taas
Progress Through Science

BioPrime: An Enterprise Providing Innovative Solutions for Sustainable Agriculture

A Success Story

Dr Renuka Diwan

Trust for Advancement of Agricultural Sciences (TAAS)

GOAL

Harnessing the potential of agricultural sciences for the welfare of people of India

MISSION

Promoting growth and advancement of agriculture through science based policy advocacy, public awareness and effective research and development partnerships

OBJECTIVES

- To act as a Think Tank to deliberate on key issues relating to agricultural research and innovation for development (ARI4D) and to influence policy decisions.
- To organize workshops, conferences, brainstorming sessions, seminars, policy dialogues and special lectures on emerging issues and new developments in agricultural sciences.
- To disseminate knowledge among stakeholders through publication of proceedings, strategy papers, policy briefs and success stories.
- To confer awards on the scientists and farmers of Indian and foreign origin for their outstanding contributions.
- To facilitate scientific interaction and partnerships of non-resident Indian agricultural scientists with Indian scientists.

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Contents

Progress Through Science

Foreword

Translating research outputs into commercially viable technologies and products is one of the most challenging aspects of research and development programs. Many laboratory and experimental field successes fail to make the expected economic and social impact due to inadequate support for outscaling or less than expected performance. BioPrime is a glowing example of a biological science-based enterprise that through its high-quality agricultural biologicals comprising plant immunity boosters, nutrient use efficiency enhancers, soil health improvers, crop protection solutions and climate-resilient crop solutions, has successfully established itself while making a significant contribution to farm productivity and quality of produce.

This publication reflects an exciting success story of establishment and growth of BioPrime under the leadership of Dr Renuka Diwan, in collaboration with two Co-Founders, Dr Amit Shinde, and Dr Shekhar Bhosale. Establishing as BioPrime Agrisolutions Pvt. Ltd. in 2016 availing a grant from the Biotechnology Industry Research Assistance Council (BIRAC), Department of Biotechnology, Govt. of India, today it has grown into a state-of-the-art bioprocessing, fermentation, and analytical testing facility and a large-scale manufacturing unit.

I appreciate that Dr Renuka Diwan has agreed to document an exciting story of BioPrime, the products developed and tested under field conditions, enhancing income of farmers. I am sure, this publication will not only generate curiosity about BioPrime products but also encourage other potential entrepreneurs to set-up similar successful enterprises for increasing farm production and income of the farmers.

RS Paroda
(*Padma Bhushan Awardee*)
Chairman, TAAS and
Former Secretary, DARE& DG, ICAR

Progress Through Science

Abbreviations and Acronyms

AI	Artificial Intelligence
BIG	Biotech Ignition Grant
BIRAC	Biotechnology Industry Research Assistance Council
FICCI	Federation of Indian Chamber of Commerce and Industry
DCM	Delhi Cloth & General Mills Co. Limited
FortiSea	Fortisea-treated plants
FPO	Farmer Producer Organizations
INR	Indian Rupee
NIV	National Institute of Virology
NUE	Nutrient Use Efficiency
PGRs	Plant Growth Regulators
R&D	Research and Development
RKVY	Rashtriya Krishi Vikas Yojana
ROI	Return on Investment
SAU	State Agricultural University
SNIPR	Smart Nanomolecule-Induced Physiological Response

SUCCESS STORY OF BIOPRIME

Agriculture is not just about growing crops — it is about resilience, adaptation, and making informed decisions under uncertainty. A deep understanding of the problem — climate resilience in agriculture — became the foundation of BioPrime's mission. BioPrime's work is driven by these challenges, and its success is measured not only by the adoption of its products but by the positive impact it has on the lives of farmers.

BioPrime successfully scaled from a small lab to a state-of-the-art production facility, with capacity to meet rising market demand. BioPrime is now recognized as a pioneer in the biologicals space, with a rapidly growing customer base and strong business-to-business partnerships. BioPrime continuously learned, iterated, and collaborated, transforming itself from an academic startup into a dynamic, farmer-centric innovation powerhouse.

Today, BioPrime has won the trust of over one lakh farmers, with many making a permanent shift toward sustainable biological inputs. Across diverse crops and geographies, BioPrime's innovations helped farmers to: (i) increase yields by 20-40 per cent; (ii) reduce input costs (fertilizers, pesticides, post-harvest losses) even upto 80 per cent; (iii) command higher prices (up to 3x higher in premium markets); and (iv) expand market reach and reduce middlemen dependency. The real measure of their success lies in the stories of farmers who can afford better education for their children, pay off long-standing debts, and achieve financial freedom for the first time in decades. These lasting positive changes for families and generations are the most significant outcomes of BioPrime's interventions.

BioPrime's products represent a holistic approach to transforming Indian agriculture, reducing dependency on imports, enhancing farmer resilience, improving resource efficiency, and supporting national sustainability goals. This aligns with global and national climate goals, further strengthening India's position as a leader in sustainable agricultural practices. With the potential to create ₹30,000+ crore/ year as combined value, BioPrime is committed to build a self-reliant, sustainable, and prosperous agricultural sector for India. The success story of BioPrime has been encompassed here under the topics – Introduction; Building an infrastructure for innovation; Challenges and constraints; Strategic funding; Major accomplishments; Key factors of success; Impacts and lessons learnt; and Looking ahead: BioPrime's roadmap to global leadership in agricultural biologicals.

BioPrime: An Enterprise Providing Innovative Solutions for Sustainable Agriculture

A Success Story

1. Introduction

The BioPrime, a Pune based company, is developing innovating solutions to production and quality related issues of agricultural crops. It came into being due to a serendipitous convergence of brilliant minds and a shared vision to make a difference to the agricultural scenario of India. Dr Amit Shinde, Dr Shekhar Bhosale, and Dr Renuka Diwan were working on their career paths in science and research. Amit, already a leader in research and development (R&D) on plant tissue culture, was set to manage international co-development projects in a reputed agritech company. Shekhar, deeply embedded in entrepreneurial incubation, had been a mentor and guide of countless startups to success. Meanwhile, Renuka, was leading high-impact research projects at the university to pursue a tenure-track academic career.

Fate intervened when Dr Renuka Diwan and Dr Premnath, the Director of Venture Center, India's leading biotech business incubator, met for setting the wheels in motion. In a casual conversation, Dr Premnath challenged Dr Renuka to consider entrepreneurship beyond academia, and it ignited a spark that soon turned into a catalyst for change. Initially hesitant, Dr Renuka found herself intrigued by the idea of translating research into real-world solutions. She shared this vision with Amit and Shekhar, and they quickly realized that they shared a common feeling – something is missing from their so-called picture perfect lives. They were enjoying their professional successes, but were driven by an unfulfilled desire to make a larger impact on chosen fields. United by their friendship since their post-graduation days at Pune University, their shared values, and complementary expertise, the trio decided to take a leap of faith. They knew their bond, built on years of collaboration and mutual trust, would help sail through the turbulent world of startups, where risks are high and challenges are endless.

The birth of BioPrime: From idea to reality

Inspired by their conversation with Dr Premnath, the trio decided to apply for the Biotech Ignition Grant (BIG), Biotechnology Industry Research Assistance Council (BIRAC; https://www.birac.nic.in/) — a prestigious government program designed to support early-stage biotech innovations. This process became their first entrepreneurial adventure, forcing them to learn the language of business plans and commercial viability. With invaluable guidance from Venture Center's (https://www.venturecenter.co.in/), they secured the grant on their first attempt. With the grant money in hand, Dr Amit Shinde, Dr Shekhar Bhosale, and Dr Renuka Diwan, the founders of BioPrime, formally registered BioPrime Agrisolutions Pvt. Ltd. on 4th July 2016.

A shared vision with different approaches

Many conventional startup playbooks suggest that founders should come from diverse backgrounds — a mix of business, technology, and operations. But, when it comes to something as complex as deep-tech innovation, it is often a shared, deep-rooted knowledge base that makes breakthrough solutions possible. The BioPrime founders, despite their common educational background, could not be more different in their approaches. As individuals, they differ but like rainbow colours — Amit, a meticulous planner, ensured scientific rigor and process efficiency; Shekhar a resourceful manager who managed operations, sourcing, vendors managing quality with efficiency; and Renuka, the visionary, relentlessly navigated business complexities of market and partnerships — present as a natural team. This blend of scientific expertise and diverse thought processes became BioPrime's biggest strength, allowing them to bridge the gap between research, real-world application, and commercial success.

A mission to transform agriculture

The early years were challenging, marked by scepticism to convince the farmers towards new biological approach. But the BioPrime team remained steadfast in their mission, i.e. helping farmers adapt to a changing climate and build resilience against unpredictable weather patterns. They understood the limitations that conventional chemical fertilizers and synthetic pesticides offered no protection against climate-induced stress. They also knew that nature itself had mechanisms to help plants survive such challenges. Their scientific training led them to a critical insight that plants use secondary metabolites — natural compounds that serve as their first line of defence against environmental stress, pathogens, and

extreme weather. These molecules were the key to developing a new generation of agricultural solutions. Determined to bridge the gap between cutting-edge science and practical agricultural solutions, the trio set out to develop biological products that could enhance plant resilience, improve soil health, and boost productivity, while minimizing the environmental impact.

Their initial research focused on: (i) understanding how plants respond to stress at a molecular level; (ii) studying plant-microbe interactions to improve nutrient uptake and immunity; and (iii) identifying bioactive secondary metabolites that could enhance crop performance. With these insights the products of BioPrime were born. Unlike traditional agri-input companies that relied on chemical-based solutions, BioPrime was founded on nature's own mechanisms, creating sustainable, bio-based products that could help farmers to combat climate stress, reduce dependency on synthetic fertilizers, and improve overall farm productivity and profitability.

2. Building an Infrastructure for Innovation

With the project grant money, the founders set-up their first facility in a friend's rented bungalow! They converted the garden into an experimental plot and the terrace into a polyhouse — embodying the true spirit of frugal innovation. Incubated at Venture Centre, they gained access to essential equipment. Every rupee counted, and every experiment was a testament to their unwavering belief. This humble beginning later paved the way for a state-of-the-art R&D lab and large-scale manufacturing unit.

Over the years, BioPrime invested heavily in creating a robust infrastructure to support its ambitious goals. Starting with a small R&D set-up (Figs. 1, 2, 3), the company gradually scaled up to include state-of-the-art facilities for bioprocessing, fermentation, and analytical testing (Figs. 4, 5). Today, BioPrime boasts a state-of-the-art R&D facility supporting two biodiscovery programs — SNIPR for biomolecule discovery and Bionexus for microbe discovery. BioPrime has named its laboratories after pioneering scientists as a tribute to their contributions in respective fields, e.g. (i) Lorenz Hiltner Microbe Isolation Facility, (ii) Rosalind Franklin Molecular Bio Lab, (iii) Albrecht Kossel Secondary Metabolite Laboratory, (iv) MS Tsvet Chromatography Laboratory, (v) Robert Koch Screening Laboratory, (vi) Ghua and Maheshwari PTC Laboratory, (vii) JR Petri Media Preparation Room, and (viii) Jagdish Chandra Bose Plant Growth Room.

The team also forged strong partnerships with academic institutions like Savitribai Phule University of Pune; Indian Institute of Technology, Powai; Karnatak

Fig. 1. *Initial lab set-up of BioPrime, consisting of a single clean room and incubation room. Amit and Shekhar explaining to Mr Vijay Chabria, MD Finolex, about functioning of biologicals discovery systems*

Fig. 2. *Small scale set-up for product filling and packing*

Fig. 3. *BioPrime team, celebrating 5th Foundational Day, in the old facility, just before shifting into the new facility*

Fig. 4. *New facility with state-of-the-art infrastructure comprising incubation lab, isolation lab, screening labs, and growth chamber*

Fig. 5. *Microbe isolation lab*

University, Dharwad; Indian Institute of Horticultural Research; corporate partners like Delta Agrigenetics; DCM Shriram; new age Startups like Agrostar and farmer groups. This collaborative approach allowed them to test their products rigorously, refine their formulations, and build credibility in the market.

Isolation lab has developed 70 different pre-treatments and media combinations to get the maximum microbes from a sample. This is a very critical and laborious work that needs precision and skill. The Isolation Lab has the capacity to process 2,000 microbes/month.

