SEED TREATMENT INDUSTRY-HISTORICAL PERSPECTIVES

Presented By

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AGENDA

01 STRUCTURAL SHIFT IN SEED TREATMENT TECHNOLOGY

02 SEED TREATMENT TECHNOLOGY – HISTORICAL PERSPECTIVES (1800's to 2000's)

03 SEED TREATMENT MARKET GROWTH TREND

04 CHANGING FOCUS ON PRODUCT INNOVATIONS & OPPORTUNITIES

05 IMPACT OF MERGERS & ACQUISITIONS ON SEED TREATMENT INDUSTRY

06 FUTURE OUTLOOK

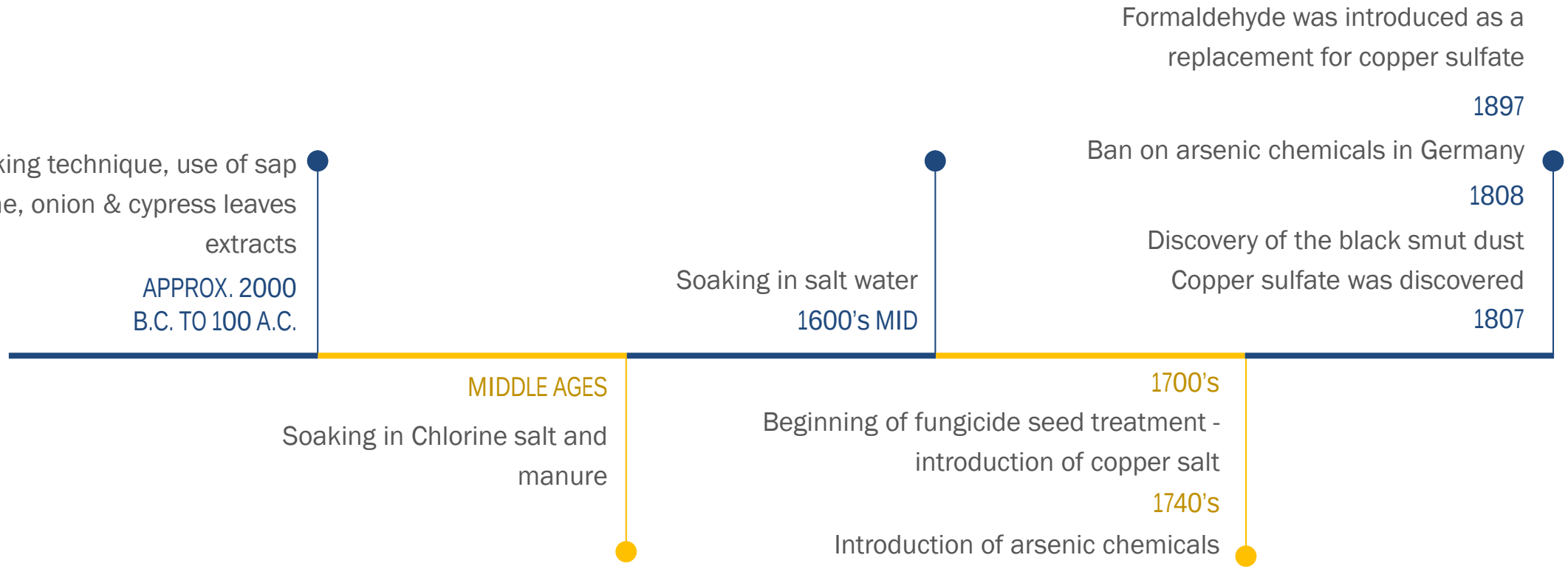
STRUCTURAL SHIFT IN SEED TREATMENT TECHNOLOGY

- Old chemistry
- Imprecise application methods
- High loading rates
- Exposure concerns
- Poor handling formulations

- Highly active and low-rate chemistry
- Better seed treatment formulations & consistent performance
- More precise application equipment
- Introduction of seed coating

- Evolution of agricultural biologicals use in seed treatment
- Combination of chemistry & biologicals
- Commercialization of seed products as yield enhancement products
- Evolution of precision farming concept
- Seed treatment products for abiotic stress tolerance

SEED TREATMENT TECHNOLOGY – HISTORICAL PERSPECTIVE - 1800'S



EVOLUTION, IMPORTANCE, UNDERSTANDING, & BEGINNING OF ADOPTION OF SEED TREATMENT TECHNOLOGY

SEED TREATMENT TECHNOLOGY – HISTORICAL PERSPECTIVE - 1900'S

Introduction of organo-mercurials
1915

1928
The first international rules for testing seed increased attention to seed-borne pathogens and insects

Discovery & use of Captan fungicide
1948
First use of seed treatment insecticides
1940's & early 1950's

1960's
Introduction of first systemic fungicide

First systemic fungicide against air borne pathogens
1970's

1982
Ban of organo-mercurial compounds
1984
Water based seed treatment formulations developed
1985
Discovery of Imidacloprid & concept of film coatings

INNOVATIONS & DEVELOPMENTS IN SEED TREATMENT TECHNOLOGY (EQUIPMENT)

INNOVATIONS ON CHEMISTRY & COMMERCIALIZATION OF NEW SEED TREATMENT FUNGICIDE PRODUCTS

1900'S IS THE ERA OF INTRODUCTION OF NEW MODERN FUNGICIDES AND INSECTICIDES

INDUSTRY STRUCTURAL CHANGES OVER THE YEARS – TECHNOLOGY & COMPANY DEVELOPMENTS (1/6)

1914 An active substance was launched as a liquid seed treatment under the brand name Uspulun in Germany

1916 Authorities in the Grand Duchy of Baden order farmers to treat cereal seed with Uspulun to recover from the mass starvation from 1916-1918.

