Contacts for Arize® Hybrid Rice Seed

Bangladesh
Md. Reaz Uddin Ahmed
Bayer CropScience Ltd
+88 2956335
reaz.ahmed@bayer.com

Brazil
Rodolpho Leal
Bayer CropScience Ltd
+55 51 568 1000
rodolpho.leal@bayer.com

China
David Yeh
Bayer CropScience (China) Co., Ltd
+86 10 65 893 455
david.yeh@bayer.com

Colombia
Luis Fernando Vanegas
Bayer CropScience
+57 14234578
luis.vanegas@bayer.com

India
S K Karavadi
Bayer BioScience Pvt. Ltd
+91 40 44 110 237
srinivasakumar.karavadi@bayer.com

Indonesia
Riyadi Purwoko
PT. Bayer Indonesia
+62 21 5703 661
riyadi.purwoko@bayer.com

Pakistan
Muhammad Akbar
Bayer CropScience (Pvt.) Ltd.
+92 301 8480141
muhammad.akbar@bayer.com

Peru
Gustavo Adolfo Noriega
Bayer CropScience
+51 14169476
gustavo.noriega@bayer.com

The Philippines
Recher Ondap
Bayer CropScience, Inc.
+63 2 450 3638
recher.ondap@bayer.com

Vietnam
Stefan Tempel
Bayer Vietnam Ltd
+84 8 39979257
stefan.tempel@bayer.com

Singapore
Frederic Top
Bayer (South East Asia) Pte Ltd
+65 6496 1791
frederic.top@bayer.com

Bayer CropScience

Bayer (South East Asia) Pte Ltd
Bayer CropScience
63 Chulia Street
OCBC Centre East, 14th floor
Singapore 049514
www.bayercropscience.com

Increasing Rice Yields, Enriching Lives

BAYER

Arize™

Better Rice Better Life

Bayer CropScience

Bayer CropScience

A Global Leader Committed to Rice

Bayer CropScience

Bayer is a global enterprise with core competencies in the fields of healthcare, agriculture, and high-tech materials. The company looks back on more than 150 years of working to fulfill its mission: Science for a Better Life.

Bayer CropScience, a subgroup responsible for the agricultural business, is one of the world's leading innovative crop science companies in the areas of seeds, crop protection and non-agricultural pest management. The company offers an outstanding range of products, including high-value seeds, innovative crop protection solutions based on chemical and biological modes of action as well as an extensive service backup for modern, sustainable agriculture.

Bayer CropScience has a global workforce of 20,800 people, and is represented in over 120 countries. Bayer CropScience is present in every major rice-growing region. We are committed to meeting the needs, current and future, of rice growers across our planet.

Rice is Life

Rice is consumed by almost half the world's population, and is a staple for many societies as a source of nutrition and income. Rice is a lifeline for farmers and stakeholders across the value chain. Throughout the world, and particularly in Asia, rice cultivation feeds people, creates jobs, generates revenue, educates families, grows communities, and connects individuals and organizations through a global network of knowledge and competencies.

Approximately 11 per cent of available agricultural land is needed to grow rice. That is more than 150 million hectares worldwide. In the last few decades research into crop sciences, and innovation from pools of public and private experts, have led to more efficient rice-production techniques that boost yield, protect rice plants from common stresses, and increase farmer incomes. However, a global population explosion is pushing for greater rice production.

By 2050, demand for rice will double that of what the world is currently producing. Current growth rates of rice are at 1% per year. If we maintain this rate, supplies will fall short of what the world needs. Consequently, we are going to need to produce much more rice with limited resources.

"My ancestors have been doing rice farming for the past 500 years."

Anjan Lal, Farmer, Chhattisgarh, India

Growing Rice Growing Challenges

As we move towards the future, the world faces multiple challenges that directly impact our ability to meet global rice demand.

Unpredictable Water Patterns

Traditional rice farming practices consume 5000 liters of water to produce just one kilogram of rice. Irregular water supply (too much or too little) to key rice growth areas significantly hurts rice yields and erodes farmer profits. In parts of some countries in Asia, such as Punjab, India, expanding rice cultivation over the years has resulted in a rapid depletion of water tables, forcing water-saving measures such as delayed transplanting. We therefore need to find new rice cultivars that are adapted to these agronomic conditions (varieties with shorter duration) or which can grow through direct seeding.

Shortage of Labor

Rice farming has traditionally been a labor-intensive practice. Growing urbanization, particularly in some Asian countries that have been major rice suppliers, is creating a shortage of labor for agriculture. Rural workers are moving away from fields to cities, to work in secondary and tertiary industries. A lack of adequate labor is pushing farming expenses up and calling for new technologies to keep growing rice within the same acreage.

"The main challenge is how to establish this [rice] production system in as many areas as possible to improve the overall productivity and income of the farmers …depend on this system…for their livelihood."