At BioPrime, women are in-charge of research and development programs and activities. In fact, 70 per cent of the research team comprising the women force. BioPrime is dedicated to helping young women grow into leaders. Many of the team leaders who guide important research projects are women (Fig. 6).

3. Challenges and Constraints

2016: The year that changed everything

When BioPrime was founded in 2016, India was facing one of its worst El Niño-induced heat waves, with Western Maharashtra's tomato belt — spanning

Fig. 6. *Women leaders for the R&D at BioPrime*

over 20,000 acres — devastated by erratic weather. Unseasonal rains followed by extreme heat at flowering stages led to 100 per cent crop losses in several areas, pushing farmers into financial distress.

At the time, BioPrime's founders were conducting early field trials, testing their first biostimulant formulations. Convincing farmers to adopt a new biological solution was an uphill task — only 100 in Yedgao, Naraynagoa, Maharashtra farmers agreed to apply it. These were mostly small- and medium-holding farmers with 2-5 acres of land. However, to build confidence, BioPrime took an innovative approach by providing free seedling treatment at a local nursery, Mauli Hi Tech, in Narayangoa, Maharashtra.

The results were remarkable — seedlings treated with the formulation showed reduced mortality, early establishment, and stronger root development. Even then, most of the farmers remained doubtful and only 100 farmers continued to use BioPrime's formulation. But when the full-blown heat wave struck, the 100 fields having used BioPrime's formulation stood lush green amid acres of wilted, virus-infected tomato crop. (News on Narayangao Crop Failure, https://www.thehindu.com/features/magazine/When-life-gives-you-tomatoes/article14399330.ece)

Witnessing this stark difference, curiosity of neighbouring farmers turned into conviction. Those 100 farmers harvested normal yields of 30-35 tons/acre — a stark contrast to others who faced complete losses. And with tomatoes commanding record farm-gate prices of ₹ 100/kg owing to scarcity, they earned nearly triple of their usual income.

The unnamed formulation became popular among farmers as the Green Product. Inspired by this, BioPrime officially named it Verdant — a tribute to the flourishing fields that defied the heatwave.

Overcoming challenges

Building a deep-tech agri-biological company from scratch was not an easy task. From navigating regulatory landscapes to scaling production while ensuring quality, and most importantly, convincing farmers to trust and adopt biological solutions, BioPrime faced major challenges along the way as described in the next section. However, rigorous science, unwavering commitment, and the farmer-first approach enabled to overcome these challenges and emerge as a trusted name in the industry.

(i) Breaking the barrier of farmer adoption

The challenge

Farmers traditionally averse risk and simply rely on proven chemical inputs for their crops. Introducing biological alternatives — even if backed by science — is met with scepticism or a stern NO. Many farmers viewed biostimulants and biofertilizers as unreliable or slow-acting compared to conventional chemical-based solutions.

How BioPrime overcame it?

- **Data-driven demonstrations:** BioPrime conducted thousands of on-field trials across diverse geographies and crops, generating scientifically validated results. Farmers were shown side-by-side comparisons, allowing them to witness the first-hand benefits.
- **Farmer education and training:** The company engaged in continuous dialogues with farmers, organized field days, training sessions, and interactive Q&A fora.
- **Pilot-scale adoption:** Instead of expecting farmers to switch overnight, BioPrime encouraged small-scale trials on a portion of their land and the positive results led to larger adoption.

- **Partnering with progressive farmers:** Early adopters and influential farmers became brand ambassadors of BioPrime, helping spread word-of-mouth credibility.
- **Performance-based ROI proof:** BioPrime ensured its products provided visible yield and quality improvements, leading to better market prices (better return-on-investment or ROI) for farmers (10-15% higher earnings in some cases).

(ii) Regulatory approvals: Navigating the complex landscape

The challenge

The agricultural biologicals industry is heavily regulated, with stringent product testing, efficacy validation, and safety compliance required before commercialization. Getting biofertilizers, biopesticides, and biostimulants approved involved navigating multiple government agencies, long approval timelines, and complex paperwork.

How BioPrime overcame it?

- **Investing in scientific rigor:** BioPrime built a robust regulatory and documentation framework, ensuring every product met or exceeded compliance standards from the start.
- **Strategic engagement with authorities:** Instead of treating regulations as roadblocks, BioPrime engaged proactively with policymakers and regulatory bodies, offering data-backed insights to support their approvals.
- **Collaborating with research institutions:** Partnering with recognized universities and agricultural research centres helped validate the efficacy and safety of their products, smoothening the regulatory approvals.
- **Developing multi-country compliance:** With global expansion in mind, BioPrime worked on ensuring compliance not just in India, but also in international markets, positioning itself for future growth.

(iii) Scaling production while maintaining quality

The challenge

Manufacturing biological products is very different from synthetic chemicals. Live microbes, bioactive compounds, and secondary metabolites require precise formulation conditions to remain viable and effective. As demand grew, BioPrime faced the challenge of scaling-up production while ensuring batch-to-batch consistency with regard to its efficacy.

How BioPrime overcame it?

- **Optimized fermentation and formulation techniques:** BioPrime invested in R&D-driven process improvements, ensuring longer shelf-life and stability.
- **Automated production facilities:** By introducing automation and precision monitoring, production was scaled 10x while maintaining quality control.
- **Stringent quality testing:** Each batch undergoes multi-stage testing, ensuring consistent potency and effectiveness before reaching to the farmers.
- **On-site warehousing and distribution planning:** A streamlined supply chain strategy ensured that products reached farmers without degradation in quality.

(iv) Building market awareness and overcoming industry resistance

The challenge

The agricultural input market is dominated by large agrochemical corporations with deep pockets and aggressive marketing strategies. BioPrime had to carve out its niche in this highly competitive landscape, educating both farmers and agribusiness partners about the merits of usage of biological solutions.

How BioPrime overcame it?

- **Strong scientific branding:** Instead of relying solely on promotional tactics, BioPrime positioned itself as a science-first, data-backed company, earning credibility.
- **Industry collaborations:** Partnering with distributors, agri-businesses, and large-scale buyers helped drive adoption beyond just individual farmers.
- **Participation in agri-expos and trade shows:** BioPrime actively showcased its innovations at national and international agriculture exhibitions, strengthening industry presence.
- **Farmer cohorts:** A mix of social media engagement, farmer groups, local influencer outreach, and on-ground demonstrations accelerated adoption. BioPrime started 'King Farmer Cohorts' that curates stage-wise learning, knowledge sharing opportunities for farmers in a particular crop (Fig. 7). Farmers visited labs and for the first time they saw the science behind the products generally used. Farmers also learned how to use soil testing kits and visited field demonstrations to see first hand the product performances.

Fig. 7. The King Farmer Cohorts: Experiential learning approach through science-based solutions developed by BioPrime

4. Strategic Funding

BioPrime grew from a modest 2,000 sq. ft. all-in-one facility — housing its lab, production, and office to a state-of-the-art 5,000 sq. ft. R&D lab and a 10,000 sq. ft. advance manufacturing unit. This transformation could happen only through relentless innovation, strategic financial planning, and strong support from government initiatives. Unlike many startups that rely heavily on venture capital from day one, BioPrime strategically focused on securing non-dilutive capital through grants, government programs, and industry awards (Table 1). This approach allowed them to achieve traction, refine their product-market fit, and scale operations without sacrificing equity.

In India, where life sciences funding remains sparse and ag-biotech startups are only few, this method enabled BioPrime to bridge the funding gap and emerge as an attractive investment opportunity for top-tier agri-tech and deep-tech investors. Their disciplined approach to growth eventually led to multiple successful funding rounds, backed by premier venture capital firms.

Today, BioPrime stands as a testament to how innovation, perseverance, and strategic capital allocation can drive scientific breakthroughs and large-scale impact for sustainable agriculture (Table 1).

Table 1. Strategic use of non-dilutive funding in BioPrime's technology advancement till TRL 6-7

Scheme	Use by BioPrime
BIRAC-BIG	Proof of concept funding
BIRAC Seed	Market test run in Maharashtra
BIRAC Leap Fund	Scale-up facility 100-500 L batch production
Tie- BIRAC WInER Award	Instrumentation
Pusa UPJA	Instrumentation, scale-up 100-500 L batch production
AIM-New India Challenge	Scale-up facility 500-1,000 L batch production
Social Alpha Agritech Challenge	Market expansion in Uttar Pradesh
Cisco Agritech Challenge	Market expansion in Uttar Pradesh

5. Major Accomplishments

(i) SNIPR and bionexus platforms

Several SNIPR-based products have already been commercialized. SNIPR and Bionexus Platforms are the innovation engines of BioPrime. Details of SNIPR differentiators, SNIPR capabilities and SNIPR portfolio are given in Fig. 8.

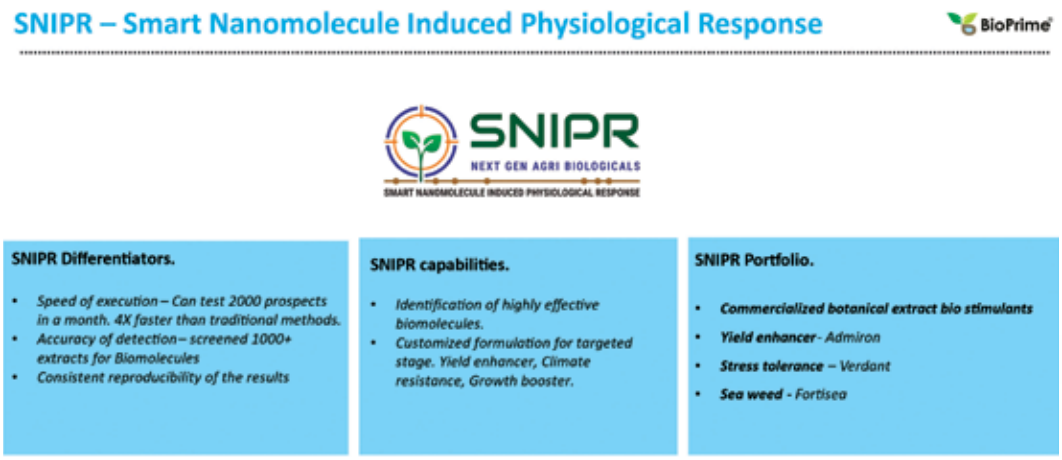


Fig. 8. SNIPR differentiators, capabilities and portfolio

BioPrime established an excellent microbe library known as BioNexus, which is the India's largest plant associated microbe library. This microbe library houses India's largest collection of 17,722 microbes from 400 plant species from 13 agroclimatic regions, representing different altitudes, rainfall and temperature regimes (Fig. 9). The BioNexus capabilities include crop productivity, abiotic stress tolerance, and plant protection. Also, the samples of plants, soil, and water from Northeast India were collected to find interesting microbes. Different microbes were separated from the samples and made sure to obtain pure, and single types of each microbe. These were labelled and identified using a special method called 16sRNA (Fig. 10). BioNexus library contains microbes from areas spanning over diverse agroclimatic zones and biodiversity hotspots (Fig. 11). The Bionexus library and the cryogenic preservation system for microbes are given in Fig. 12. The BioPrime facility also includes the screening of functionality of novel biofungicides (Fig. 13).