1921 Uspulun first exported to Mexico

1924 Bayer Biological Institute setup in Leverkusen

1926 Mechanical seed treater invented in the U.S.

1929 Bayer launches Caresan, a dry seed treatment

1930
- First commercial seed treater developed in the U.S
- Contract seed treatment concept emerged

1935 Ben Gustafson develops first cottonseed treater in North Dakota (U.S.).

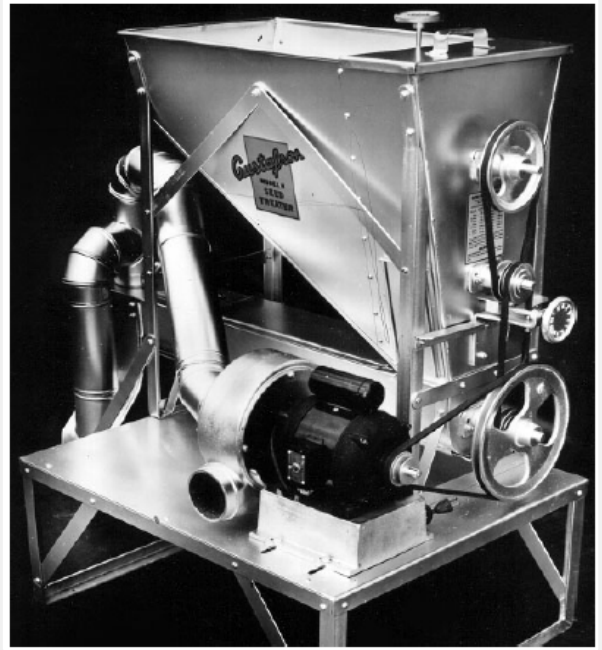
1941 Seed Testing stations opened in Japan

EVOLUTION, UNDERSTANDING, & ADOPTION OF SEED TREATMENT TECHNOLOGY

INDUSTRY STRUCTURAL CHANGES OVER THE YEARS – TECHNOLOGY & COMPANY DEVELOPMENTS (2/6)

1945	Gustafson develops first slurry treater to treat hybrid corn seeds
1946	First patent for seed pelleting technology
1955	Launch of Mist-O-Matic seed treaters
1958	Triple Treat seed treater introduced
1961	Introduction of Mesurol seed treatment
1966	Variable speed seed treaters introduced
1978	Incotec started seed coating activities in U.S.
1979	Concep, the first sorghum seed safener, is introduced
1980	A broadly based communication campaign introduced the new era in seed treatment as Baytan replaced banned mercury based products.
1881	Model 200 Rotary Seed Cleaner introduced.
1982	• Apron, the first seed treatment fungicide to offer protection from downy mildew, enters market • Launch of on-farm seed treater

SEED TREATMENT TECHNOLOGY (EQUIPMENT) INNOVATIONS & DEVELOPMENTS



Gustafson produced the Model H seed treater

INDUSTRY STRUCTURAL CHANGES OVER THE YEARS – TECHNOLOGY & COMPANY DEVELOPMENTS (3/6)

1984	Water based seed treatment formulations developed • Discovery of Imidacloprid. • Patented metering system in the U.K. for liquid based formulations • Launch of Certop film coatings
1985	
1986	Bayer opens first Seed Growth center in Monheim (Germany).
1987	Bayer launches film coating brand Peridiam
1988	Introduction of computerized seed treaters
1989	Launch of on-seed fungicide Raxil
1991	Launch of on-seed insecticide Gaucho
1993	Maxim seed treatment fungicide, the first seed treatment to be registered under the EPA's "Reduced Risk" classification, is launched
1994	Dividend, the first broadspectrum systemic fungicide for cereals, receives registration
1997	Cruiser, the first seed treatment insecticide launched globally
2000	Launch of Bayer Quantum 30 TPH batch treater in the UK.

INNOVATIONS ON CHEMISTRY & COMMERCIALIZATION OF NEW SEED TREATMENT FUNGICIDE PRODUCTS

INDUSTRY STRUCTURAL CHANGES OVER THE YEARS – TECHNOLOGY & COMPANY DEVELOPMENTS (4/6)

2001

Cruiser insecticide is introduced in the U.S.

2003

- Cruiser Extreme 250, the first insecticide/ fungicide combination of separately registered products for corn, enters market.
- Launch on on-seed insecticide Poncho
- Launch of root protector Galmano

2004

- CruiserMaxx Beans, the first insecticide/fungicide seed treatment combination of separately registered products for soybeans, is introduced.
- Bayer acquires Gustafson.

2006

On-seed fungicide Lamardor introduced
Avicta, the first seed treatment nematicide, receives registration for use on cotton

2007

- 2007 - Syngenta opens Seedcare Institute in Stein, Switzerland.
- Launch of Aeris, a nematicidal seed treatment in cotton

2008

- BASF & Monsanto entered into agreement for new fungicide seed treatment in soybean

2009

- Germains Seed Technology was the first to introduce T-22 (organic biological) seed treatment to North America and Mexico
- Avicta Complete Corn, the first nematicide/insecticide/ fungicide seed treatment combination of separately registered products, is launched

2010

Launch of Poncho/VOTIVO in the U.S

CruiserExtreme®

ATTENTION OF INDUSTRY PLAYERS & LAUNCH OF PRODUCTS

BASF
The Chemical Company

syngenta

"~2.8 TIMES GROWTH IN GM CROP AREA"

INDUSTRY STRUCTURAL CHANGES OVER THE YEARS – TECHNOLOGY & COMPANY DEVELOPMENTS (5/6)

2011

- New Bayer SeedGrowth centers opened in Argentina, China, Brazil & Mexico.
- Bayer acquires biological companies AgraQuest & Prophyta

2012

- EverGol registered in North America
- Vibrance, the first fungicide developed specifically as a seed treatment from Syngenta, is introduced.
- Bayer introduced On-Demand automated seed application system

2013

- Launch of SeedGrowth competence brand
- Clariva first biological seed treatment nematicide introduced
- Restriction and ban on the use of three neonicotinoids in EU countries
- Syngenta AG registered and launched FORTENZA
- Nufarm established a new manufacturing facility in Chicago to support growth in the fungicides, insecticides, and seed treatment segments.