Eufemio Rasco
Executive Director
The Philippines Rice Research Institute, PhilRice

Lack of Suitable Technology

Rice farmers are constantly grappling with the management of weeds, pests and diseases. Abiotic stresses, like high salinity and extreme temperatures, are also intensified under climate change and seriously threaten rice production. Traditional agronomic practices are inadequate to deal with such issues. New technologies are therefore imperative in controlling and withstanding the stresses from biotic and abiotic sources. Rice farmers ultimately require solutions that are both sustainable and scalable for greater yields, better economies and improved social conditions.

Shrinking Land

Arable land is shrinking worldwide. Urbanization, together with a host of competing activities, is resulting in fewer areas for rice farming. In South East Asia, for example, a number of paddy fields have been converted to plantations. Reductions in land available for rice cultivation are forcing rice growers to not only farm in smaller spaces, but to increase their yield in order to maintain the same levels of production.

“I hope [Bayer] keeps making progress in these research technologies that reach the farmers...”

Harish Kumar Gandhi, Chhattisgarh, India

ARIZE HYBRID RICE

Better Rice

Better Life

Global population and global demand for rice are both on the rise. We need solutions that produce more rice to nourish large populations. Food security around the world will benefit from an adaptive solution that keeps creating better lives and better livelihoods. We require new innovation that can sustainably boost rice yields, feed farmers’ families, create prosperity for the community, and secure self-sufficiency for countries.

Arize Hybrid Rice — Better Rice, Better Life.

Hybrid Rice, Higher Yield

Hybrid rice seed is the first generation of seed obtained by crossing two genetically different rice lines. Rice is a self-pollinating crop and the development of hybrids requires the cross-pollination between two parental lines.

Hybridization is achieved through the use of a male sterile parental line called the female line, which does not produce pollen. When it is grown alongside a fertile parent (male line) in an isolated plot, it can produce hybrid seeds due to cross-pollination by the adjoining male parent.

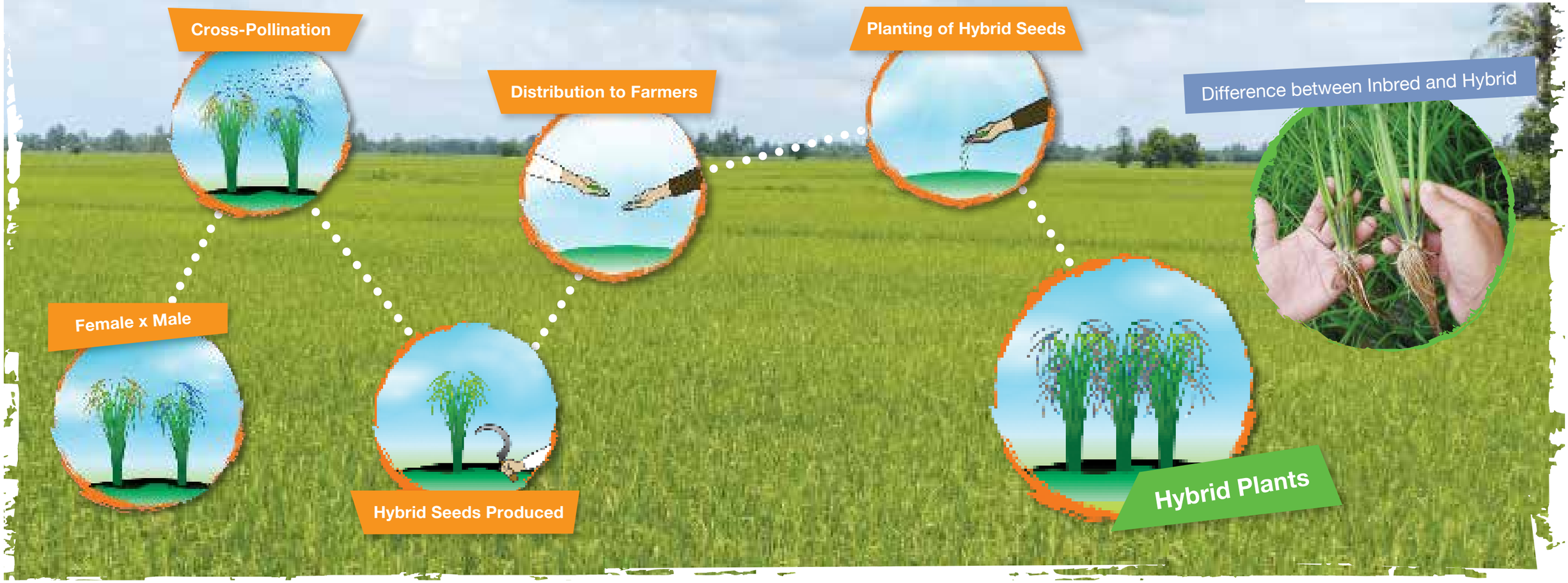
The seed set on the female plant is the hybrid seed which is used for growing the high-yielding commercial hybrid crop.