BioPrime also established advance biomanufacturing capabilities that enabled the consistent production of high-quality agricultural biologicals. These facilities are the backbone of its product line, ensuring scalability and reliability as the company grows. These facilities were built slowly and painstakingly over the span of 8 years, through funding received from government schemes like Atal Innovation Mission's Atal New India Challenge, RKVY Raftar, PUSA, and several awards that the company won like TiE-BIRAC Winner, Social Alpha Agritech Challenge, Cisco

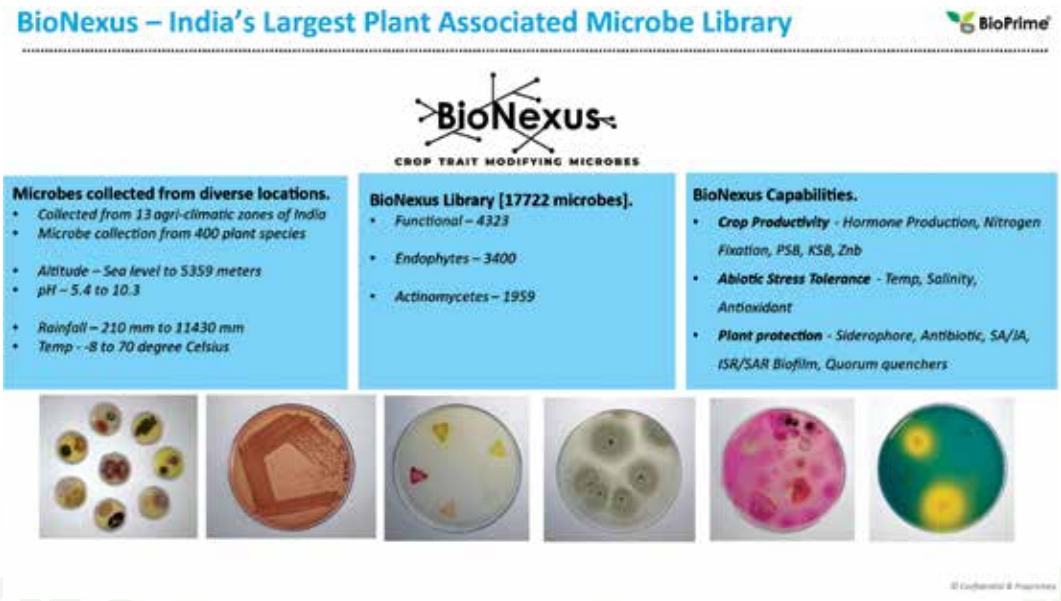


Fig. 9. *BioNexus — India's largest Plant Associated Microbe Library*

Fig. 10. *Plant, soil, water samples collection to microbe identification from North-eastern regions*

Agritech Challenge (Table 1). This helped BioPrime build the initial infrastructure, proof of concept and traction which helped them secure venture capital from Omnivore, Inflexor, and recently Series A funding from Edaphon. Supported with the new infusion of capital and trust, the BioPrime is now expanding outside India

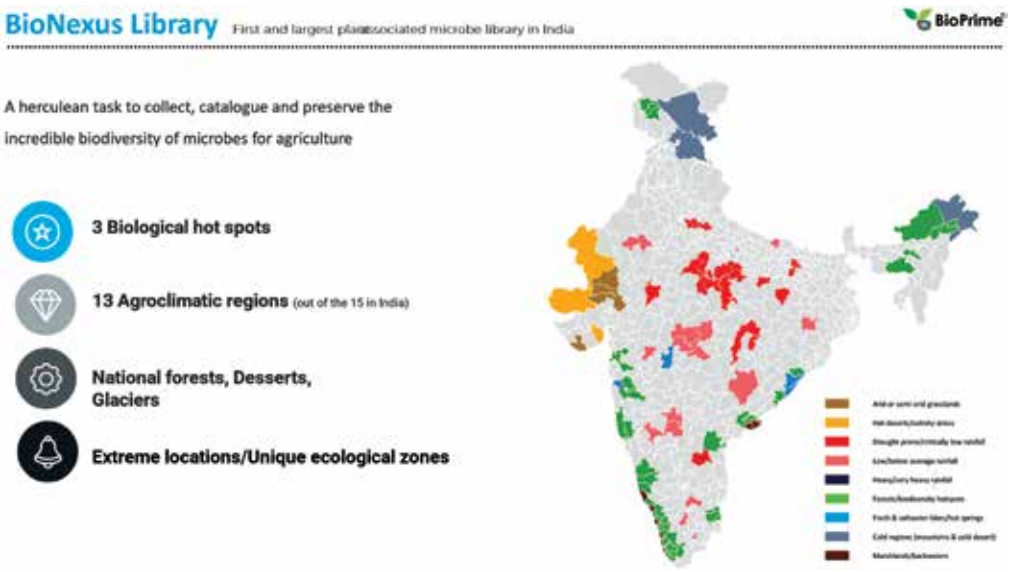


Fig. 11. *Bionexus library spanning over diverse agroclimatic zones and biodiversity hotspots*

Fig. 12. *Bionexus library and cryo-preserved microbe bank*

Fig. 13. *Microbe functionality screening for novel biofungicides*

Fig. 14. *BioPrime's philosophy of biologicals design*

in Southeast Asia and the United States of America with modified philosophy of biological design (Fig. 14).

(ii) BioPrime innovations and products

A Portfolio of innovative solutions

BioPrime is revolutionizing agriculture with innovative solutions. Leveraging their patented SNIPR™ technology, the company develops solutions that address critical challenges of farmers. The product portfolio includes several products under different segments (Fig. 15).

BioPrime uses a cold percolation extraction technology as an alternative to the more commonly used fermentation-based methods. Globally, 90 per cent of seaweed products are derived from *Ascophyllum nodosum*, with the extract typically produced through hydrolysis or fermentation. While these conventional processes yield products rich in polysaccharides, sugars, and amino acids, they suffer from significant batch-to-batch variability in active ingredients. More importantly, the harsh conditions of hydrolysis and fermentation often degrade secondary metabolites, compromising their bioactivity.

Secondary metabolites are specialized compounds that plants naturally produce as a defence mechanism against stress, pathogens, and to attract pollinators. These

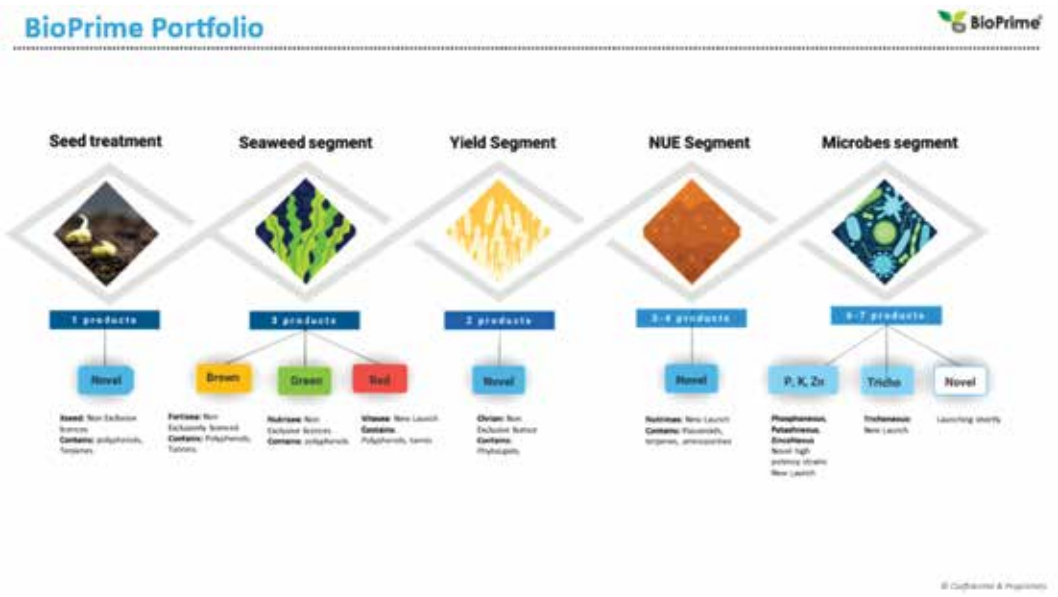


Fig. 15. *BioPrime's portfolio of products*

molecules form a plant's first line of defence in stressful environments, providing resilience and protection. Recognizing their critical role, BioPrime's extraction process focuses on preserving these potent bio-actives in their most natural and active form. Their gentle, slow cold-extraction process preserves the integrity and stability of valuable secondary metabolites, resulting in consistently effective formulations for plant health and resilience. Understanding the impact of extraction techniques on the active compound profile of a sample is crucial. BioPrime distinguishes itself by using a proprietary cold percolation technique to extract small molecule secondary metabolites from plants, offering a distinct advantage over widely used fermentation methods. This focus on extraction technique allows BioPrime to optimize the recovery of specific valuable compounds (Fig. 16).

Different seaweeds have different beneficial secondary metabolites and each is selected for their ability to improve growth, stress resistance or immunity. BioPrime's SNIPR formulations, using these seaweeds, outperform fermentation-based products for stress tolerance and antioxidant effects.

A significant positive impact on root architecture was observed under stress conditions with FortiSea-treated plants (Table 2). The ability to sustain root branching, lateral development, and tertiary branching under drought and heat stress enhances a plant's capacity to access deeper moisture and essential nutrients,

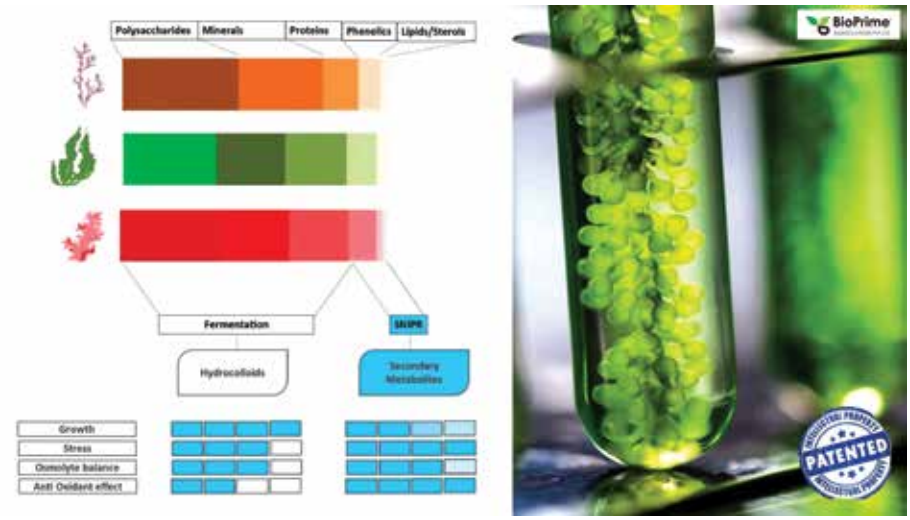


Fig. 16. Optimizing extraction of secondary metabolites at BioPrime

Table 2. Comparative stress tolerance performance (market products ***vs*** BioPrime products), comparing market products with BioPrime technology

Treatments	Relative water content (%)			Cell membrane stability index (%)		
	Drought	Salinity	Heat	Drought	Salinity	Heat
Absolute control (not exposed to stress)	87.57	89.31	95.2	62.97	74.02	81.33
Control (no product application) subjected to stress	34.92	76.46	80.7	53.56	44.21	59.21
Competitor applied plants subjected to stress	44.3	78.56	92.1	60.45	48.27	68.21
Fortisea-applied plants subjected to stress	66.44	84.70	95.4	61.49	60.24	71.59

ensuring greater resilience. This robust root system improves stress tolerance and also accelerates post-stress recovery, reducing yield loss and minimizing the overall impact of environmental stress on the farm (Fig. 17).

Yield comparison in several crops across geographies, has successfully shown that this extraction process and the seaweed formulation are much superior to the traditional fermentation-based seaweed formulations. Fortisea treated crops showed on an average 24-30 per cent increase in yield, which was on an average 14 per cent higher than that of competitor product (Table 3).

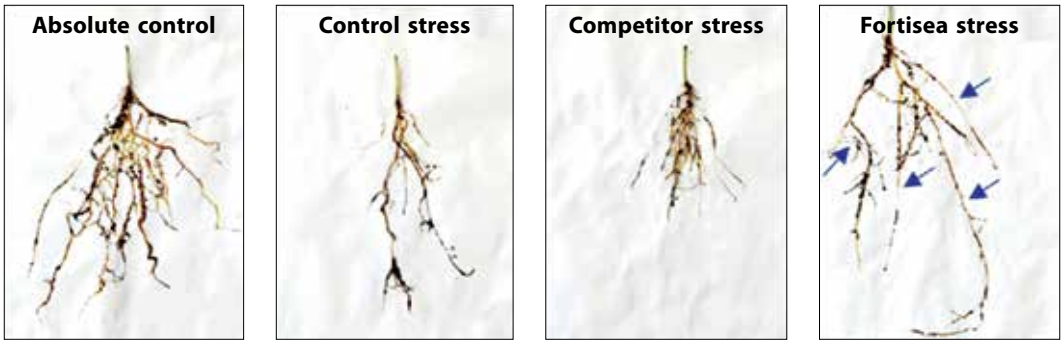


Fig. 17. Comparing impact on root architecture under stress

Table 3. Comparing impact on yield in different crops

Crop	No. of plots	Yield control (mt/plot)	Yield comp (mt/plot)	Yield fortisea (mt/plot)	Comp increase over control (%)	Fortisea increase over control (%)
Tomato	5	6.97	7.93	9.03	13.8	29.5
Chili	5	4.52	5.33	6.35	17.9	40.4
Soybean	5	13.0	14.4	16.23	10.77	24.8
Rice	6	10.03	11.35	12.97	13.2	29.3
Cotton	6	12.02	13.52	16.32	12.5	35.7

Driving the next agricultural revolution

BioPrime is at the forefront of sustainable agriculture, bringing cutting-edge biological innovations to increase productivity, improve crop resilience, and enhance soil health. The company's science-driven approach focuses on harnessing secondary metabolites, microbial biostimulants, and novel biochemical formulations to offer effective, environment- friendly alternatives to traditional agrochemicals.