PRODUCT VARIANTS, EXPLORATION OF GEOGRAPHIES & APPLICATIONS

IMPORTANCE TO NEMATICIDES & BIOLOGICALS

VALENT

Nufarm

2014

- Launched Clariva Complete Beans, nematicide/insecticide/ fungicide seed treatment combination of separately registered products Bion 500FS, a fungicide seed treatment for sunflower and sorghum, introduced
- Valent Canada Inc. signed an agreement to provide exclusive rights to Nufarm Agriculture Inc. (Canada) to distribute NipsIt seed treatments (NipsIt Inside and NipsIt Suite) for on-farm use in Canadian markets.
- Valent U.S.A Corporation launched INTEGO SUITE (fungicide) System for protection of soybean seeds and seedling

INDUSTRY STRUCTURAL CHANGES OVER THE YEARS – TECHNOLOGY & COMPANY DEVELOPMENTS (6/6)

2015

- BASF SE received the approval for their seed treatment Systiva in Australia
- Koppert launched new biostimulant seed treatment product
- Syngenta AG introduced Mertect 340-F fungicide to its portfolio of seed treatments
- Bayer CropScience introduced Redigo Pro and Deter seed treatments in the U.K. Valent U.S.A Corporation, a subsidiary of Sumitomo Chemical, acquired Mycorrhizal Applications, Inc. (U.S.), the world's largest producer of mycorrhizal fungal inoculum

FOCUS ON CROP-WISE SEED TREATMENT PRODUCTS

2016

- Syngenta launched EPIVO, a range of new biostimulants to address abiotic stresses through seed treatment
- Koppert and Lantmännen BioAgri partner to further develop biological seed treatment
- The BioAg Alliance Launches new yield-boosting microbial seed coating
- BASF launched a new seed treatment facility in Argentina.
- BASF's fungicidal seed treatment Systiva XS was approved for use on the sugar beet crop in the U.S.
- Syngenta and Oscar Pemán Semillas (Argentina) co-launched a seed treatment product, namely Plenus technology for use on pastures.
- Syngenta launched a seed treatment, Visivio in Canada

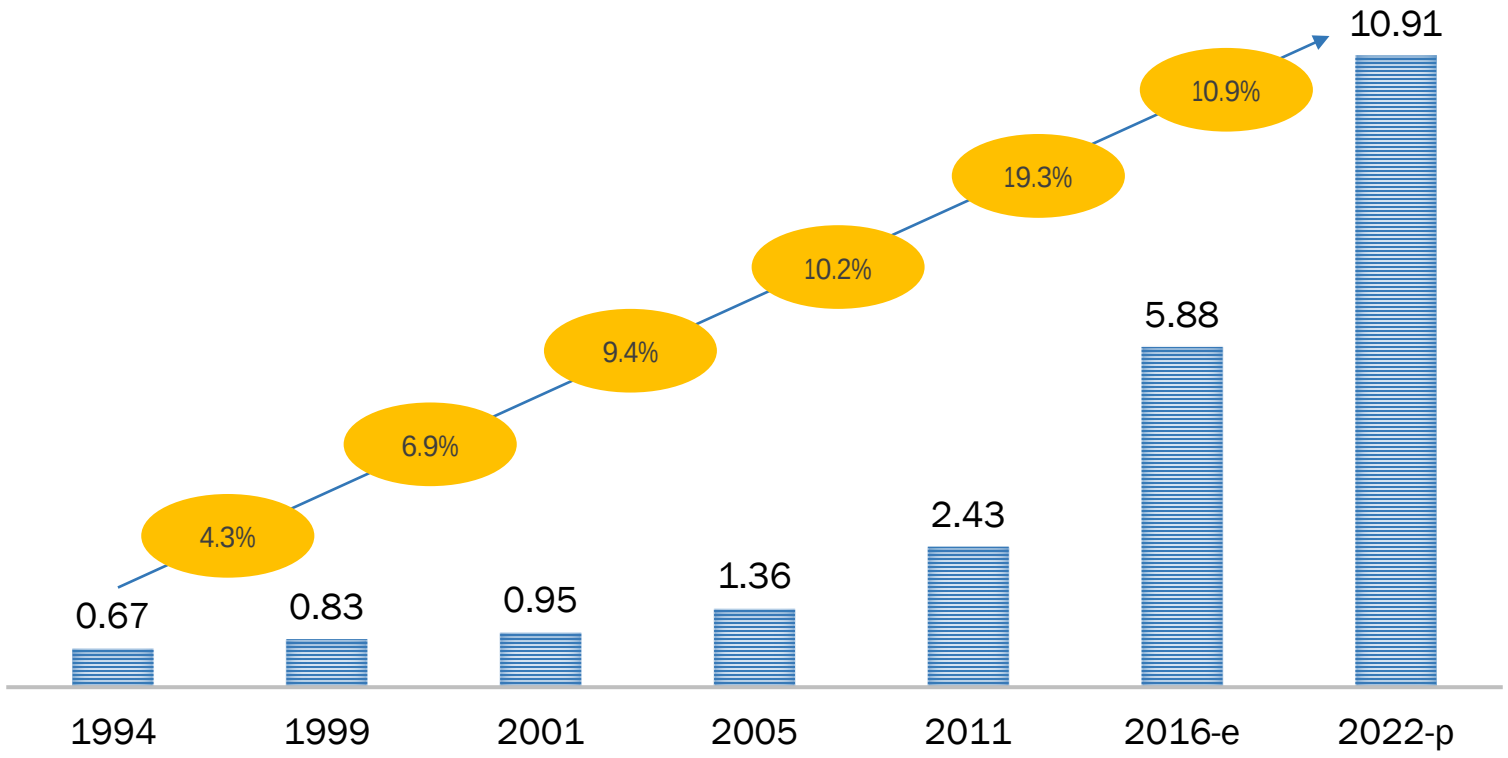
NEWER OPPORTUNITIES WITH BIOSTIMULANTS

PLAYERS IN THE SEED TREATMENT INDUSTRY

Many more…..