Bayer CropScience is the global leader in developing rice hybrids which are adapted to various agro-climatic conditions. Our breeders strive to develop hybrids with increased yield that can fit our customers' needs, whether in Asia or in the Americas. We use conventional breeding as well as molecular breeding to discover new traits against biotic and abiotic stresses, and incorporate these traits into superior agronomic germplasm via backcrossing and forward breeding. Each year new hybrids are extensively tested in several countries, and only the best are selected for commercial use.

As a leader, Bayer CropScience has also established a high-performing supply chain. We have developed real expertise in producing hybrid seeds, a complex process that requires considerable time and labor. We have successfully established seed production operations in India, The Philippines, Bangladesh and Brazil, and are continuously expanding these operations to meet the demands of the market. We have also invested heavily in new processing and storage capabilities, to ensure that our Arize Hybrid seeds reach rice growers with the highest standards in terms of purity levels and germination rates.

"Arize B-TE1 gives better yield and can better tolerate pests and diseases than any other varieties so farmers can save more money when they use this hybrid rice."

An Kieu – Vinh Thuan town, Vinh Thuan district, Kien Giang province



Arize Hybrids - Sowing Benefits for Farmers

Stronger Biotic Stress Tolerance

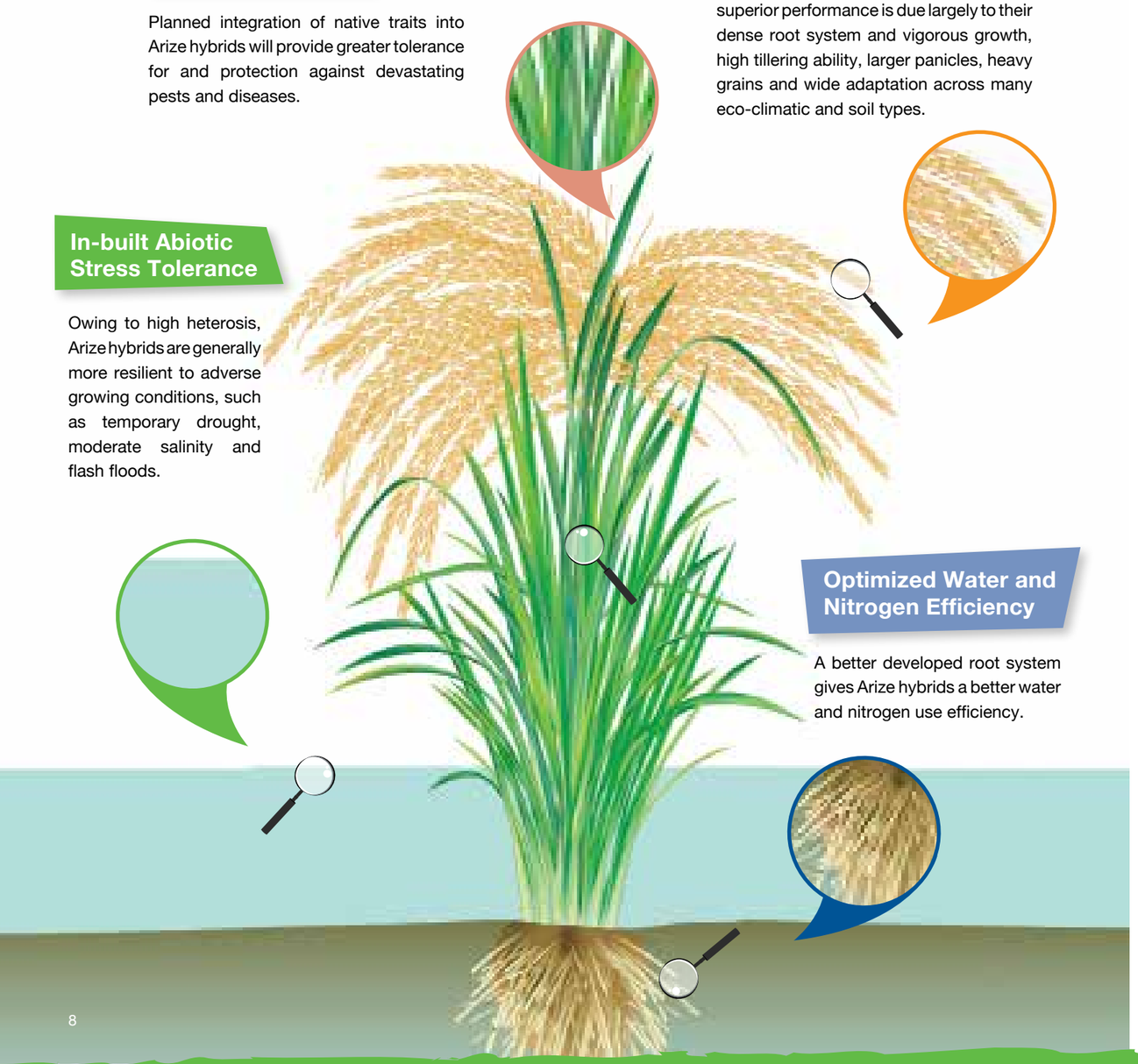
Planned integration of native traits into Arize hybrids will provide greater tolerance for and protection against devastating pests and diseases.

