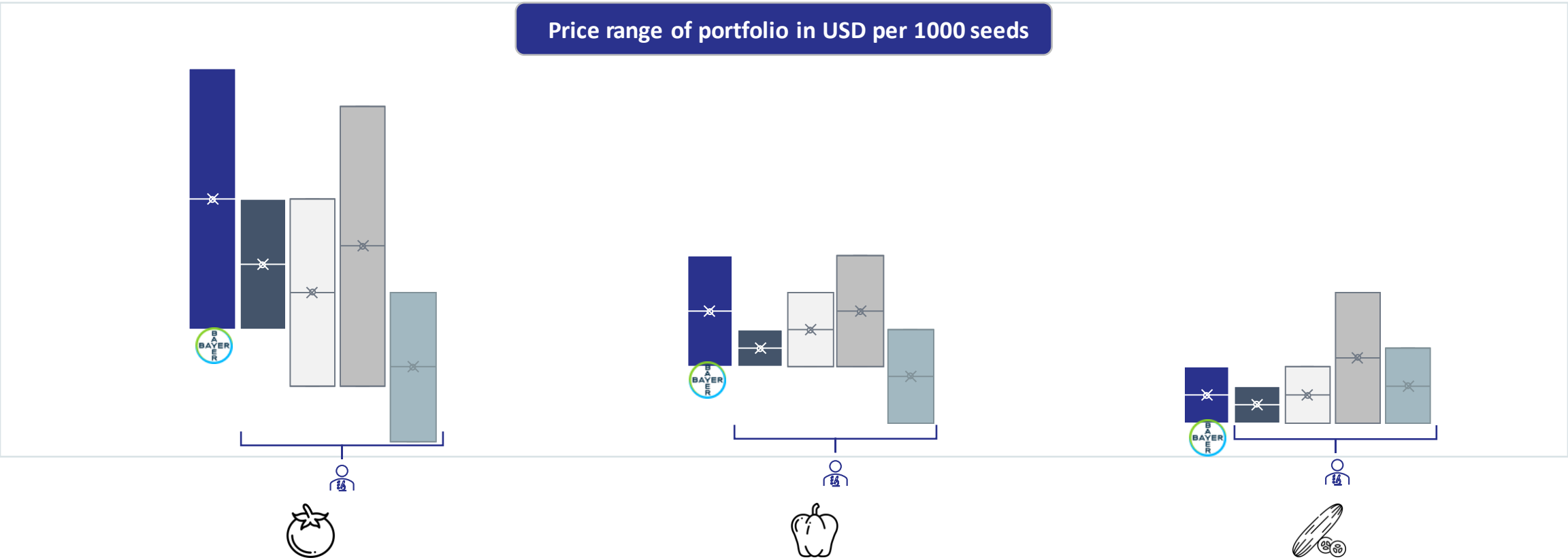
% of Crop Contribution to Revenue

Companies/ Crops	BAYER				
	~xx%	~xx%	~xx%	~xx%	~xx%
	~xx%	~xx%	~xx%	~xx%	~xx%
	~xx%	~xx%	-	~xx%	~xx%

In terms of market share in the tomato segment, XX lies in the top three players. However, in comparison to larger players like Bayer Crop Science and XX, **Axia's portfolio is predominantly reliant on xx**, while the latter companies have more diversified and sustainable revenue streams.