SEED TREATMENT MARKET GROWTH TREND

GLOBAL SEED TREATMENT MARKET TREND



Tremendous growth witnessed during the period from 2011 to 2016

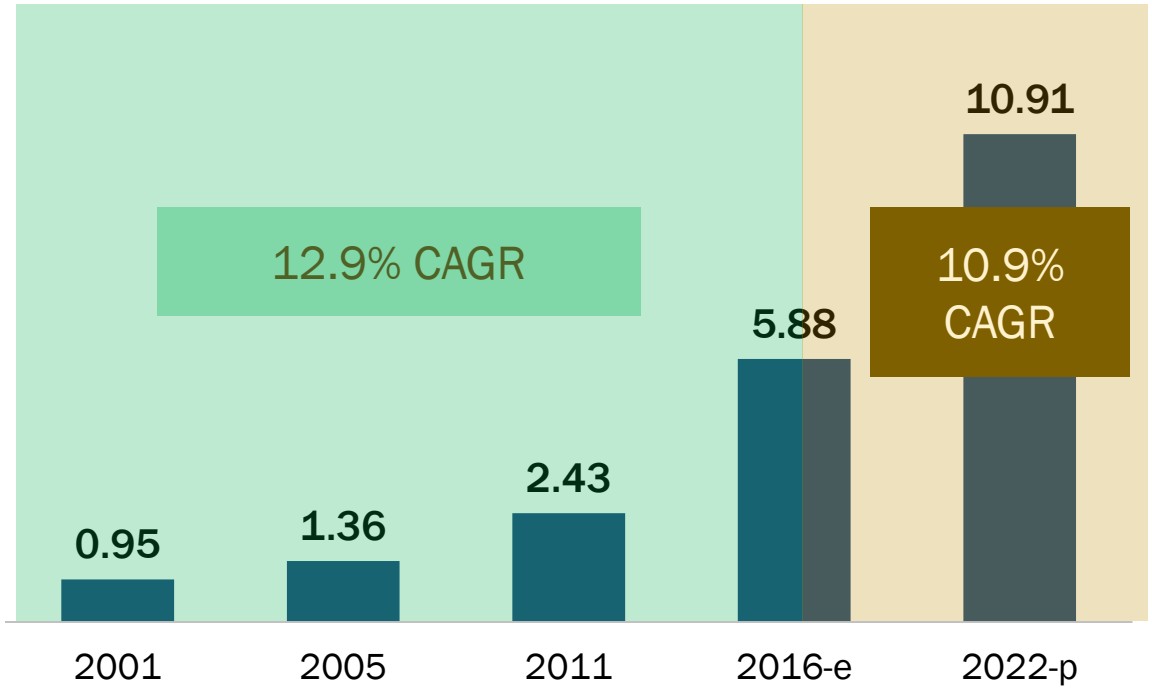
> SEED TREATMENT SALES EXPECTED TO GROW FROM USD 5.88 BILLION IN 2016 TO 10.91 BILLION BY 2022