(iii) Seed treatment – seed shine

Seeds are the foundation of a good harvest. BioPrime's Seed Shine range ensures good germination, early vigour, and protection against environmental stress causing factors, giving crops the best possible start.

Current products

- **Seed Shine ST1** – Enhances germination rate, root strength, and stress resistance, ensuring uniform plant establishment (Fig. 18).

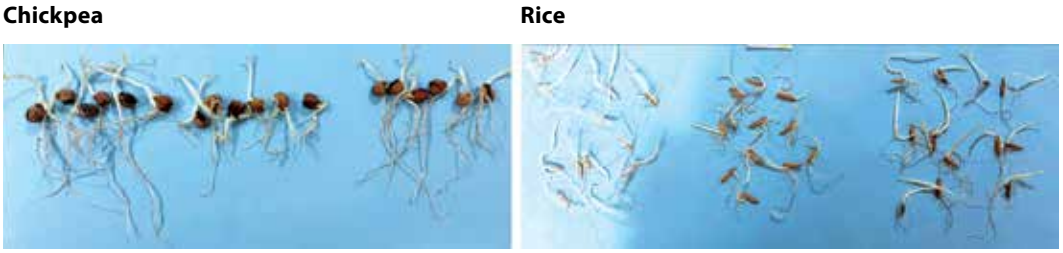


Fig. 18. Comparing impact of seed shine on germination under stress

- **Seed Shine ST2 –** A unique blend of bioactive molecules and beneficial microbes that boost seedling metabolism, enhancing nutrient uptake from day one.

Upcoming innovations

- Biofungicidal seed treatment is currently in advance development stage. This formulation will combat fungal infections of *Pythium*, *Fusarium*, and *Rhizoctonia*, providing an eco-friendly alternative to synthetic seed coatings.
- The seed treatment increased seedling survival rates by 25 per cent in field trials.
- The treatment resulted in 40 per cent better root mass development, leading to healthier crop stands.

(iv) Nutrient use efficiency (NUE) enhancers

Traditional fertilizers often suffer from low absorption efficiency, with much of the applied nutrients getting lost through leaching and volatilization. BioPrime's NUE enhancers increase nutrient uptake and utilization, reducing input costs and environmental impact.

Current products

- **PhosphoNexus –** Unlocks bound phosphorus from soil, making it available to plants and reducing dependency on synthetic phosphorus fertilizers.
- **NutriMax –** Enhances nitrogen assimilation, allowing crops to thrive even at reduced nitrogen application rates (Fig. 19).
- **MicroNexus –** Prevents micronutrient deficiencies (Zn, Fe, B), ensuring balanced plant growth and higher photosynthetic efficiency.
- Field trials demonstrated that even at 80 per cent reduced fertilizer doses, crop yields remain unaffected.
- Improves nutrient availability in the rhizosphere, reducing fertilizer wastage by 30-40 per cent.

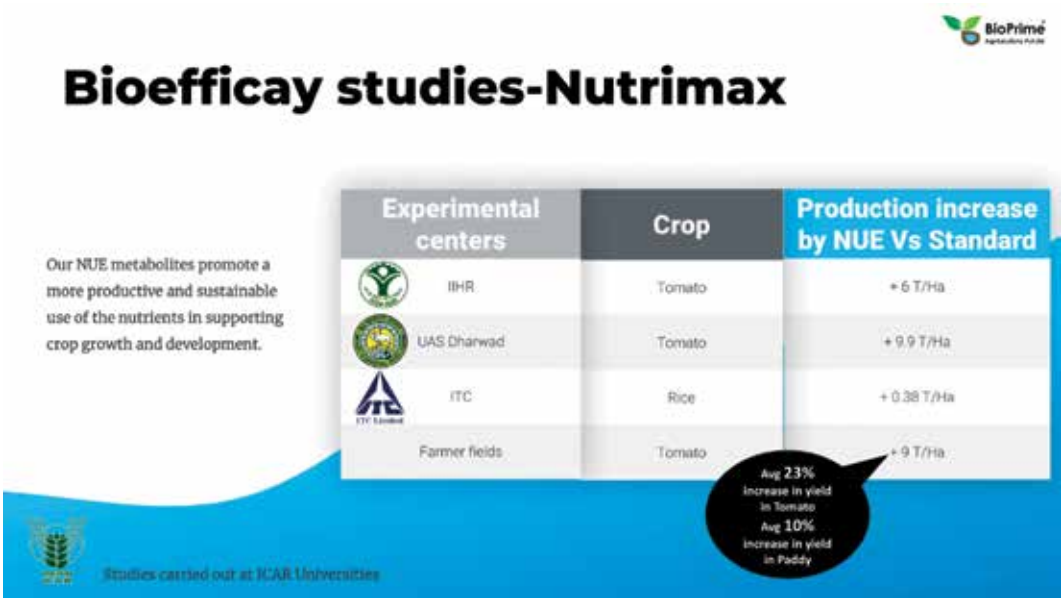


Fig. 19. Bio-efficacy of NutriMax in different crops

(v) Stress mitigation solutions

Climate change is becoming increasingly unpredictable, with erratic rainfall, heat waves, and salinity issues, affecting global agriculture. BioPrime's stress mitigation products help crops withstand extreme conditions, ensuring consistent yields.

Current products

- **FortiSea –** A seaweed-based biostimulant rich in bioactive compounds, enhancing crop resilience against heat, drought, and salinity stress and enhanced yield in okra (Fig. 20).
- **Verdant –** A botanical extract-based growth enhancer that stimulates flowering, pollination, and fruit set, even under adverse climatic conditions.
- **Admiron/Chiron –** A breakthrough botanical extract based yield enhancer, which increases quality and shelf-life.
- Heat-tolerant wheat varieties treated with FortiSea saw a 30 per cent reduction in yield loss during heatwaves.
- Verdant-treated crops had a 15 per cent higher fruit set rate, even in high-temperature stress conditions.
- Farmers using Shelf+ were able to command 10-15 per cent higher market prices due to superior shelf-life.

- Bio-efficacy data on use of Chiron at 3 SAUs in 3 different agroclimatic zones showed increase in tomato yield (Fig. 21).

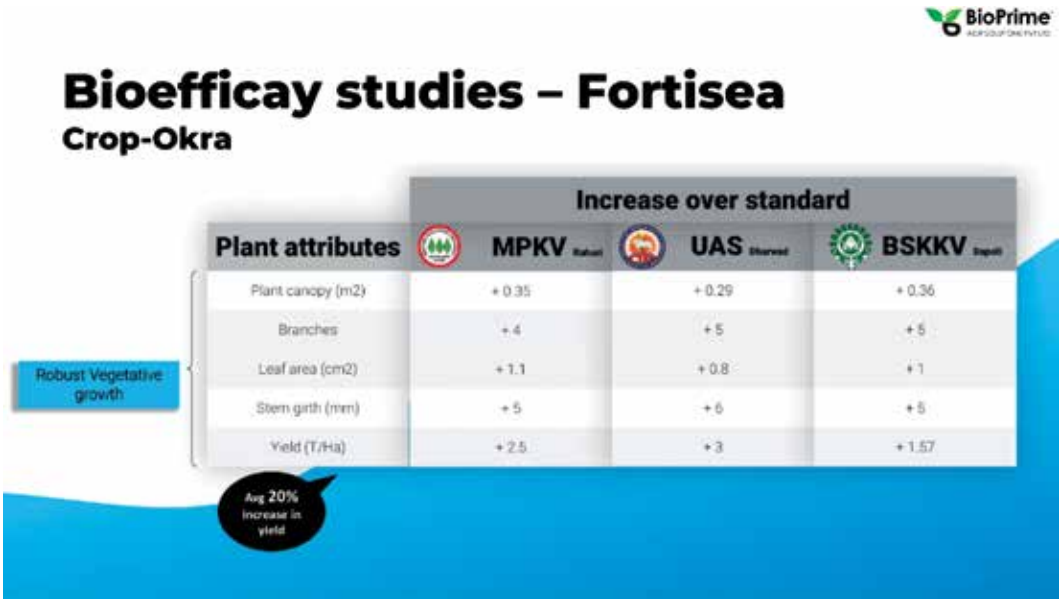


Fig. 20. *Bioefficacy studies of FortiSea on okra in 3 State Agricultural Universities from 3 different agroclimatic zones*

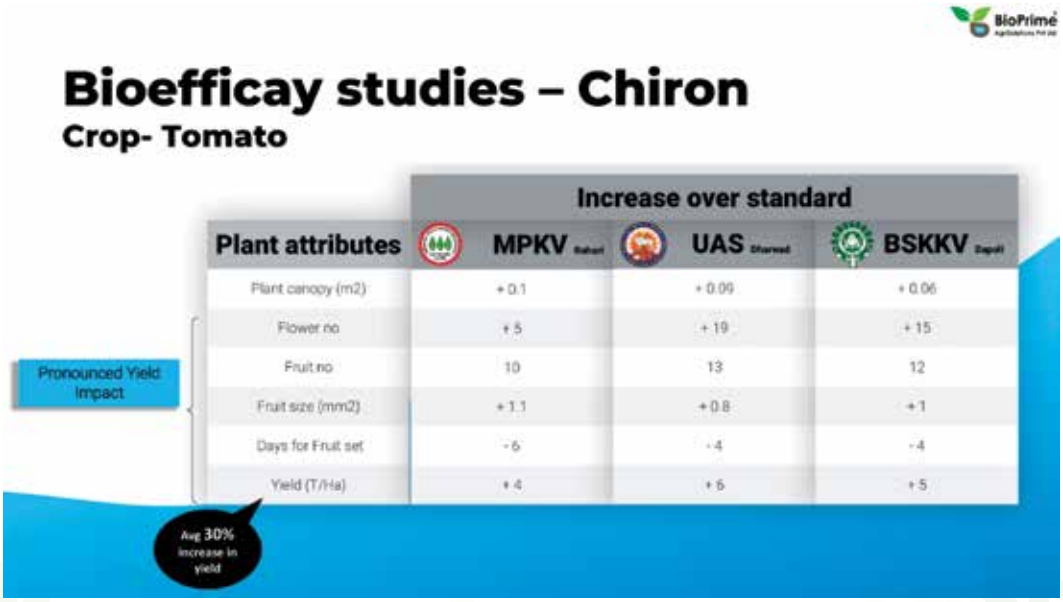


Fig. 21. *Bio-efficacy data on use of Chiron from 3 SAUs from 3 different agroclimatic zones*

(vi) Soil health improvers

Decades of intensive farming have depleted soil organic matter and microbial diversity, leading to poor nutrient retention and reduced productivity. BioPrime's soil solutions restore soil vitality, improve structure, and increase microbial activity.

Current products

- **SoilJet –** A carbon-rich soil enhancer that boosts microbial populations and improves soil texture.
- **MycoNexus –** A mycorrhiza-based biofertilizer that increases nutrient and water uptake by expanding root surface area.
- **TrichoNexus –** A *Trichoderma*-based soil inoculant, promoting root health while suppressing soil-borne pathogens.

(vii) Crop protection solutions

With growing concerns over chemical pesticide residues, BioPrime is pioneering biological crop protection solutions that are effective, residue-free, and safe for beneficial insects.

Current products

- **BioShield F –** A next-gen biofungicide with preventive and curative action against 12 soil-borne fungal pathogens.
- **TrichoNexus+ –** A dual-action *Trichoderma* formulation, providing long-term protection against root and foliar diseases.