Price range comparisons

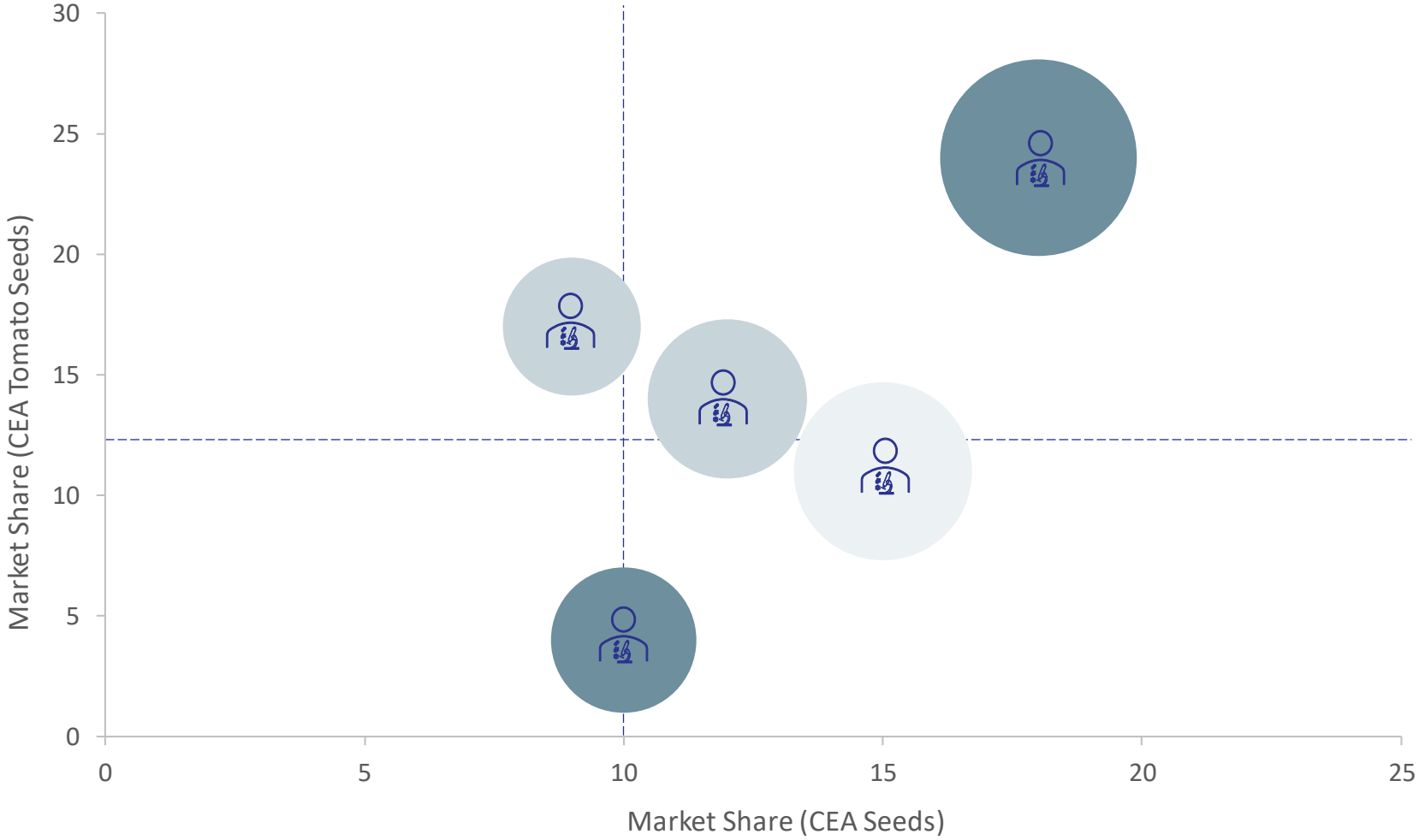
Although XX have the largest number of varieties, Bayer's tomato portfolio is more spread out in terms of price



- XX has priced its tomatoes on the higher side as it majorly deals in specialty tomatoes
- In contrast, XX , XX, and XX have price ranges on the lower side as they have comparatively lesser number of varieties and are dealing in cheaper varieties of tomatoes

Comparative assessment of players based on their market share and strategic focus

XX holds the second highest position in the tomato segment



Strategic Focus

Strategic focus is a composite indicator that factors in the following parameters:

- Focus on research and development considered as a % of the total revenue
- Partnerships across the value chain
- Global reach
- Strength of product portfolio