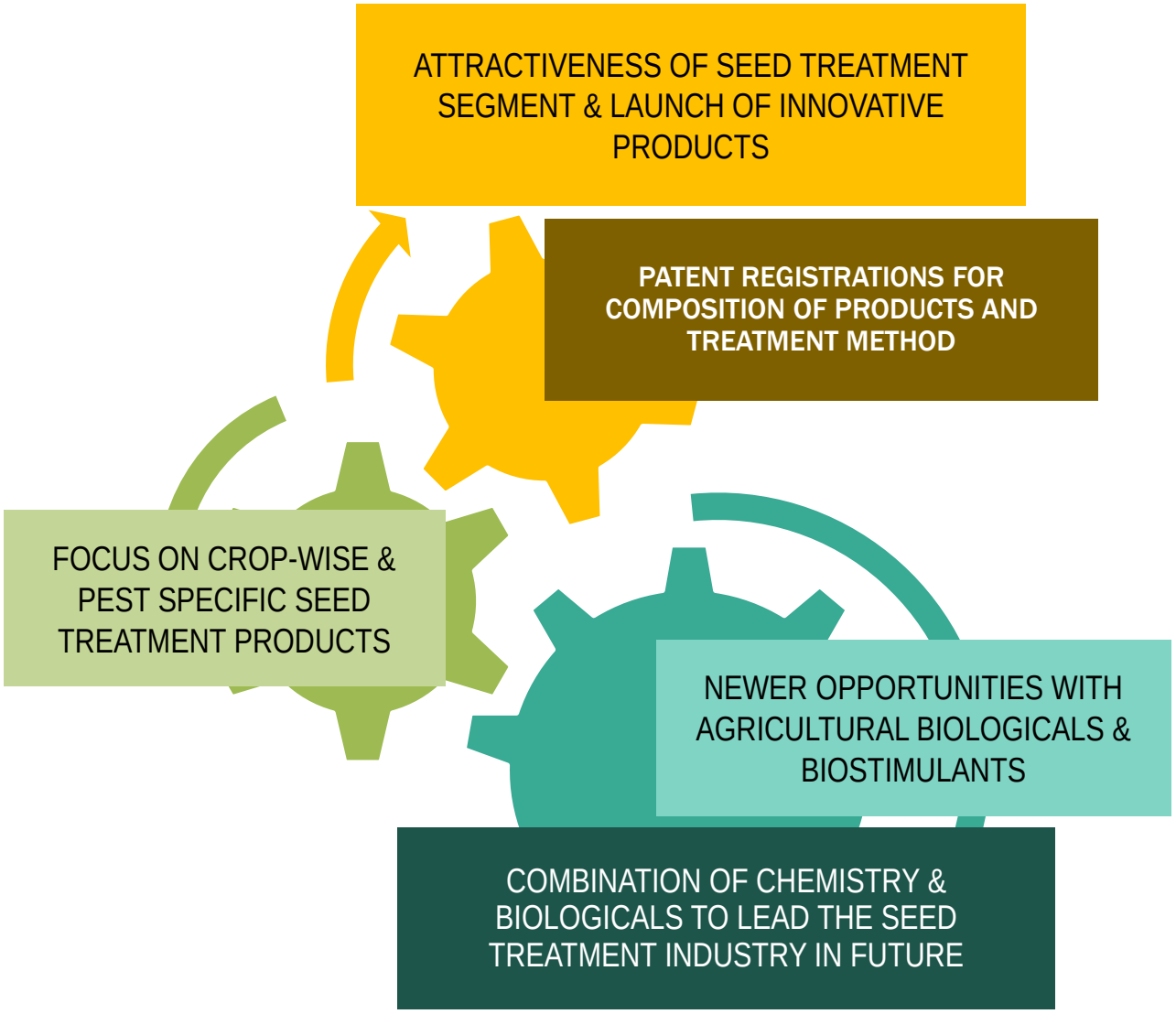
Note: E- estimated, P - projected

SEED TREATMENT TECHNOLOGY – HISTORICAL PERSPECTIVE - 2000'S

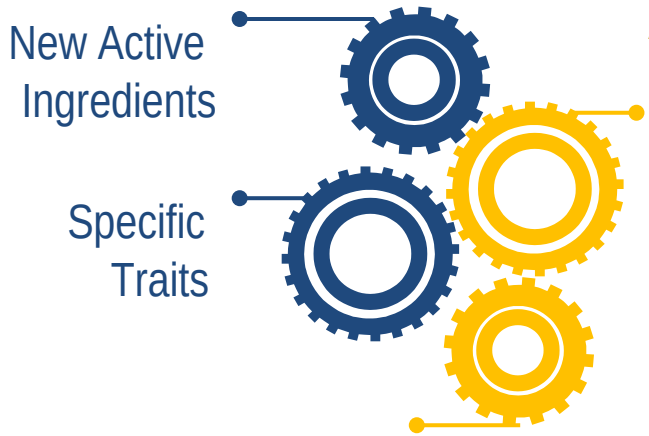
SEED TREATMENT MARKET GROWTH FACTORS

- Innovations & adoption of seed technologies
- Increased awareness & adoption of crop protection chemicals





CHANGING FOCUS ON PRODUCT CATEGORIES



GROWTH STAGES OF PRODUCT INNOVATIONS

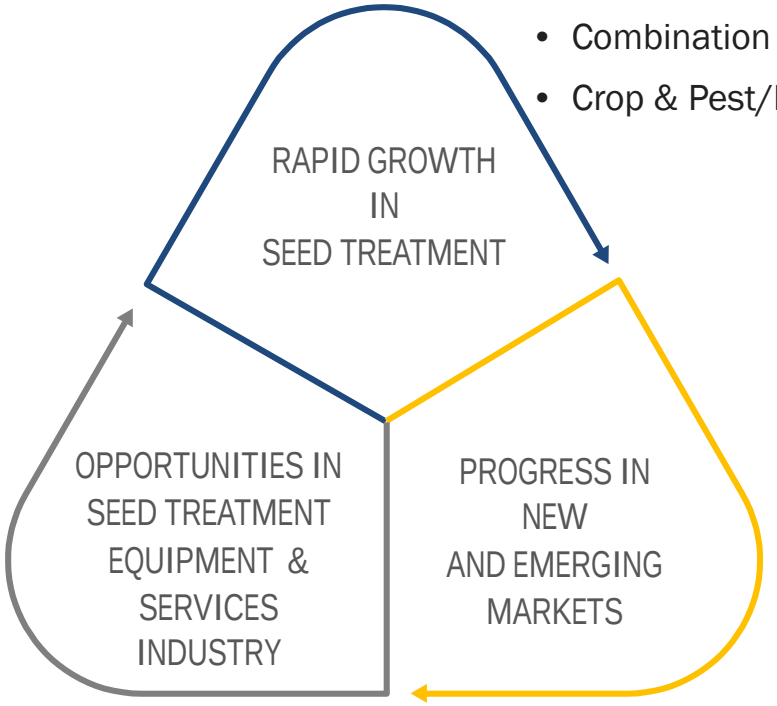
MARKET GROWTH

PRODUCT CATEGORY	SCOPE FOR INNOVATIONS
FUNGICIDES SYSTEMIC INSECTICIDES NEMATICIDES	Additional chemistries with different mode of action
BIOLOGICALS STARTER NUTRIENTS & STRESS TOLERANCE	R&D focus on biological controls and more complex microbiome inoculants

Companies investments in R&D for seed treatment product combinations (chemistry & biologicals) to meet growers need along with seed treatment services

OPPORTUNITIES IN THE SEED TREATMENT INDUSTRY

- Growing Environmental Considerations Driving Demand For Bio-pesticides
- Combination of Chemistry & Biologicals
- Crop & Pest/Disease Specific Products



- Launches of advanced technologies such as On Demand seeks to bring the accuracy, efficiency and reporting available at commercial plants downstream to the seed retailer or dealer.
- Seed treatment equipment industry players venturing to provide seed treatment services to farmers on demand.