Upcoming innovations

- **Bioinsecticides:** Novel formulations targeting caterpillars, whiteflies, and borers, offering precise and effective control without harming pollinators.
- **Broad-spectrum biopesticides:** Several promising botanical-based and microbial-based biopesticides in development, offering natural alternatives to synthetic chemicals.

6. Key Factors of Success

Can success be packaged into a formula? Probably not. However, the process of analyzing successes and failures provides valuable lessons for improvement. What lessons, then, can we extract from BioPrime's journey? What did BioPrime get right? The key to BioPrime's success is its unwavering focus on its basic principles.

Scientific rigour

Every product is backed by years of research and validated through extensive trials. BioPrime generated deep gene level understanding on how the product works, what pathways get activated due to the biomolecules on one hand and on the other hand, BioPrime demonstrated consistency of results through multi-location, multi-crop trials. Developing deep understanding of each product's performance on target crops is crucial in ensuring product success.

Farmer-centric approach

Solutions are designed to be easy to use, affordable, and impactful for farmers. Benchmarks on use, price brackets, prevalent agronomic practices, are gathered before any product development commences. These success metrics help BioPrime maintain a razor-sharp focus in farmer-centricity.

Faster iterations

BioPrime's deep R&D capabilities led to a very fast testing-iteration cycles. They developed rapid screening protocols where reliable, predictable data can be gathered on a formulation within weeks. Using this information, BioPrime rapidly iterates on formulation, composition, and other variables. This data-driven optimization allows for a minimum of 4-5 iteration cycles per season, with market response influencing each adjustment.

Manufacturing

Contrary to the industry standard of setting up fermentation-based seaweed or botanicals processing plants, BioPrime challenged the *status quo* and established a new extraction technology. BioPrime's raw material to finished product yield rate is extremely high, leading to healthy margins on products, where most players struggle.

Clarity on go-to-market approach

Though most of the players in the industry opt for a business-to-consumer approach of establishing their own distribution networks, BioPrime has consciously chosen the business-to-business approach, allowing them to use capital for research and product advancement rather than working capital and credit cycles. BioPrime has always focused on early revenue generation and maintaining positive Unit economics.

Sustainability

By promoting resource efficiency and reducing environmental impact, BioPrime is paving the way for a greener future - **From Nature, For Nature, Always!**

7. Impact and Lessons Learnt

Contributing to national priorities

BioPrime's work is fundamentally aligned with several of India's national priorities, including the *Atmanirbhar Bharat* (Self-Reliant India) initiative, import substitution, and the promotion of sustainable agriculture. As a pioneering biotechnology company focused on creating innovative, locally manufactured solutions, BioPrime plays a vital role in reducing India's dependency on imported agricultural inputs, especially in the high-growth segment of biostimulants and bio-based agricultural solutions.

Estimated value created by BioPrime

The estimated values created by BioPrime in different sectors are briefly given below:

Import substitution and revenue generation

- Estimated ₹200-300 crore/year in domestic market revenue by replacing imported seaweed biostimulants.
- ₹1,000 crore/year savings in foreign exchange through local production.

Savings on fertilizer subsidies

- Potential to reduce fertilizer subsidy spending by ₹30,000 crore/year, directly easing the government's financial burden.

Job creation and economic impact

- Creation of 500-700 direct jobs and thousands of indirect jobs in associated industries.
- Annual economic contribution of ₹500-700 crore through job creation, local business growth, and supply chain activities.

Environmental and sustainability impact

- Reduction of 3-5 million tons of CO_2 annually, contributing to national carbon reduction goals.

- Restoration of 2 million hectares of degraded farmland through sustainable agricultural practices.

Collaboration and learning

One of the biggest lessons BioPrime learned was the power of collaboration in overcoming challenges and accelerating BioPrime's success, whether it was for: (i) working with scientists to unravel plant-microbe interactions; (ii) partnering with agricultural universities for product validation; (iii) engaging with industry leaders to scale reach; and (iv) listening to farmers and co-developing solutions based on their real-world challenges.

BioPrime's contributions go far beyond individual products — they represent a holistic approach to transforming Indian agriculture, reducing dependency on imports, enhancing farmer resilience, improving resource efficiency, and supporting national sustainability goals. This aligns with global and national climate goals, further strengthening India's position as a leader in sustainable agricultural practices. With the potential to create ₹30,000+ crore/year as combined value, BioPrime is committed to build a self-reliant, sustainable, and prosperous agricultural sector for India.

BioPrime successfully scaled from a small lab to a state-of-the-art production facility, with capacity to meet the rising market demand. BioPrime successfully registered and commercialized multiple products, and is fast-tracking approvals for its upcoming innovations. It is now recognized as a pioneer in the biologicals space, with a rapidly growing customer base and strong business-to-business partnerships. BioPrime continuously learned, iterated, and collaborated, transforming itself from an academic startup into a dynamic, farmer-centric innovation powerhouse. Today, over one lakh farmers trust BioPrime, with many making a permanent shift toward sustainable biological inputs. Use of BioPrime crop protection products resulted in 50-70 per cent reduction in fungal disease severity in multiple crop trials. BioShield F provided 25-30 days of disease protection with a single application, reducing the need for frequent spraying. Similarly, with the use of BioPrime soil health improvers, soil organic carbon levels increased by 20-30 per cent in treated fields within two seasons. Also, there was a significant improvement in soil aeration, structure, and microbial diversity.

Empowering Indian farmers

The impact of BioPrime's work is evident in the lives of the farmers. The real measure of its success lies in the stories of farmers who can now afford better

education for their children, pay off long-standing debts, and achieve financial freedom for the first time in decades. Such impact is not about one successful harvest, it is a course correction that sets a family and generations to come on a different, better trajectory path. These lasting positive changes for families and generations are the most significant outcomes of BioPrime's interventions.

BioPrime is enabling Indian farmers to build resilience and adapt to the growing challenges of climate change. Agriculture is not just about growing crops; it is about resilience, adaptation, and making informed decisions under uncertainty. BioPrime's work is driven by these challenges, and its success is measured by the adoption of its products and also by its positive impact on the lives of farmers.

Farmers take charge of climate resilience

Fast forward to early 2023, and El Niño concerns resurfaced. Would farmers, having suffered massive losses in 2016, risk planting high-investment crops like tomato and capsicum again?

BioPrime feared reluctance, but what happened next was extraordinary. Farmers were no longer apprehensive; they were strategically planning their seasons, leveraging BioPrime's solutions as an insurance against climate risks. Instead of crop failures, 2023 made headlines for record-breaking farmer profits. Farmers made it to front page news, this time for their financial success.

Holistic approach to transforming Indian agriculture

BioPrime's contributions go far beyond individual products — they represent a holistic approach to transforming Indian agriculture, reducing dependency on imports, enhancing farmer resilience, improving resource efficiency, and supporting national sustainability goals. This aligns with global and national climate goals, further strengthening India's position as a leader in sustainable agricultural practices. With the potential to create ₹30,000+ crore/year as combined value, BioPrime is committed to build a self-reliant, sustainable, and prosperous agricultural sector for India.

Farmers' positive experiences with BioPrime

BioPrime's innovations have transformed agricultural practices for thousands of farmers, helping them increase yields, reduce losses, and command higher market prices. Success stories of farmers who took bold steps and leveraged BioPrime's solutions to maximize their income, are detailed in the ensuing pages.

SACHIN DURAPE
(Chrysanthemum Farmer, Narayangaon, Maharashtra)

Farmer persona : A 32-year-old second-generation engineer turned farmer, Sachin is known for his scientific approach to floriculture. He constantly explores new ways to improve flower quality and market reach.

Challenge : Uneven blooms, short shelf-life, and dependence on middlemen for selling flowers.

BioPrime solution : Prime Chiron, a biostimulant for stress tolerance and quality enhancement.

Control plot *vs* treated plot:

- **Control plot:** 800 kg/acre with a shelf-life of 5-6 days
- **Treated plot:** 1,120 kg/acre with a shelf-life of 10-12 days

Market rate : ₹25/kg (local traders) *vs* ₹70/kg (direct market in Hyderabad)

Increased earnings:

- **Before:** ₹20,000 per acre
- **After:** ₹78,400 per acre
- **Profit Increase:** 3.9x

ROI: 7.5x on investment in BioPrime inputs

VISHAL SHINDE
(Melon Farmer, Ottur, Maharashtra)

Farmer persona: A young, tech-savvy farmer who experiments with market trends and timing to maximize profits.

Challenge: Wanted to harvest melons early to fetch higher prices.

BioPrime solution: Growth enhancers to accelerate fruiting and ensure early market entry.

Control plot *vs* treated plot:

- **Control plot:** 10,500 kg/acre
- **Treated plot:** 12,000 kg/acre

Market rate: ₹18/kg (normal season) *vs* ₹32/kg (early season)

Increased earnings:

- **Before:** ₹1.89 lakh/acre
- **After:** ₹3.84 lakh/acre
- **Profit increase:** 103%

ROI: 6.5x

KIRAN PATIL
(Capsicum Farmer, Sangli, Maharashtra)

Farmer persona: A traditional farmer who took a calculated risk by growing capsicum in open fields instead of polyhouses.

Challenge: Needed to protect crops from heat stress and improve market price.

BioPrime's solution: Abiotic stress mitigators for heat stress tolerance.

Control plot *vs* treated plot:

- **Control plot:** 9,000 kg/acre
- **Treated plot:** 12,500 kg/acre

Market rate: ₹40/kg (local traders) vs ₹ 50/kg (quick-commerce platforms)

Increased earnings:

- **Before:** ₹ 3.6 lakh/acre
- **After:** ₹ 6.25 lakh/acre
- **Profit increase:** 73.6%

ROI: 5.2x

SUNIL VERMA
(Strawberry Farmer, Awadh, Uttar Pradesh)

Farmer persona: A fruit farmer who realized the importance of branding and premium market positioning.

Challenge: Needed to enhance fruit quality and shelf life to target high-value markets.

BioPrime's solution: Prime Chiron for fruit uniformity and extended shelf-life.

Control plot *vs* treated plot:

- **Control plot:** 900 kg/acre
- **Treated plot:** 1250 kg/acre

Market rate: ₹ 80/kg (local) *vs* ₹ 240/kg (premium market in Lucknow)

Increased earnings:

- **Before:** ₹72,000 per acre
- **After:** ₹3 lakh per acre
- **Profit increase:** 316%

ROI: 8.2x

RAVI DESHMUKH
(Grapes Farmer, Nashik, Maharashtra)

Farmer persona: A commercial grape farmer focused on improving fruit size and export potential.

Challenge: Needed better nutrient absorption to produce export-quality grapes.

BioPrime's Solution: Nutrient use efficiency enhancers for optimized nutrient uptake.

Control plot *vs* treated plot:

- **Control plot:** 7.2 tons/acre
- **Treated plot:** 8.6 tons/acre

Market rate: ₹ 80/kg (local market) *vs* ₹ 150/kg (export)

Increased earnings:

- **Before:** ₹ 5.76 lakh/acre
- **After:** ₹ 12.9 lakh/acre
- **Profit increase:** 124%

ROI: 7.1x

ANJALI PAWAR
(Tomato Farmer, Satara, Maharashtra)

Farmer persona: A small-scale farmer seeking to reduce post-harvest losses and improve market price.

Challenge: Needed to prevent spoilage and increase shelf life.

BioPrime's solution: Biostimulants for quality enhancement and calcium mobility boosters.

Control plot *vs* treated plot:

- **Control plot:** 16,000 kg/acre
- **Treated plot:** 19,500 kg/acre

Market rate: ₹ 12/kg (local) *vs* ₹ 18/kg (premium buyers)

Increased earnings:

- **Before:** ₹ 1.92 lakh/acre
- **After:** ₹ 3.51 lakh/acre
- **Profit increase:** 83%

ROI: 5.8x

PAWAN JHA
(Rice Farmer, Bihar)

Farmer persona: A progressive rice farmer adopting innovative nutrient management practices.

Challenge: Needed to improve yield with reduced fertilizer costs.

BioPrime's solution: Nutrient use efficiency enhancers for better nutrient absorption.

Control plot *vs* treated plot:

- **Control plot:** 24 quintals/acre
- **Treated plot:** 28 quintals/acre

Market rate: ₹ 2,000/quintal

Increased earnings:

- **Before:** ₹ 48,000 per acre
- **After:** ₹ 62,000 per acre
- **Profit increase:** 29%

ROI: 4.5x

SURAJ PARMAR
(Pomegranate Farmer, Solapur, Maharashtra)

Farmer persona: A pomegranate grower looking to increase fruit setting and reduce fungal infections.