Enhanced Yield

Arize hybrids have the potential to yield at least 20% more than the best inbred variety grown in similar conditions. Their superior performance is due largely to their dense root system and vigorous growth, high tillering ability, larger panicles, heavy grains and wide adaptation across many eco-climatic and soil types.

In-built Abiotic Stress Tolerance

Owing to high heterosis, Arize hybrids are generally more resilient to adverse growing conditions, such as temporary drought, moderate salinity and flash floods.



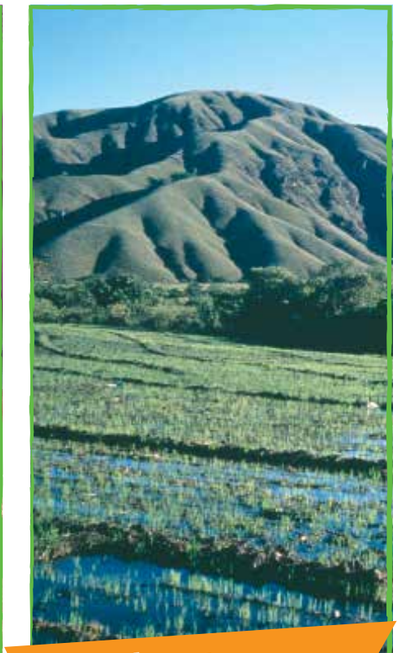
Optimized Water and Nitrogen Efficiency

A better developed root system gives Arize hybrids a better water and nitrogen use efficiency.

Arize Hybrids – Towards Sustainable Rice Production

Economy

Arize contributes to better yield security and enhances productivity, which in turn helps to secure the incomes of smallholder farmers. Arize also reduces a country's reliance on rice imports, increases the potential to achieve self-sufficiency, and opens possibilities towards becoming a rice exporter.



Ecology

Due to their strong heterosis, Arize hybrids are more resilient to climatic stresses owing to a robust root system that is able to take in more water and nutrients from the soil. Arize hybrids are therefore more adapted to specific technologies like direct seeding that uses less water and subsequently produces fewer methane emissions. In regions where water is still in abundance, the higher income provided by Arize allows farmers to keep growing profitable rice, thus maintaining the rich, unique ecosystem of flooded paddy fields.