Detailed criteria for the rating is explained in the following slide

High	Medium	Low

Company Size

- Area of the circle represents CEA seeds Revenue in Mn USD

Bayer Crop Science has xx% market share in the CEA seeds market in the USA & Canada

~xx% of Bayer Crop Science's CEA seeds revenue comes from tomatoes

Overview:

- Bayer Group, with its **headquarters in Leverkusen, Germany**, consists of **xx consolidated companies**
- Operates in three key segments: **Crop Science, Pharmaceuticals, and Consumer Health Division**
- Crop Science specializes in **crop protection, seeds, traits, and digital farming**
- The indoor production setup is spread globally, and strategically placed for efficiency through its proximity to resources, enhanced market access, and streamlined logistics
- Have seed production sites in South America, Central America, and several in the USA

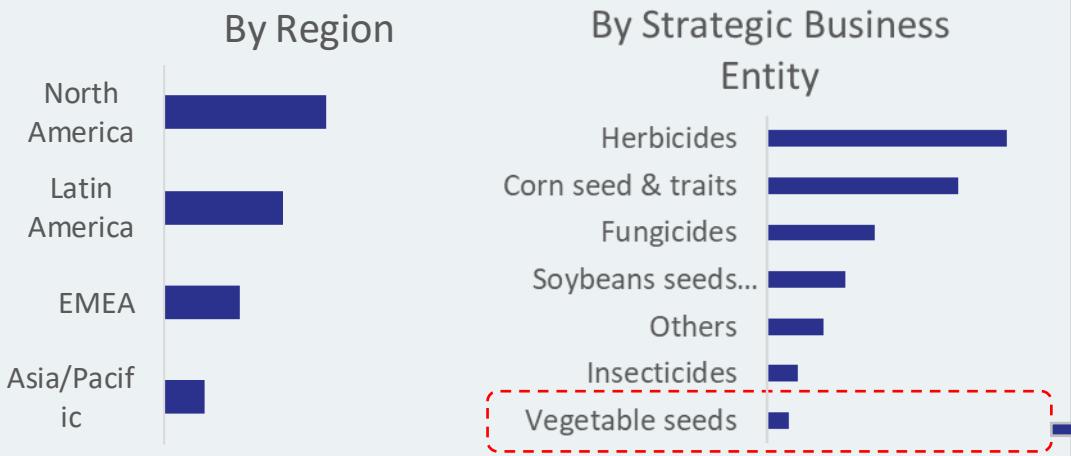
Certifications: GSPP Good seed and plant practices nak tuinbouw

Key Facts	
Geographic reach	xx Countries
Headquarters	Germany
No. of employees	xx
No. of Patents	xx
Production Facilities (CEA)	xx

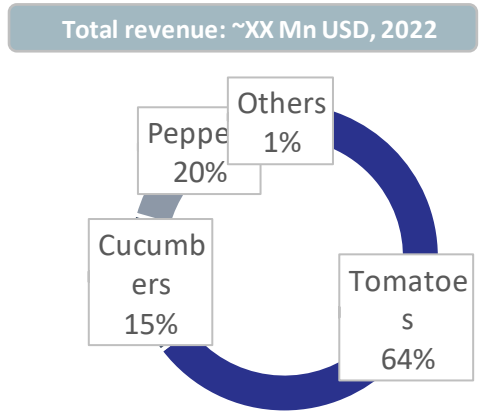
Pricing for CEA Seeds Per 1000 Seeds

- USD xx
- USD xx
- USD xx

Bayer Crop Science Revenue in Bn USD (26.45 Bn)



CEA Seeds Revenue, USA and Canada, Mn USD



Bayer utilizes its robust worldwide distribution network to maintain a leading position

Currently operates in xx. While its current presence in xx is limited, there are expansion plans in place for all these markets

Product Portfolio and Key Solutions

Key Solutions

- **Agriculture Biologicals –** Biocontrols and Biostimulants
- **Crop Protection –** Herbicides, Fungicides and Insecticides
- **Seeds and Traits – seeds** Portfolio, Trait enhancement in genetically modified seeds
- **Digital Farming –** tools such as sensors and UAVs integrating smart data-based solutions