Challenge: Fungal infections and irregular fruiting cycles reducing market value.

BioPrime's solution: Biofungicides and biostimulants to enhance fruit set and prevent diseases.

Control plot *vs* treated plot:

- **Control plot:** 5.2 tons/acre
- **Treated plot:** 7.1 tons/acre

Market rate: ₹90/kg (local) *vs* ₹160/kg (high-quality export)

Increased earnings:

- **Before:** ₹ 4.5 lakh/acre
- **After:** ₹ 8.2 lakh/acre
- **Profit increase:** 82%

ROI: 6.9x

Transforming farmers' profit with BioPrime

Across diverse crops and geographies, BioPrime's innovations have helped farmers to: (i) increase yields by 20-40 per cent; (ii) reduce input costs (fertilizers, pesticides, post-harvest losses); (iii) command higher prices (up to 3x higher in premium markets); and (iv) expand market reach and reduce middlemen dependency.

Through scientific rigor, on-ground support, and farmer education, BioPrime is reshaping Indian agriculture, enabling farmers to earn more with sustainable practices.(https://thebetterindia.com/318467/pune-agritech-startup-helps-farmers-fight-harvest-loss-due-to-climate-change/).

Beyond products: The changing face of Indian farmers

When we think of an Indian farmer, outdated stereotype often comes to mind — a risk-averse, poorly informed individual. But these stories paint a different reality. Today's Indian farmers are strategic, data-driven, and eager to adopt innovative solutions — if they deliver real value. They are no more just growers, they are entrepreneurs, decision-makers, and problem-solvers.

As climate unpredictability increases, agri-biologicals like BioPrime's solutions are not just inputs; they are insurance against uncertainty. The success of their farmers is BioPrime's success. And as they grow, so does BioPrime's commitment to revolutionizing Indian agriculture — one resilient harvest at a time.

The numbers speak for themselves

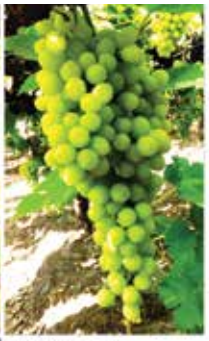
- **2016 losses in Maharashtra's tomato belt:** ₹2,000+ crore, 100 per cent crop loss in tomato
- **Farmers using Verdant in 2016:** ₹100 in 2016 expanded to 20,000+ in 2023
- **Increase in yield with Prime Chiron:** 30-40 per cent in floriculture, 20-25 per cent in fruit and vegetable crops
- **Market price premium achieved:** As a result of increase in shelf-life, the farmers fetched ₹3-4 /kg extra for their produce at farm gate. Also, 40 per cent increase in the income was observed in case of high-value crops like flowers, fruits, capsicum, and tomato on account of the use of A grade produce
- **Farmers using BioPrime's solutions, reaching distant markets:** 10,000+ and counting

A few successful examples of impact of BioPrime products

Grapes

Mr Shantaram Shinde, and Mr Balasaheb Shinde like many farmers in Nasik, Maharashtra had a delayed harvesting of grapes due to climate change the previous year. Delayed harvests mean the grapes at maturity suck more nutrition from the vines. Depleted nutrition from vines leads to poor quality of produce the next year or leads to higher percentage of early bud necrosis. These farmers were facing a yield loss of 20-30 per cent due to early bunch abortion or low quality and shifted to BioPrime product schedule. Mr Shantaram Shinde was very happy to achieve production of export quality berries and thus fetched a far greater market price with net profit of ₹124,725 per acre (Fig. 22), while Mr Blasaheb Shinde achieved 20 per cent higher fruit yield with a net profit of ₹275,375 (Fig. 23).

Mr Anil Shinde faced untimely rains during the berry development stage. High moisture led to fungal attack and necrosis. The bunches that were left were very small, and Anil feared that he would not be able to sell even in the local market. He turned to BioPrime products, learning from the success stories of other farmers in the region. He was able to avert the total crop loss and got 30 per cent more

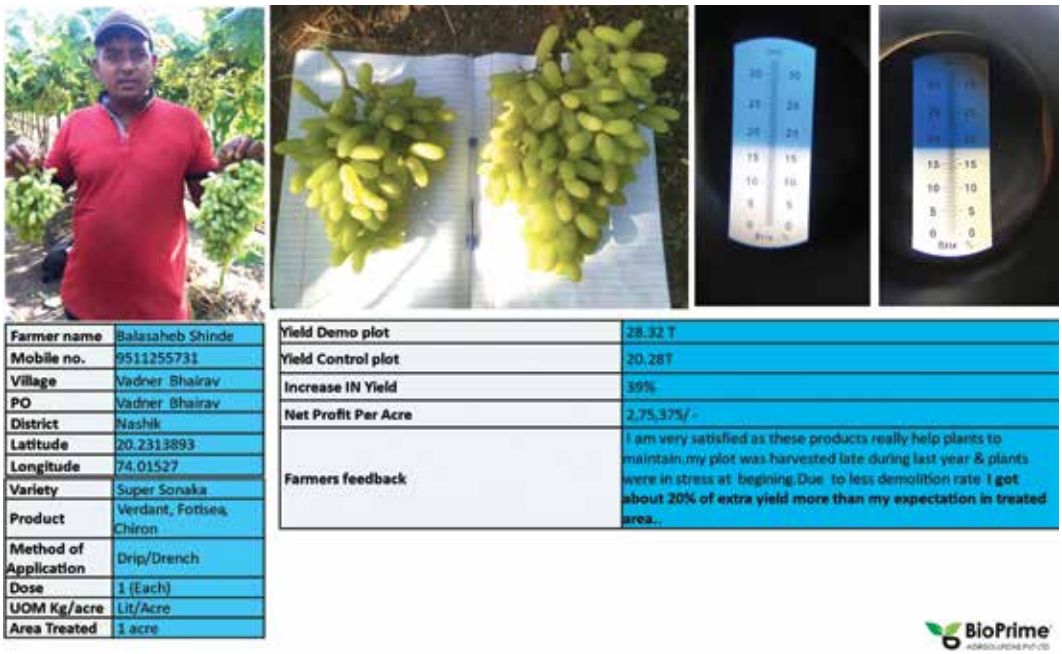




Farmer name	Shantaram Shinde
Father Name	Rangnath Shinde
Mobile no.	8767163905
Village	Umberkhed
PO	Umberkhed
District	Nashik
Latitude	20.1558161
Longitude	73.95581
Variety	Thomson
Product	Verdant, Fortisea Chiron
Method of Application	Drip/Drench
Dose	1.5 (Each)

Yield Demo plot	30.4 T
Yield Control plot	26.67 T
Increase in Yield	14 %
Net Profit Per Acre	1,24,725/-
Farmers feedback	Products are very good, I got better quality berries with more size, sugar & lustre. Everyone should use these products. My plot was harvested very late during last season, after using these products I got more yield than my expectation. I am very satisfied..

BioPrime

Fig. 22. *Fruit quality improved in grapes with use of BioPrime product*



Farmer name	Balasaheb Shinde
Mobile no.	9511255731
Village	Vadner Bhairav
PO	Vadner Bhairav
District	Nashik
Latitude	20.2313893
Longitude	74.01527
Variety	Super Sonaka
Product	Verdant, Fortisea, Chiron
Method of Application	Drip/Drench
Dose	1 (Each)
UOM Kg/acre	Lit/Acre
Area Treated	1 acre

Yield Demo plot	28.32 T
Yield Control plot	20.28T
Increase IN Yield	39%
Net Profit Per Acre	2,75,375/-
Farmers feedback	I am very satisfied as these products really help plants to maintain.my plot was harvested late during last year & plants were in stress at begining.Due to less demolition rate I got about 20% of extra yield more than my expectation in treated area..

BioPrime

Fig. 23. *Fruit yield increased in grapes with use of BioPrime product*

yield than his expectation. He earned net profit of ₹108,825 per acre. He was also able to achieve the fruits with size and quality suitable for local market (Fig. 24).

Onions

Mr Mahesh Saykar from village Ranvad in Nasik district was delighted with BioPrime products as he could harvest the produce earlier and sell the onions before market flooded with onion harvests. This gave him relatively better price and net profit of ₹21,200 per acre (Fig. 25). Mr Sunil Korade of village Kothure in Nasik district was happy as he got better gradation, higher percentage of A grade produce and improved shelf life. He got a net profit of ₹34,200 per acre. Usually farmers loose anywhere between 10-30 per cent of produce during storage. This was drastically reduced for Sunil to less than 8 per cent (Fig. 26). Mr Vaibhav Bairagi of village Patoda in Nasik district also got 30 per cent increase in yield along with better size and lustre, and a net profit of ₹65,575 per acre (Fig. 27).

Potato

Mr Ramachandra of village Dhuswa in Uttar Pradesh noted early tuber development, more white roots and ultimately got 17 per cent increase in tuber

Farmer name	Anil Shinde
Father Name	Raosheb Shinde
Mobile no.	8208575624
Village	Vadner Bhairav
PO	Vadner Bhairav
District	Nashik
Latitude	20.2341891
Longitude	74.0024
Variety	Thomson
Product	Verdant, Fortisea, Chiron
Method of Application	Drip/Drench
Dose	1 (Each)
UOM Kg/acre	lit/Acre
Area Treated	1 acre

Yield Demo plot	21.10 T
Yield Control plot	17.74 T T
Increase in yield	18% more yield.
Net Profit Per Acre	1,08,825 /-(@35/kg)
Farmers feedback	during berry development stage due to rain & fog my plot was infested with necrosis but still I got same yield as last year, So **about 30 % of more yield** than expectation due to Bioprime agrisolutuions products.

BioPrime

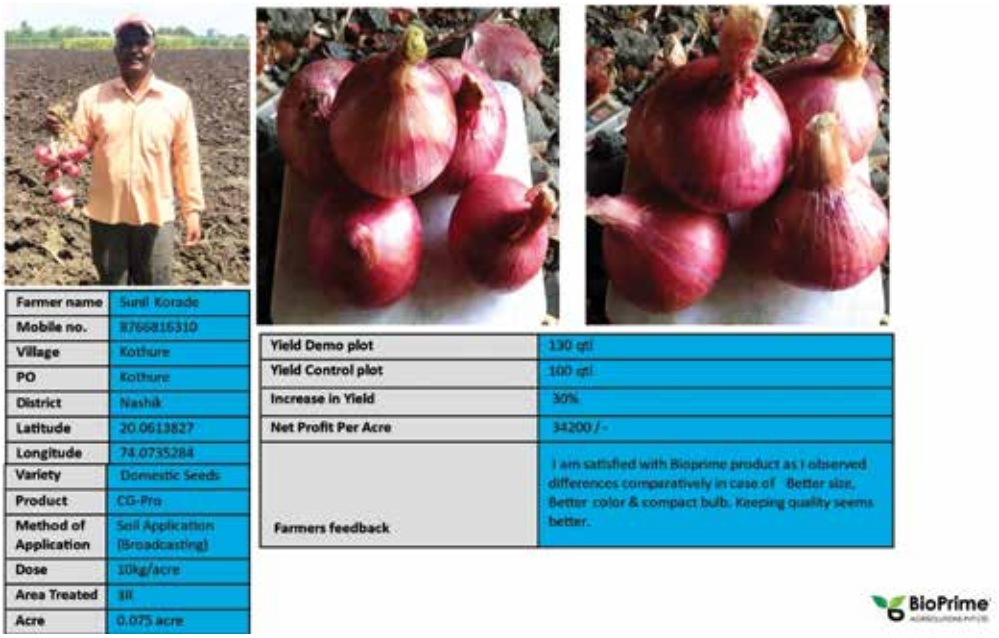
Fig. 24. *Fruit yield in grapes increased with use of BioPrime product*

BioPrime

Farmer name	Mahesh saykar
Father Name	Anil Sayakar
Mobile no.	9527233061
Village	Ranwad
PO	Ranwad
District	Nashik.
Latitude	20.1739204
Longitude	74.1113042
Variety	Panchaganga Red
Product	CG-Pro
Method of Application	Soil Application
Dose	10kg/acre
UOM	Kg/acre
Area Treated	3R

Yield Demo plot	120 qtl
Yield Control plot	100 qtl
Increase in Yield	20%
Net Profit Per Acre	21200 /-
Farmers feedback	I am satisfied with this products, I found treated plot can be early harvested and more size ,better quality. I had 20% more yield than expected.