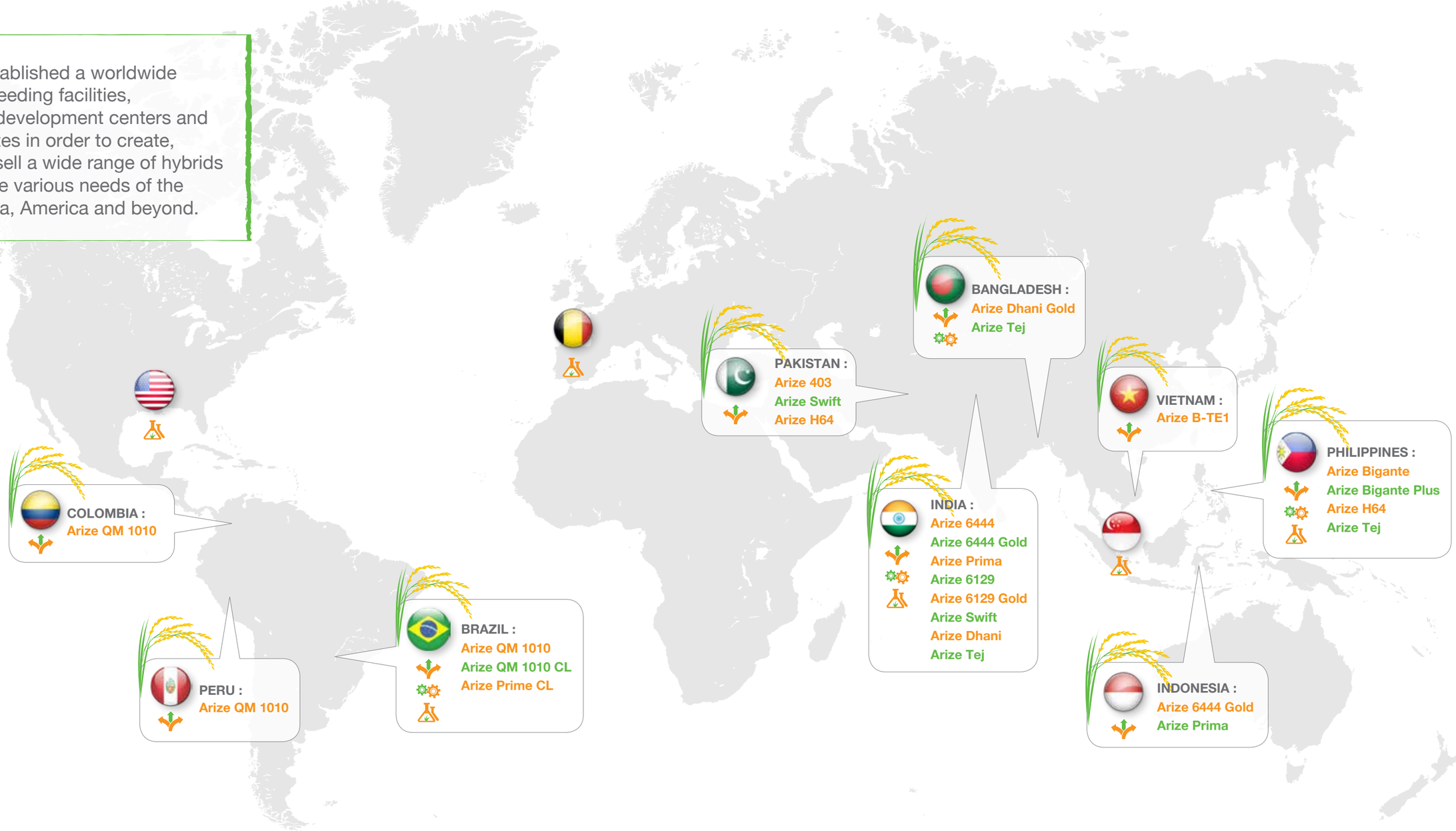
Society

Arize hybrids produce more yield, which translates to higher income for farmers. This surfeit allows farmers and their families to not only achieve self-sufficiency but also to sell their rice surplus and use these earnings to better their livelihood. This opens possibilities for children's education and growth, and prevents child-labor in paddy fields. Improved stability in families leads to greater ties within the community and ultimately mitigates the rural exodus.

Reaching Out with Global Expertise

Bayer has established a worldwide network of breeding facilities, laboratories, development centers and production sites in order to create, develop and sell a wide range of hybrids adapted to the various needs of the farmers in Asia, America and beyond.

Research & breeding
Production
Distribution



Working with Rice Farmers in Asia

Vietnam

Since 2006 Bayer has successfully launched two hybrid varieties in Vietnam. These hybrids address the needs of farmers living in the north and south of Vietnam. Arize hybrids have been well received by both farmers and government authorities, for their high yields and good eating and cooking qualities. Arize hybrids are consistently gaining strong market share in an economy that has for decades been dominated by hybrids from China. Arize hybrids have also found success in the Mekong Delta. Better yield and strong tolerances towards abiotic and biotic stresses have resulted in Arize hybrids gaining the trust of growers who are becoming more exposed to climatic challenges in the region. To date, Arize is the only hybrid rice brand that has been successfully launched and has maintained continuous growth in the Mekong Delta. Arize hybrids are now the backbone of rice cultivation in many provinces. This success is due also to the implementation of an educational program consisting of on-farm as well as off-farm training, conducted jointly with the Agricultural Extension Departments. Such training has ensured that Arize growers are able to make the most out of their crop, and constantly achieve high yields, while limiting the risks of crop failure.

The Philippines

Rice is the staple for 95 million Filipinos, and a key source of income of more than 2 million rice farmers in The Philippines. Nonetheless yields have been low in comparison to other Asian countries. Most of the varieties planted are still inbreds. The hybrid rice technology however has been growing steadily with Arize being the brand of choice for quality hybrid rice seeds. Arize Hybrid Rice seeds can be planted all year-round both in wet or dry season and in any rice culture (irrigated or rainfed, transplanted or direct-seeded). Four Arize hybrids, fit for different market segments in The Philippines, are commercially available: Arize Bigante, Arize H64, Arize Tej and Arize Bigante Plus. Since its introduction in 2004, Arize Bigante easily became popular among Filipino rice farmers because of its consistent high yield and excellent eating qualities, gaining recognition by several millers and food retailers across the country. With the recent introduction of Arize Bigante Plus, our new hybrid with built-in tolerance to BLB, farmers are now more assured of achieving yield and quality, even during the wet season. Arize Bigante Plus is currently the most BLB-tolerant hybrid registered in The Philippines.