- Adoption of biological seed treatment in emerging markets
- Demand for seed treatment technologies expected to grow continually in early adopting countries such as Brazil and exponentially in the new and emerging markets such as India and China.

IMPACT OF MERGERS & ACQUISITIONS ON SEED TREATMENT INDUSTRY

R&D SYNERGIES FOR INNOVATIONS

MUTUAL ACCESS TO EXPERTISE SEGMENTS (SEED, TRAITS, CROP PROTECTION CHEMICALS, & BIOLOGICALS)

INCREASED MARKET CONCENTRATION & ACCESS TO BROADER CUSTOMER BASE

OPPORTUNITY TO RESHAPE THE ACTIVITY PORTFOLIO

FUTURE OUTLOOK

NEEDS

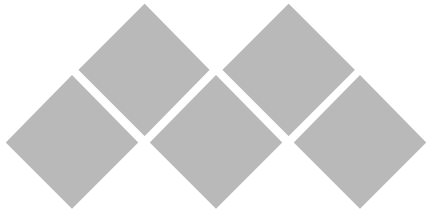
- Refinement of carriers and polymers
- Diversify insecticide options
- Alternatives for restricted active ingredients

OPPORTUNITIES

- Increasing number of market players, mergers, acquisitions, collaborations and partnerships
- Establishment of supportive schemes such as European Seed Treatment Assurance Scheme

RISKS

- Reliance on few modes of action in broad portfolio of products
- Emerging insect resistance
- Regulatory limitations such as restrictions on use of neonicotinoids



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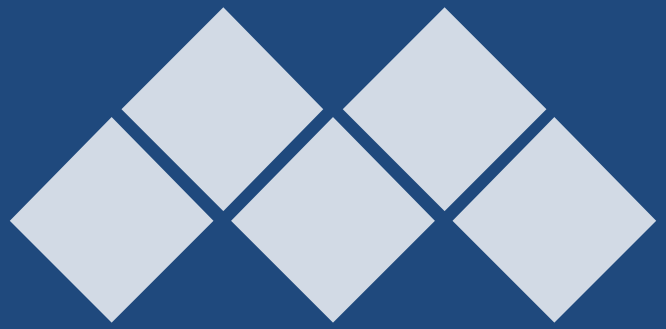
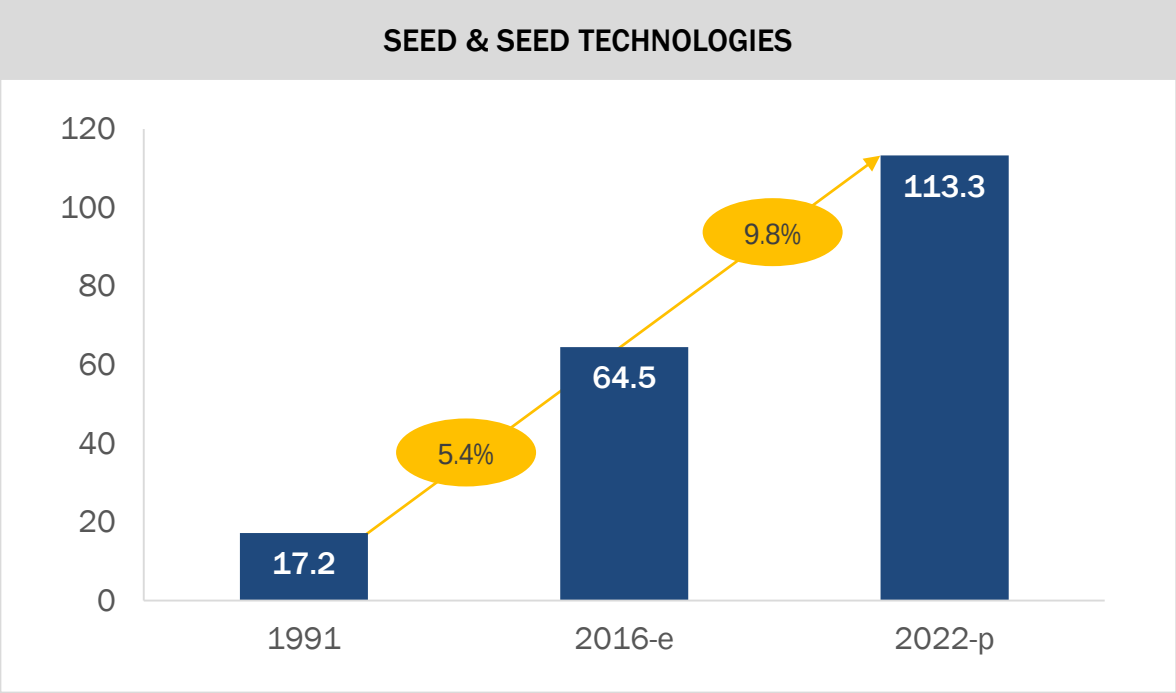
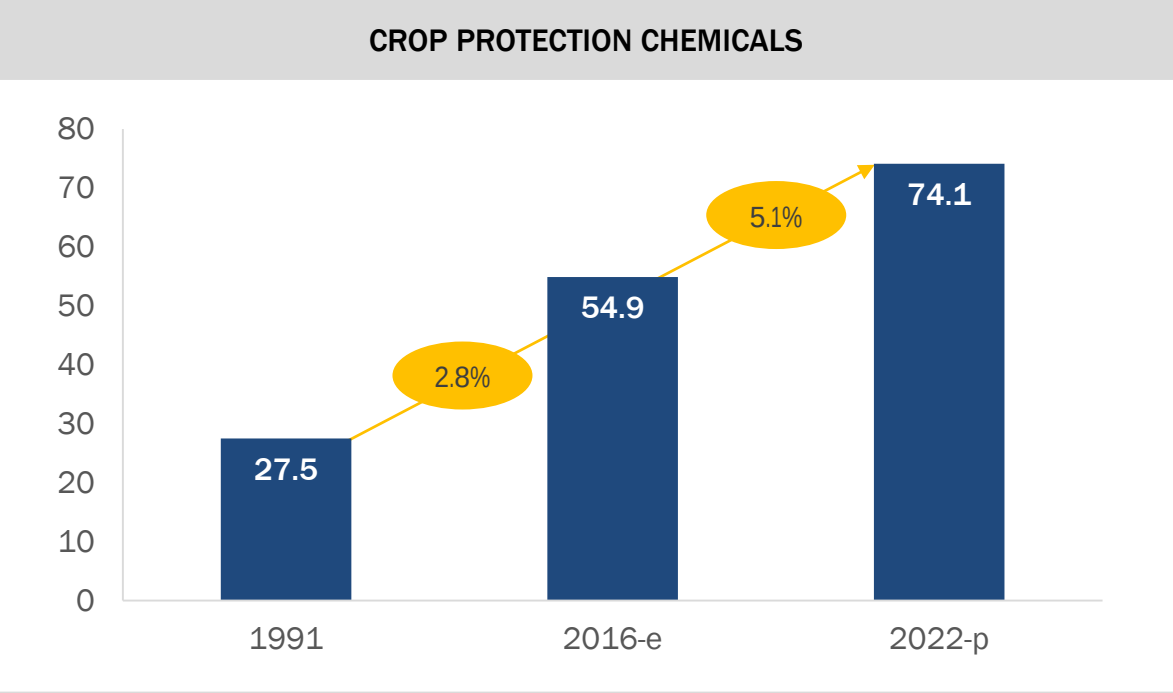
APPENDIX