Fig. 25. *BioPrime product induced early maturity of onion crop fetching higher price*

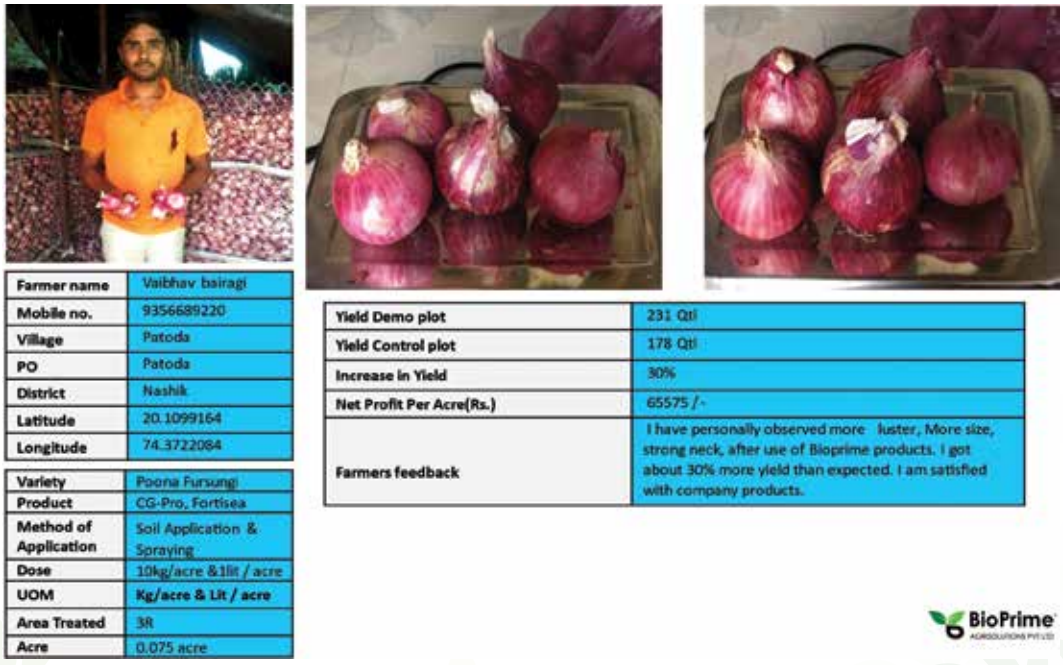


Farmer name	Sunil Korade
Mobile no.	8766816310
Village	Kothure
PO	Kothure
District	Nashik
Latitude	20.0613827
Longitude	74.0735284
Variety	Domestic Seeds
Product	CG-Pro
Method of Application	Soil Application (Broadcasting)
Dose	10kg/acre
Area Treated	3R
Acre	0.075 acre

Yield Demo plot	130 qtl
Yield Control plot	100 qtl
Increase in Yield	30%
Net Profit Per Acre	34200 /-
Farmers feedback	I am satisfied with Bioprime product as I observed differences comparatively in case of Better size, Better color & compact bulb. Keeping quality seems better.

BioPrime

Fig. 26. *BioPrime product resulted in better gradation, high quality, improved shelf-life and low storage loss of produce in onion*



Farmer name	Vaibhav bairagi
Mobile no.	9356689220
Village	Patoda
PO	Patoda
District	Nashik
Latitude	20.1099164
Longitude	74.3722084

Variety	Poona Fursungi
Product	CG-Pro, Fortisea
Method of Application	Soil Application & Spraying
Dose	10kg/acre &1lit / acre
UOM	Kg/acre & Lit / acre
Area Treated	3R
Acre	0.075 acre

Yield Demo plot	231 Qtl
Yield Control plot	178 Qtl
Increase in Yield	30%
Net Profit Per Acre(Rs.)	65575 /-
Farmers feedback	I have personally observed more luster, More size, strong neck, after use of Bioprime products. I got about 30% more yield than expected. I am satisfied with company products.

BioPrime

Fig. 27. *Increase in yield along with better size and lustre in onion*

yield with a net profit of ₹5,700 per acre (Fig. 28). On an average, 15-20 per cent increase in tuber yield was noted by many potato farmers.

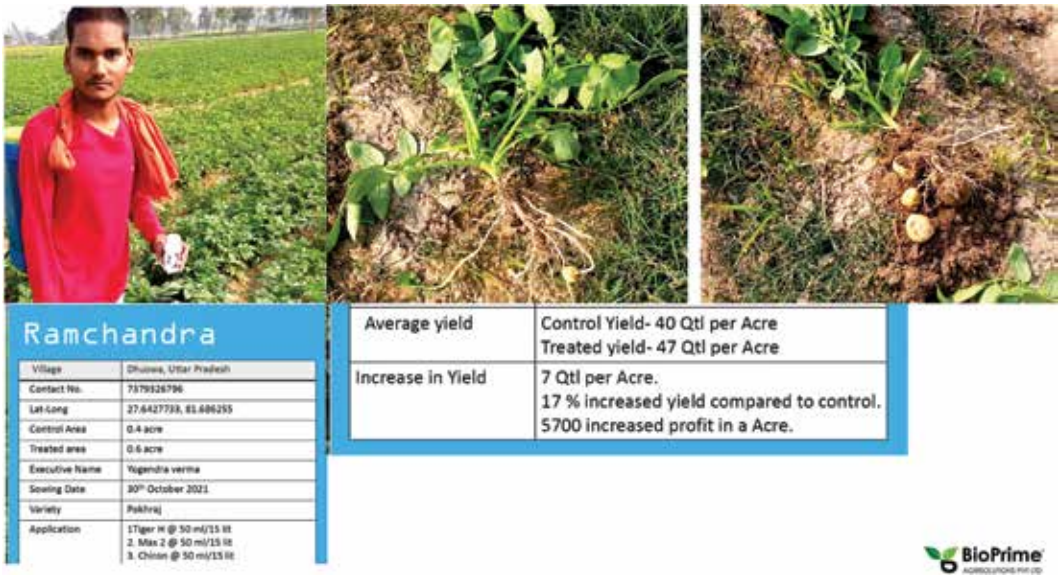
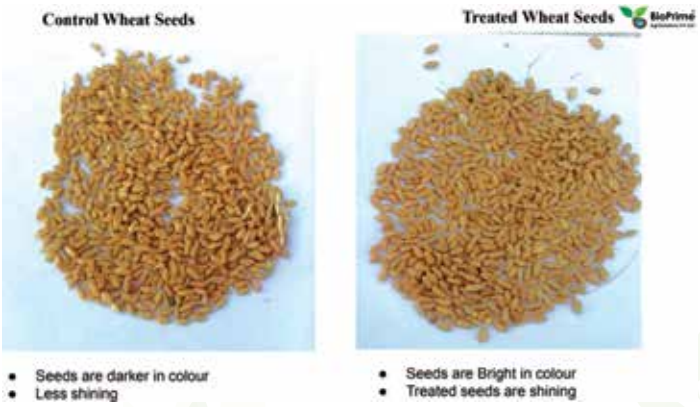


Fig. 28. *Significant increase in potato yield with the use of BioPrime product*

Wheat

Mr Mannu Singh of village Mahurakala in Lucknow district of Uttar Pradesh recorded 10-15 per cent yield increase by using BioPrime product Tigar. He also compared the control and treated plants and observed better plant development along with 5-8 per cent more tillering in the treated plants. Ear head emergence was better in treated plants as compared to untreated plants. The ear-heads were heavy in weight with less chaffing of grains and the 1,000 grain weight was 5 per cent higher in treated than that in control plants. The seeds of treated plants were bright in colour with more shining as compared to untreated (control) plants (Fig. 29). Net profit was ₹13,100 per acre.



FDO	Sandeep Pal
No.	5
Farmer name	Mannu Singh
Father Name	Rameshawar
Mobile no.	7754891929 9919976619
Village	Mahurakala
PO	
District	Lucknow
Latitude N	26°45'5"
Longitude E	81°8'14"

Crop	Wheat
Variety	Shree Ram 303
Product	Tiger
Method of Application	Broadcast
Dose	8
UOM	Kg/acre
Area Treated Acre	0.25
Qty	2
UOM	Kg
DOS or DOT	28/11/2018
Date of application	11/2/2019
Days of 1st Application	75
Crop Stage	Boot Leaf

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1st Check	26/2/2019
Results noticed after days	15
Differences after 1st app	Difference in the weight of the plants. The application has been done after tillering so no impact on tillers number but the weight per tiller is 16.2 gm compared to 11gm in control
Date of 2nd application	2/3/2019
Crop Stage	Milking
Yield Demo plot	3210
Yield Control Plot	2340
Net Profit Per Acre	13100
Farmers feedback	Farmer is fully satisfied
Retailer	Chaudhary Pesticides, Mahurakala
Retailer convinced	The Retailer is also fully convinced

BioPrime

Control

- The Control plants were having uneven growth.
- Few plants have emerged earheads while few are in process
- Less root growth than Treated plants
- More plant weight

Treated

- The Treated plants were growing at uniform pace
- Almost all the earheads have emerged
- Good root growth
- More plant weight

Fig. 29. *Use of BioPrime product Tiger resulted in higher grain yield, better plant growth, higher grain weight and bright and shining grains*

Mr Umesh Kumar of village Chaksar in District Barabanki recorded high grain yield by using BioPrime product Tigar. He also observed that treated plants were growing uniformly with good root growth. The treated plants had more ear head weight, less chaff and higher grain weight than untreated (control) plants (Fig. 30). The net profit was ₹9,600 per acre.

FDO	Sandeep Pal
No.	8
Farmer name	Umesh Kumar
Father Name	Ramdev
Mobile no.	9108905872
Village	Chaksar
PO	
District	Barabanki
Latitude N	26°45'37"
Longitude E	81°13'32"

Crop	Wheat
Variety	502
Product	Tiger
Method of Application	Broadcast
Dose	6
UOM	Kg/acre
Area Treated Acre	0.25
Qty	1.5
UOM	Kg
DOS or DOT	28/11/2018
Date of application	11/2/2019
Days of 1st Application	75
Crop Stage	Boot Leaf

1st Check	26/2/2019
Results noticed after days	15
Differences after 1st app	Difference in the weight of the plants. The application has been done after tillering so no impact on tillers number but the weight per tiller is 11.33 gm compared to 7.39gm in control
Date of 2nd application	06/03/2019
Crop Stage	Milking
Yield Demo plot	2600
Yield Control Plot	1960
Net Profit Per Acre	9600
Farmers feedback	Satisfied with the product
Retailer	Shree Ram Beej Bhandar, Gangagunj
Retailer convinced	

- The control plants are light in colour
- Less root growth than treated plants
- Less plant weight

- The treated plants were growing at uniform pace
- Good in colour
- Good root growth
- More plant weight

10 Earheads of Control **10 Earheads of Tiger Treated**

- Control earheads are light in weight
- More chaff in control earheads
- Less grain weight to earhead weight

- Treated earheads are heavy in weight
- Less chaff in treated earheads
- More grain weight to earhead weight

Fig. 30. *Use of BioPrime product Tiger resulted in higher grain yield, better plant and root growth, less chaff and higher grain weight*

Other crops

BioPrime products have also created a significant impact in other crops. In Uttar Pradesh, farmers are venturing into new crops like strawberries. Tomato farmers in Maharashtra are defying extreme summer conditions to achieve profitable harvests. And potato farmers in Uttar Pradesh are celebrating a disease-free yield, marking their first harvest in years without rot or cracking (Fig. 31).

Fig. 31. *Examples of BioPrime-enabled farmers' success - tomatoes in Maharashtra, strawberry in Uttar Pradesh, and healthy potatoes in Uttar Pradesh*

This is just the beginning. BioPrime is not just selling products, they are shaping the future of climate-resilient farming. From enabling climate-resilient farming to improving soil health and crop yields, the company is making agriculture more sustainable and profitable. Beyond farmers, their work is creating ripple effects across the agricultural value chain — boosting employment, fostering innovation, and reducing environmental degradation. BioPrime is empowering farmers nationwide to achieve unprecedented success.