India

Bayer has constantly been a key company for innovation within the private sector to establish the concept of hybrid rice in India. Arize hybrids in India have won critical acclaim from farmers and government experts alike. With almost half of these receiving official public Notification, our Arize hybrids have gained the trust of farmers by consistently outyielding the best local inbreds. Bayer's efforts and investment in developing the hybrid rice market for the last 20 years have helped scores of marginal and small farmers to enhance their crop productivity and gain prosperity. During its journey, the Arize portfolio has achieved many milestones to help India meet its goal of ensuring food security: first was Arize 6444, which was launched in 2001 and started the hybrid adoption revolution; then came Arize Dhani, which was the first BLB-tolerant hybrid in India; most recently, Arize 6444 Gold was launched which became the first hybrid rice to be registered for direct-seeded cultivation in Eastern India.

Bangladesh

In Bangladesh, the Arize brand was introduced in 2008 and within 5 years of launching has become the preferred rice seeds brand for farmers in the country. Addressing farmer needs for a slender hybrid with good taste, Bayer launched Arize Tej during the dry season of 2008. In 2009, Bangladesh witnessed the launch of the first BLB-tolerant hybrid (Arize Dhani) whose success has lead to the recent release of Arize Dhani Gold — the only high-yielding BLB-tolerant hybrid registered for both the wet and dry seasons in Bangladesh.

Pakistan

In Pakistan, despite a gradual increase in rice cultivation, productivity is still very low, averaging about 2.4 tons per hectare. Poor performance is attributed to traditional low-yielding inbreds, high prevalence of disease, and frequent flooding during the monsoon season. Bayer CropScience started developing Arize hybrids in Pakistan in 2004. To-date four Arize hybrid varieties were launched, targeting farmers' needs in either the Sindh province or Punjab: Arize 403, Arize H64, Arize XL and Arize Swift. In 2012, Bayer introduced Arize H64 in the Sindh province, providing not only a hybrid with yield advantage but also excellent grain quality. Most recently, Arize Swift was launched in 2013, fitting very well in the three-crop rotation potato segment of Punjab, and the late sowing segment of Sindh. Arize Swift is not only the highest-yielding hybrid but also has the earliest maturity rate among all market hybrids.

Raising Income Through Arize

"I tried Arize B-TE1 on 2.5 hectares in the first year and the yield was 10 tons per hectare! This hybrid gives very high yield and now I am cultivating it on all my fields… it really gives me a better life."

Nguyen Van Be
Thang Loi Ward, Tan Thanh Commune, Kien Giang province

BANGLADESH COMPILATION WET SEASON 2012

	Total Cost (BDT/ha)	Yield (kg/ha)	Income (BDT/ha)	Benefit (BDT/ha)
Arize Dhani Gold	49,557	6,200	98,000	48,443
Local inbreds	46,357	4000	64,500	18,143

30,300 BDT/ha more

VIETNAM MEKONG DELTA WET SEASON 2012

	Total Cost (VND/ha)	Yield (kg/ha)	Income (VND/ha)	Benefit (VND/ha)
Arize B-TE1	14,500,000	8,300	47,310,000	32,810,000
Local referent inbred	14,800,000	5,500	31,350,000	16,550,000

16,260,000 VND/ha more

PHILIPPINES LAGUNA WET SEASON 2012

	Total Cost (PHP/ha)	Yield (kg/ha)	Income (PHP/ha)	Benefit (PHP/ha)
Arize Bigante Plus	32,850	7,834	117,510	84,660
PSB Rc18	26,750	6,383	95,745	68,995

15,665 PHP/ha more

PAKISTAN PUNJAB WET SEASON 2012

	Total Cost (PKR/ha)	Yield (kg/ha)	Income (PKR/ha)	Benefit (PKR/ha)
Arize Swift	110,730	7,834	177,840	67,110
KSK 282	102,950	6,383	146,960	44,010

23,100 PKR/ha more

INDIA COMPILATION WET SEASON 2012

	Total Cost (INR/ha)	Yield (kg/ha)	Income (INR/ha)	Benefit (INR/ha)
Arize 6444	38,300	7,000	94,150	55,850
Local referent inbred	35,800	5,500	73,975	38,175

17,675 INR/ha more

INDONESIA COMPILATION WET SEASON 2012

	Total Cost (IDR/ha)	Yield (kg/ha)	Income (IDR/ha)	Benefit (IDR/ha)
Arize 6444/Tej	9,900,000	9,000	31,500,000	21,600,000
Ciherang	8,250,000	7,000	24,500,000	16,250,000

5,350,000 IDR/ha more

Arize - New Traits. Unique Solutions.

Rice farmers face constant threats from weeds, insects and diseases — some of which are developing resistance to current solutions — that can potentially wipe out entire rice fields.

Bacterial leaf blight (BLB) is a common disease that afflicts severe damage to fields, especially during the rainy season, and against which there is presently no chemical cure. Bayer CropScience was the first to introduce a hybrid in Asia with in-built tolerance to BLB. Today, this trait is being progressively incorporated into all Arize hybrids to protect against this threat during the wet months.