OVERVIEW ON PARENT MARKETS





Factors that contribute to the growth of seed & agrochemicals market

- GM crops in developed and developing markets
- Seed replacement (from farm saved to commercial seeds) in developing markets

SEED TREATMENT TECHNOLOGY - OVERVIEW

DEFINITION: Seed treatments refers to the application of biological, physical, and chemical agents and techniques to the seeds prior to sowing in order to provide protection from pests and to improve the establishment of healthy crops. (International Seed Federation)

ADVANTAGES

- Precise mode of applying products in the field
- High level of protection against insects and diseases
- Reduced exposure of crop protection products to human and environment

BENEFITS TO GROWERS

- Protection to high value seeds
- Allows for early season planting
- Uniform seedling emergence and crop stand establishment
- Higher plant population
- Reduces the need for additional rescue treatment or replanting of crop

HUMAN & ENVIRONMENT

- Precise application of crop protection products
- Reduces the need for application of crop protection products over the entire field and reduces soil surface exposure
- Reduces potential off-target exposure to plants & animals

KEY PATENTS REGISTERED FOR SEED TREATMENT

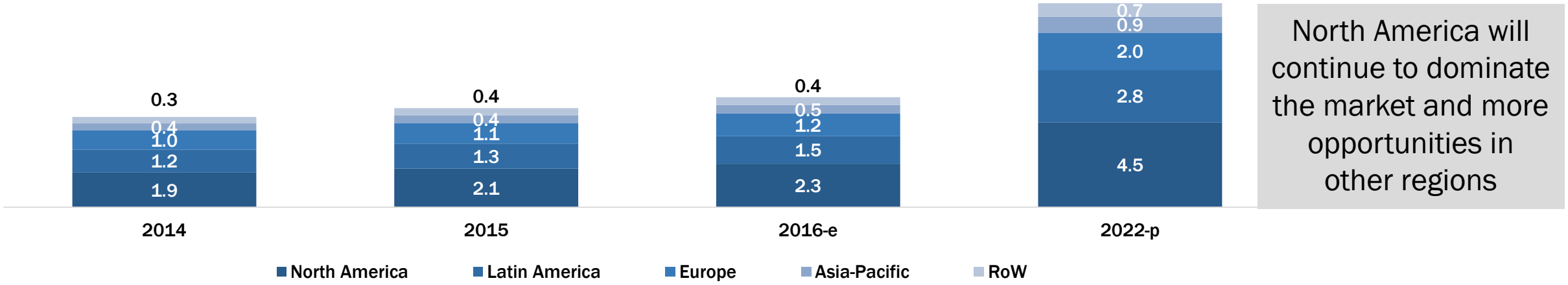
PUBLICATION NUMBER	PATENT TITLE	PUBLICATION DATE	COMPANY
US9538751 B2	Canola seed treatment composition and method	10-Jan-17	Dow Agrosciences Llc
US9474274 B2	Canola seed treatment composition and method	25-Oct-16	Dow Agrosciences Llc
US8466087 B2	Seed treatment compositions and methods	18-Jun-13	Fbsciences Holdings, Inc.
US8458953 B2	High speed seed treatment apparatus	11-Jun-13	Pioneer Hi-Bred International, Inc.
EP2524596 A1	Seed treatment uses	21-Nov-12	BASF SE
WO2012152737 A1	Seed treatment method and composition	15-Nov-12	Syngenta Participations Ag
WO2010100638 A2	Seed treatment and pesticidal composition	10-Sep-10	Celsius Property B.V. Amsterdam (Nl)
EP1863350 A2	2-cyanobenzenesulfonamide compounds for seed treatment	12-Dec-07	Basf Aktiengesellschaft
WO2007003319 A2	Seed treatment method and pesticidal composition	11-Jan-07	Syngenta Participations Ag
WO2006024333 A2	Aqueous neonicotinoid compositions for seed treatment	9-Mar-06	Syngenta Participations Ag
US20030224936 A1	Seed treatment composition	4-Dec-03	Gerhard Kretzschmar
CA2485172 A1	Fungicidal seed treatment agent for oilseed rape	4-Dec-03	Basf Agro B.V., Arnhem (Nl) Wadenswil-Branch
WO2000063356 A2	Herbicidal seed treatment	26-Oct-00	Syngenta Participations Ag
WO2000054568 A1	Seed treatment composition	21-Sep-00	Aventis Cropscience Gmbh
WO2000028825 A1	Pesticidal composition for seed treatment	25-May-00	Syngenta Participations Ag
US5661103 A	Seed treatment composition and method	26-Aug-97	Donlar Corporation
US5586411 A	Method of preparing a seed treatment composition	24-Dec-96	Her Majesty The Queen In Right Of Canada, Philom Bios Inc.
EP 0150766 A2	Device for wet pickling of seeds	7-Aug-85	Mantis ULV-Sprühgeräte GmbH
CA976134 A	Methods of seed treatment and apparatus therefor	14-Oct-75	James, Michael Trading As Design Link,
US3155542 A	Cottonseed-treating maching	3-Nov-64	Ben Gustafson & Son Mfg. Company