Seed Portfolio

Vegetables		Field crops
• Carrot • Cauliflower • Cucumbers • Eggplant • Gourd • Green bean • Green pea • Lettuce • Melon • Rootstock	• Peppers • Broccoli • Pumpkin • Squash • Tomatoes • Watermelon • Okra • Onion • Bean • Pea	• Millets • Rice (paddy) • Soybean • Wheat • Corn • Cotton • Oilseed • Sugarcane • Beet

Bayer now includes strawberries in its expanded fruits and vegetables business.

Strategic Focus

Research & Development

- R&D investment 2022: **xx Mn USD** which is **xx% of revenue**
- In August 2023, announced the investment of **xx Mn USD in a new R&D facility** at its xx site, making the largest single investment towards their xx business
- **Inaugurated a new facility for xx testing in xx**, the xx, which will help strengthen and accelerate their research for resistant varieties

Key Partnerships

- Partnered with Microsoft for their Bayer AgPowered Services using the Azure data manager platform
- In 2021, collaborated with Pairwise, a food and agriculture company aiming **to enhance corn kernel row numbers by up to xx%,** potentially leading to a substantial increase in yield

Value Proposition

- Robust global distribution network
- Scale of business in North America due to robust R&D and technological capabilities

Customer Relationship

- Long-term contracts with clients and a **xx% retention rate**

Presence across the value chain

Bayer Crop Science is present in all segments of the seed value chain. They are working closely with growers, retailers, and distributors to serve the demands of regional and global markets

	Seed Development	Seed Production	Seed Processing and Treatment	Seed Marketing and Distribution
Activities	• Allocate the **highest annual investment towards research and development** in plant breeding • Use **genome editing** in the development of seeds and microbial products • R&D for genome editing focuses on enhancing **plant architecture, increasing yield, improving quality, and boosting disease resistance, especially in row crops**	• Have **xx facilities for seed production** around the world situated across South America, Central America, and North America	• Use advanced methods like **X-rays and MRI scans in growing and processing seeds** • Have a **crop protection segment** and collaborates with diverse agricultural stakeholders, **committing 5 billion Euros to advance integrated weed management** through a comprehensive, future-oriented approach • Have **implemented integrated pest management** to safeguard against pests	• Created a **Transportation Management System, reducing trucks and optimizing routes for better service** • The indoor production setup is spread globally, strategically placed to access markets and resources • Even though it costs more, they have multiple sites in the **EU for quick seed movement**
Focus				

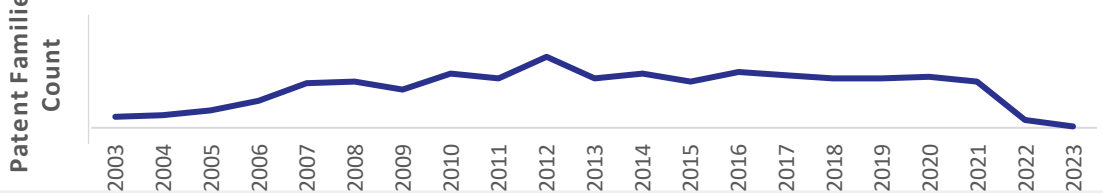
High | Medium | Low

Patent portfolio

Bayer Crop Science has done an extensive research with over xx patent families focusing on hybrid seed varieties; showing an interest in tomato, cucumber and pepper with xx patent families