Arize 6444 Gold (BLB-tolerant) Check (non BLB-tolerant)

Insects such as the brown plant hopper (BPH) are capable of destroying entire fields of rice. This migratory pest is resistant to most plant protection products and can induce severe yield losses by sucking the sap of rice plants and introducing viruses that cause serious setbacks to harvests. Bayer CropScience is about to launch a new high-yielding hybrid with good tolerance to BPH. This will also ensure that farmers have a first line of defense against this unpredictable pest.

Rice Blast damage

Rice blast is another serious cause for concern to rice farmers. This fungus is capable of attacking the leaves, stems, and panicles of rice plants throughout the rice-growing season. Bayer CropScience has started to work on various genetic sources of tolerance to blast and will be able, in the coming years, to introduce some hybrids with a high tolerance to this virulent disease.

Weedy rice (also known as red rice) is present all across the Americas and also in some ecosystems of Asia where direct-seeded rice has been established for a long time. It is a wild version of domesticated rice and therefore very difficult to fight. In addition, weedy rice has developed some resistance to the few herbicides used to counter its effects. Bayer CropScience is therefore intensively researching for herbicides with new modes of action to suppress this invading weed.

Excessive salinity, fluctuating temperatures, and water stresses such as droughts and floods significantly affect the actual yield produced in the field, in different rice growing regions.

Vast areas of Asia contain soil that is too saline and therefore unsuitable for rice cultivation. This is true for both coastal and inland areas in many countries. Climate change is exacerbating this phenomenon, with more and more intrusion of seawater in river deltas, severely restricting cultivation in these rice-abundant areas and thus jeopardizing the livelihoods of the communities in these areas. Bayer CropScience, in the near future, will introduce a hybrid that is able to grow in levels of salinity that are twice as high as the ones currently accepted by the most salinity-tolerant hybrids to date.

High temperatures, caused by heat waves that occur during the rice flowering period, are detrimental to plant fertility. Low temperatures, during the cold season in parts of Northern Asia, may hamper the development of young seedlings in nurseries. Bayer CropScience is working to find new parental lines which are more tolerant to extreme temperatures, in order to have a more reliable hybrid rice seed production.

Rice is especially sensitive to water quantity. Irregular water supply (either too much or too little) is a serious threat to rice production. Excessive water in particular, over an extended period, can submerge rice plants for longer than they can survive. Bayer CropScience will shortly be introducing a hybrid that will be able to tolerate up to two weeks of submergence.

“We face problems from blast, water [management] and BPH…BLB is also seen.”

Dindayal Hanumantha, Farmer, Chhattisgarh, India

Cultivating Strong Partnerships

At Bayer CropScience, we are convinced that to make sustainable progress towards enhancing food security and nutrition, stimulating economic growth and protecting the environment, it is critical that we work resiliently together. In each country, we partner with governments, local foundations, institutes, non-governmental organizations, and individuals along the entire rice food chain. We have also been forging strong collaborations with global partners such as the International Rice Research Institute (IRRI), the German cooperation (GIZ), The International Maize and Wheat Improvement Center (CIMMYT), and the Bill and Melinda Gates Foundation (BMGF). We work together to tackle the challenges of rice production, and find solutions that are both innovative and sustainable.

Owing to water issues and labor scarcity, we believe there is a potential in many Asian countries to switch from traditional manual transplanting of rice seedlings (TPR), to direct seeding of rice seeds (DSR). Direct-seeded systems provide several advantages to rice farmers, such as better water efficiency, mitigation of greenhouse gas methane, the possibility to harvest the rice crop earlier, and a significant reduction in the amount of labor and hours required.

When using traditional rice transplanting methods, the labor requirements are 30 people per hectare, whereas sowing using the direct-seeded rice method requires just 1 to 2 people per hectare. However not all rice varieties are adapted to this mode of cultivation because in these conditions the rice plants have to withstand more water stress and more pressure from some weeds, pests and diseases.

Due to their strong vigor and better resilience to general biotic stresses, Arize hybrids have a clear advantage over inbred varieties when used with DSR. Most Arize hybrids have proven to be highly adaptive to direct-seeding techniques, whether in dry or in wet conditions. Arize 6444 Gold was, for instance, the first hybrid to be registered in India for use under the direct-seeding method. Furthermore, under stressful conditions the yield advantage of Arize hybrids over inbred varieties is generally higher than in transplanted conditions. These factors come together to increase rice yields and income levels for farmers and simultaneously reduce the amount of resources required for rice production. (See Table 1.)

Bayer is notably promoting wet direct-seeding with a drum seeder through a sustainable rice solution in Indonesia, called Tabela. The system benefits the environment through the mitigation of methane — a potent greenhouse gas. This methodology recently achieved official approval by the United Nations Framework Convention for Climate Change (UNFCCC).