8. Suggestions for Aspiring Entrepreneurs: Lessons from BioPrime's Journey

BioPrime's story is not just about developing cutting-edge agricultural biologicals — it is about perseverance, problem-solving, and an unwavering commitment to

making an impact. For those looking to embark on their entrepreneurial journey, here are some key lessons drawn from BioPrime's experience:

Start with a clear understanding of the problem you want to solve

Many startups begin with an innovative idea, but true success lies in solving real, pressing problems. Before launching BioPrime, its founders spent years in the field, interacting with farmers and understanding their challenges. Renuka comes from a farming family and witnessed first-hand diminishing returns from their fields. Her love for farming comes from her grandmother who broke stereotypes and managed their entire farms in rural Solapur.

In 2016, when El Niño wiped out tomato crops across Maharashtra, they witnessed first-hand how climate variability was pushing farmers to the brink of financial ruin. This deep understanding of the problem — climate resilience in agriculture — became the foundation of BioPrime's mission.

Lesson : *Do not build a product first and then look for a problem to solve. Start with a problem, validate it with real-world users, and then develop solutions tailored to their needs.*

Be patient — validation and acceptance take time

Innovations, especially in science-based sectors like agriculture, do not see overnight adoption. When BioPrime introduced its biological formulations, only 100 farmers agreed to try them, despite clear evidence from lab trials. The team faced scepticism, ridicule from farmers. Day after, day they went to the fields only to be turned away by the farmers. But they persisted–conducting free trials, demonstrating results in the field, and letting the product speak for itself. By 2023, thousands of farmers had adopted BioPrime's solutions, proving that trust is built over time, not overnight.

Lesson : *Be prepared for resistance. Create awareness amongst your customers, prove your value, and let time build credibility.*

Build a strong network of collaborators and mentors

Entrepreneurship is not a solo journey. Having the right mentors, advisors, and collaborators can make all the difference. BioPrime's growth was accelerated by partnerships with agricultural universities, research institutes, and farmer groups. These collaborations helped refine products, scale operations, and gain credibility faster. Having a commercial partner early on, significantly accelerated BioPrime's journey to find the product-market fit. Corporate partners come with decades of

sector knowledge and market experience that can fast track technology or science-based product adoption. In turn, BioPrime openly supports entrepreneurs trying to build in this space.

Lesson : *Seek mentors who have walked the path before you. Surround yourself with a network that challenges you, supports you, and helps navigate difficult decisions.*

Focus on creating solutions that are impactful and scalable

A great product is not enough — it must be scalable to make a widespread impact. BioPrime's technology is rooted in science, but its success comes from ensuring it is practical, affordable, and scalable. They designed products that fit seamlessly into a farmer's existing workflow — requiring no expensive equipment, complex protocols, or excessive investment. As a result, farmers across India — from floriculture fruit cultivation to row crops — are able to integrate BioPrime's solutions effortlessly, leading to rapid adoption.

Lesson : *Always think about scale. Your solution should not just work in a controlled environment; it should be replicable across diverse users and conditions.*

Customer centricity — always put farmers at the centre of innovation

At BioPrime, every decision–from product development to market strategy–is made with farmers in mind. This means actively listening to farmers, co-creating solutions with them, and ensuring affordability and accessibility. When farmers nicknamed BioPrime's early product as the Green Product, it was a sign that they saw value in it. The company embraced this feedback, officially naming it Verdant — a tribute to the farmers' trust. BioPrime's approach to customer-centric innovation has not only driven adoption but also turned farmers as brand ambassadors also.

Lesson : *Listen, adapt, and build for your end users. A business that truly understands and prioritizes its customers will always have an edge over competitors.*

The entrepreneur's mindset

BioPrime's journey underscores an essential truth about entrepreneurship:

- It is not about having the perfect idea — it is about solving real problems.
- It is not about immediate success — it is about persistence and long-term impact.
- It is not about working alone — it is about building a strong ecosystem.
- It is not about short-term profits — it is about creating solutions that improve lives.

For aspiring entrepreneurs, the path is rarely easy. But as BioPrime has shown, when you stay true to your mission, put your customers first, and remain resilient, success will follow.

9. Looking Ahead: BioPrime's Roadmap to Global Leadership in Agricultural Biologicals

BioPrime's mission is far from complete. The company has proved its capacity to help transform climate-resilient farming in India, but the next phase of its journey is about scaling innovation, expanding globally, and redefining sustainable agriculture at an unprecedented level.

With a steadfast commitment to science, farmer-centric solutions, and environmental impact, BioPrime is poised to emerge as one of the world's leading agricultural biologicals companies in the coming times. This will be driven by three key pillars: cutting-edge product development, global expansion, and strategic partnerships.

(i) Expanding product portfolio: Next-generation biologicals for a changing climate

Future R&D of BioPrime will focus on developing highly differentiated biological solutions that go beyond traditional biostimulants. The company is set to introduce the new products.

Advance biostimulants and bioprotection solutions

- **Precision microbial consortia:** A new wave of microbial formulations that improve nutrient uptake, enhance stress tolerance, and boost yields, and are customized for specific crops and soil conditions.
- **Abiotic stress tolerance enhancers:** Next-generation solutions tailored to combat heat waves, droughts, and soil salinity, which are major challenges for global food production.
- **Non-hormonal growth enhancers:** Leveraging secondary metabolites to stimulate plant growth without synthetic hormones thus providing a natural alternative to synthetic plant growth regulators (PGRs).

Disruptive biological crop protection technologies

BioPrime is shifting the paradigm in pest and disease management by developing:

- **Botanical and microbial biofungicides:** Targeting major plant pathogens with non-toxic, residue-free alternatives to chemical fungicides.
- **Bioinsecticides for sustainable pest control:** Harnessing novel microbial strains and plant-based compounds to reduce reliance on synthetic pesticides.

Soil health and carbon sequestration solutions

With 80 per cent of global soils degraded, BioPrime is investing in:

- **Microbial soil regeneration products:** Enhancing carbon sequestration, improving soil structure, and increasing fertility through beneficial microbial activity.
- **Nutrient use efficiency (NUE) enhancers:** Helping farmers optimize fertilizer use, reducing input costs while maintaining high yields.

(ii) Global expansion: Taking BioPrime's innovation to new markets

As adoption of biologicals accelerates worldwide, BioPrime is positioning itself as a global leader in sustainable agriculture.

Entry into high-growth international markets

- **Latin America and Africa:** Targeting Brazil, Argentina, and key African nations where agricultural productivity is threatened by climate variability.
- **Europe and North America:** Expanding into organic farming and regenerative agriculture segments where demand for biological alternatives is skyrocketing.
- **Southeast Asia:** Leveraging India's regional trade relationships to enter Indonesia, Vietnam, and the Philippines, where rice and vegetable production depend heavily on biologicals.

Localized product development and manufacturing

To ensure product effectiveness and compliance with regional agricultural regulations, BioPrime will:

- Set-up global R&D collaborations with universities and research institutes,
- Establish regional manufacturing hubs to reduce logistics costs and support local economies, and
- Customize formulations based on local climate, soil conditions, and regulatory requirements.

(iii) Strengthening strategic partnerships and distribution networks

Collaborating with agri-input giants and FPOs

To accelerate adoption, BioPrime will:

- Partner with large distributors, multinational agri-companies, and co-development firms like DCM Shriram, Insecticides India Limited, Yara India.
- Expand its farmer outreach programs *via* Farmer Producer Organizations (FPOs) to make its biologicals widely available at the grassroots level.

Integration with digital and AgTech platforms

BioPrime will leverage artificial intelligence (AI) and digital tools to:

- Offer precision advisory services based on satellite data and real-time crop monitoring.
- Use blockchain traceability for product authenticity and supply chain transparency.
- Develop a farmer-centric App that provides usage guidelines, weather alerts, and market trends for better farm decision-making.

(iv) Pioneering regulatory and sustainability leadership

BioPrime is committed to shaping the future of agricultural biologicals by actions discussed here.

Leading policy and regulatory advocacy

- Working closely with governments to streamline regulatory approvals for biologicals, reducing farmers' dependence on synthetic chemicals.
- Actively participating in global climate initiatives such as carbon credit programs and sustainable farming coalitions.

Setting new standards for sustainability and carbon footprint reduction

- Implementing eco-friendly manufacturing processes with zero-waste extraction techniques.
- Helping farmers reduce their carbon footprint by minimizing synthetic fertilizer and pesticide use.
- Promoting sustainable supply chains by sourcing raw materials ethically and responsibly.

(v) Becoming a global leader in agricultural biologicals

BioPrime envisions a future where:

- Farmers worldwide have access to cutting-edge, climate-smart biologicals.
- Synthetic pesticides and fertilizers are replaced with sustainable, high-performance alternatives.
- Agricultural productivity is increased without harming soil health or biodiversity.
- BioPrime's innovations drive the next green revolution — one powered by biology, not chemicals.

By continuing to push the boundaries of innovation, expanding globally, and fostering strategic collaborations, BioPrime is making steady progress marching ahead to becoming a global leader in agricultural biologicals.

10. Conclusion

The BioPrime story showcases a potent combination of scientific rigor, strategic resourcefulness, and unwavering dedication to a sustainable future. Their journey, from an accidental and modest beginning to a thriving company with a global footprint, underscores the importance of: (i) a shared vision among founders; (ii) a deep understanding of the problem being solved; (iii) a strategic approach to funding that prioritizes long-term growth; and (iv) a commitment to building innovative solutions that address the evolving needs of farmers.

As BioPrime continues to make steady progress towards agricultural innovation, expanding globally and strengthening strategic collaborations, it is on the right path to serve as a beacon of hope for a more sustainable and resilient agriculture and becoming one of the most successful biologicals companies in the world, revolutionizing farming for generations to come.

About the Author

Dr Renuka Diwan is a dynamic leader whose career bridges ground-breaking scientific research, entrepreneurial success, and strong advocacy for women in agri-tech. A visionary plant biotechnologist and accomplished entrepreneur, Dr Diwan has over 25 years of experience in R&D spanning plant genetic engineering, bioactive compounds, and microbial solutions. She combines academic rigor with strategic vision to drive the mission of BioPrime Agrisolutions: *"From Nature, For Nature."*

As Co-Founder and Chief Executive Officer of BioPrime Agrisolutions Pvt. Ltd. since 2016, Dr Diwan has built a fast-growing agri-biotech startup focused on climate-resilient biologicals. She has spearheaded strategic initiatives, forged co-development and licensing partnerships, and expanded markets across India, the United States, Southeast Asia, and Africa. Under her leadership, BioPrime has raised $6 million in funding to accelerate research on biofungicides and bioinsecticides. She oversaw the successful launch of proprietary innovation platforms such as SNIPR and the Bionexus Microbial Library, which houses more than 15,000 isolates.

Before co-founding BioPrime, Dr Diwan conducted impactful scientific work, exploring the anti-cancer effects of coumarins and flavonoids targeting topoisomerase I & II, which led to a patent on coumarin extraction. She holds a Ph.D. in Plant Biotechnology from the University of Pune, India, and completed postdoctoral research in plant genetic engineering at both the University of Pune and Cambia in Australia. She has also contributed extensively to academia, serving as Visiting Faculty at the Institute of Bioinformatics & Biotechnology (IBB) and the National Institute of Virology (NIV) in Pune, as well as a member of the Advisory Board for Environment & Sustainability Studies at the University of Pune. Her academic contributions include more than 10 peer-reviewed research papers published in high-impact journals, and she is the inventor of several patents.

Dr Diwan's work has been widely recognized with prestigious awards, including the FICCI-BIRAC Women in Entrepreneurial Research Award, recognition among the BioAg Top 10 Innovative Startups in Rio de Janeiro, the Samunnati Women Startup Leaders Award, and the Global BioAg Innovation Award in India.

As an outspoken advocate for women's leadership in STEM and agriculture, Dr Diwan regularly addresses gender bias issues and supports female empowerment through policy advocacy efforts within BioPrime, social groups, and media channels. She also contributes to policy discussions on climate-resilient agriculture in both mainstream and scientific forums.

Dr Diwan is based in Pune, Maharashtra, India, and can be reached at renuka@bioprimeagri.com

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2. National Symposium on Hybrid Technology for Enhancing Crop Productivity (NSHT) - Proceeding and Recommendations, April 2025.
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