SEED TREATMENT TECHNOLOGY PATENTS REGISTERED ARE MAINLY FOR COMPOSITION OF PRODUCTS AND TREATMENT METHOD

GLOBAL SEED TREATMENT MARKET – MARKET SIZE ESTIMATION & FORECASTS

BY REGION

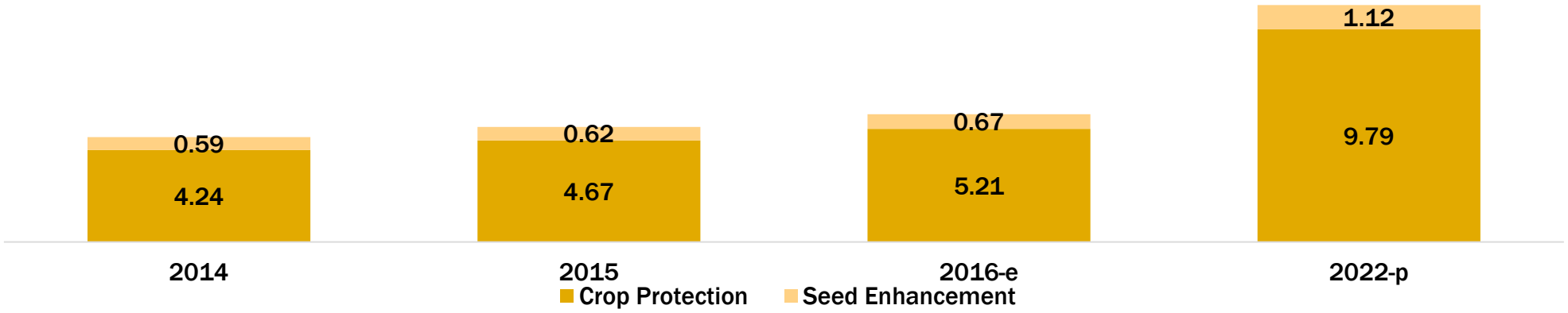
GLOBAL SEED TREATMENT MARKET, BY REGION (VALUES IN USD BILLION)



North America will continue to dominate the market and more opportunities in other regions

BY FUNCTION

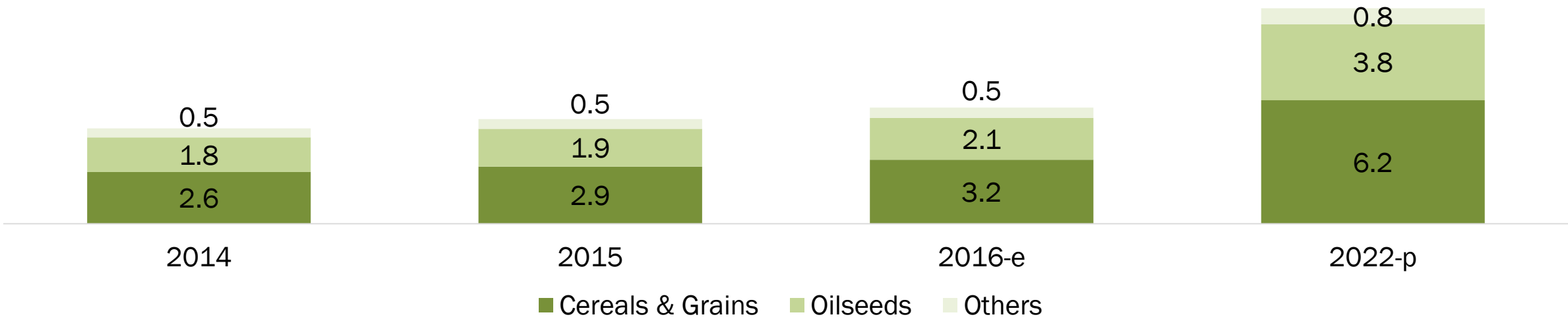
GLOBAL SEED TREATMENT BIOLOGICALS MARKET, BY FUNCTION (VALUES IN USD BILLION)



GLOBAL SEED TREATMENT MARKET – MARKET SIZE ESTIMATION & FORECASTS

BY CROP TYPE

GLOBAL SEED TREATMENT MARKET, BY CROP TYPE (VALUES IN USD BILLION)



Corn, wheat, and rice crops are to lead the market for seed treatment

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