Table 1

Rice Variety	Crop Establishment	Grain Yield (kg/ha)	Cost of Product (US$/ha)	Gross Return (US$/ha)	Net Income (US$/ha)	Saving in Cost of Product Under DSR (US$/ha)	Gain in Income Under DSR (US$/ha)
Arize 6129	DSR	6870	914	1512	598	114	140
	TPR	6744	1029	1487	458		

Source: Economic Analysis of Direct-Seeded Rice Production Technology : A Case of Haryana, India, CYMMIT/CSISA Average of 2 Years (2010-2011).

Living Our Social Values

“Arize increases our harvest. It helps to support our financial needs, especially for the education of our children and our daily expenses.”

– Susana Arucan, Bertese Quezon, Nueva Ecija, The Philippines

Our hybrid rice production is an activity, which is done under contract with selected rice growers. It requires intense manual work in the field. Although child labor is deeply rooted in many Asian cultures, including the agricultural sector, we make sure that there is no child working in our hybrid rice production fields. This is our commitment: Our Child Care Program.

Our teams use the program’s comprehensive strategy to get the message across that working in the fields can be profitable without resorting to the use of child labor. Education opportunities are also provided for children under our ‘Learning for Life’ program, and our communication measures make parents more aware of the problem. Last but not least, the initiative provides additional incentives such as micro-credits and knowledge transfer on crop production.

The Bayer CropScience Child Care Program covers far more than a contractual ban on child labor and the necessary age verifications in the fields. Five years since the inception of this program, there is an unequivocal acknowledgement by the NGOs working on this issue that Bayer has been successful in implementing a clear zero-tolerance policy on child labor.

Offering an Integrated Solution

Arize is also a technology which is proposed under the The Bayer Much More Rice program, which was created to improve and optimize agricultural practices through the efficient protection and enhancement of rice plants. Each solution and technology in the program is a critical component in a totally integrated approach to rice production.

The program has been scientifically designed by Bayer rice experts to ensure the efficient use of integrated crop protection solutions with improved agronomic practices to realize yield potential, produce quality grains, and increase farmer income. The inclusion of high-yielding Arize Hybrid Rice seeds allows rice growers to further maximize yield potential.

NATIVO®

NATIVO®

Regent® 50 SC

BELT®

Glamore®

Ricestar®

FAME®

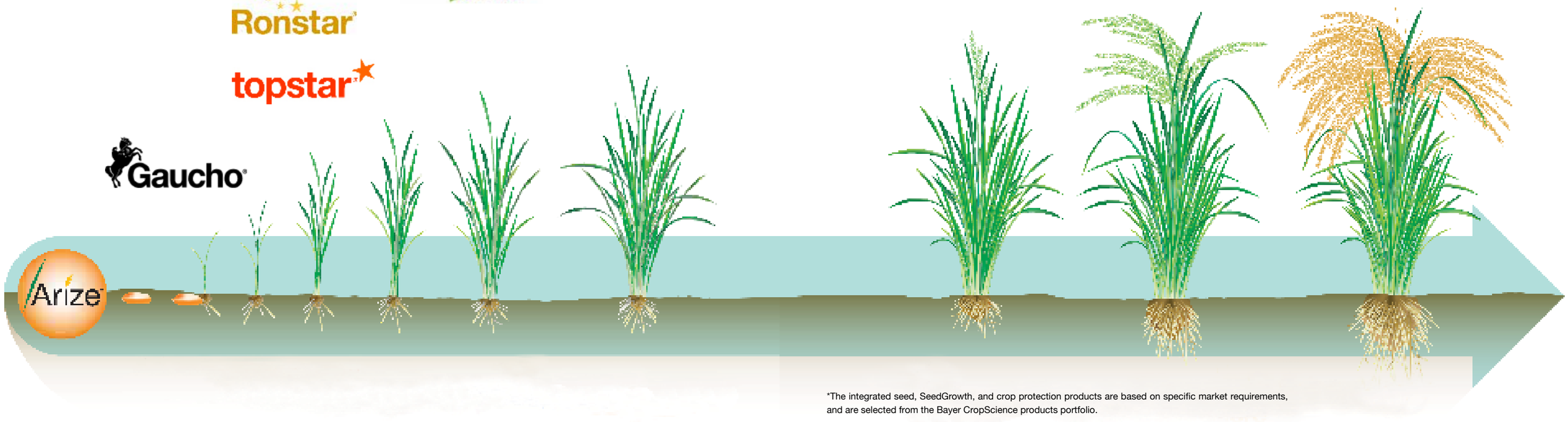
Curbix®

Antracol® with Zinc++

Ronstar®

topstar™

Gaucho®



*The integrated seed, SeedGrowth, and crop protection products are based on specific market requirements, and are selected from the Bayer CropScience products portfolio.