Patent Families - Filing Trend - Seeds

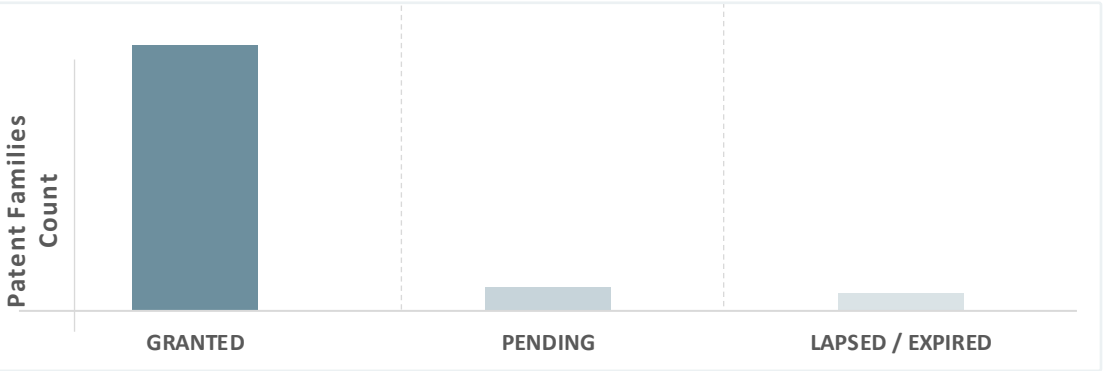
- Bayer Crop Science filed a **total of xx patent families** in the last two decades on greenhouse cultivation with or without mentioning about seeds



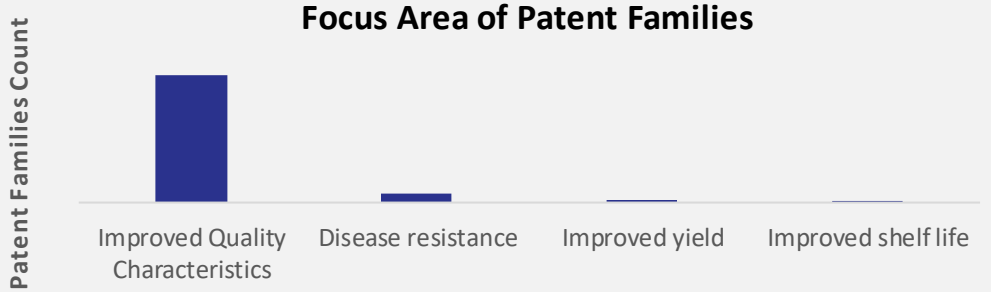
Patents - Geographical Coverage - Seeds

- Research originated from United States
- Most preferred patent filing geographies are WO (xx), EP (xx), AU (xx), CN (xx) and CA (xx)

Patent Families - Legal Status - Seeds



Focus Area – Tomato, Cucumber, Pepper Seeds



CEA ADAPTABLE SEEDS (Tomato, Cucumber & Pepper)

- **xx patent families identified**
- Below varieties are **adapted to greenhouse farming** methods:
  - **Tomato (xx)**
  - **Pepper (xx)**
  - **Cucumber (xx)**

Note: 1. Abbreviations used: CN - China, WO PCT application, EP- Europe, AU-Australia, CA - Canada. Number in parenthesis denotes number of patent families or patent publications wherever applicable

Strategic focus: Parameters and ranks

Parameters		Parameter Weightage	Rating Scale					
R&D	R&D Investment %	15%	Below 20% (1), 20-24% (2), 25-29% (3), 30-35% (4)	2	3	2	3	4
	Patent Strength	15%	No. of patents: Below 100 (1), 100-250 (2), 250-500 (3), 500 and above (4)	1	1	4	2	3
Partnerships		30%	Based on expert inputs on partnerships and relationships across value chain From lowest focus on partnerships and customer relationships (1) to Highest focus on partnerships and customer relationships (4)	4	2	2	4	3
Global Reach		20%	No. of countries: 25 and below (1), 25-50 (2), 50-75 (3), 75 and above (4)	4	3	4	1	4
Product Portfolio		20%	Varieties of seeds: <50 (1), 50-100 (2), 100-150 (3), 150 and above (4)	3	4	1	1	2
Cumulative Rating				**3.05**	**2.6**	**2.5**	**2.35**	**3.15**

High	Medium	Low

Sources: Benori Analysis, Expert inputs

Management team

Xx heads the xx for Bayer Crop Science