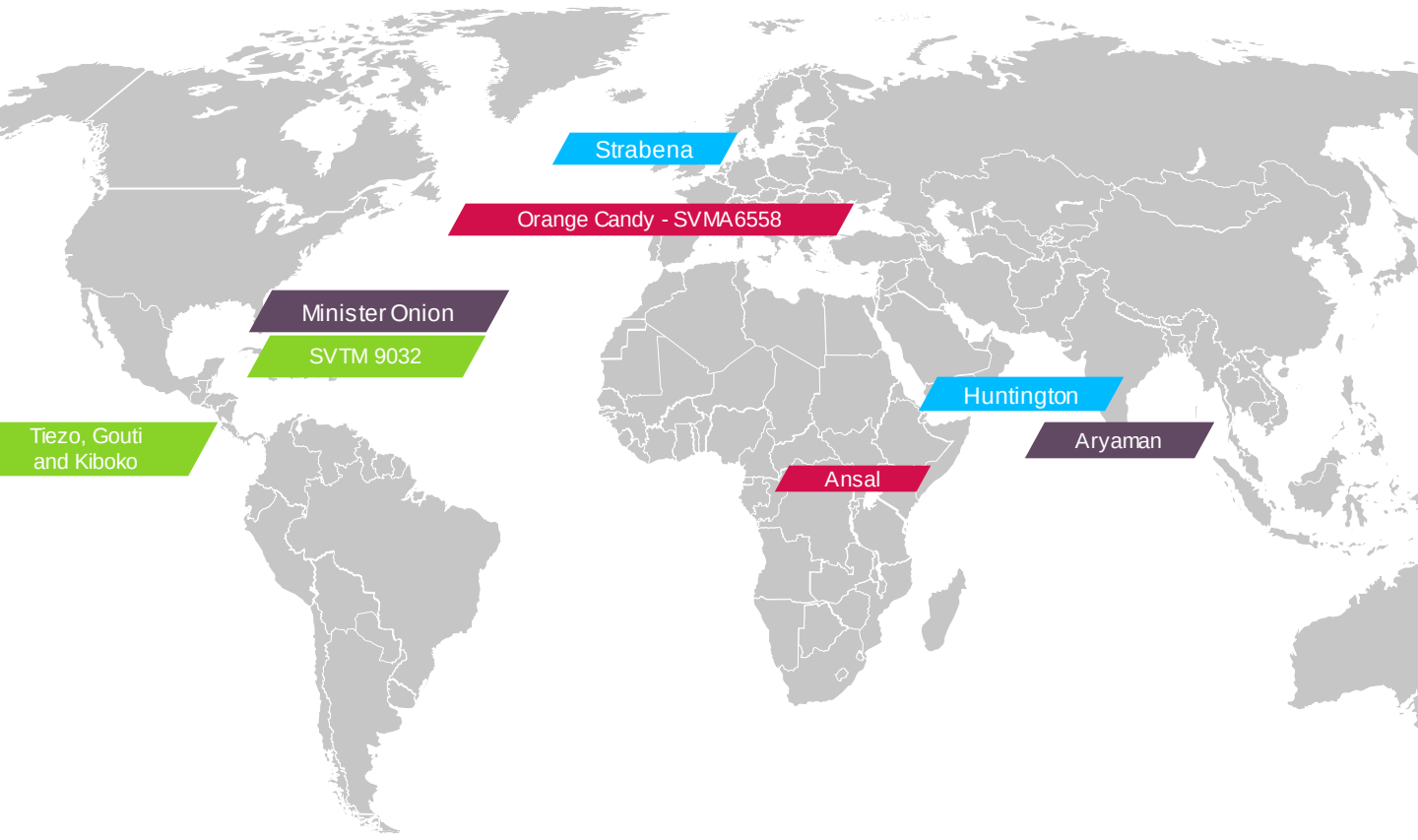
/// Vegetables by Bayer

Innovations advancing sustainability



Success Stories

Get attached to the perfect tomato.

Our Strabena tomato

Available in several countries in Europe, Strabena variety has shown an excellent attachment to the vine and good shelf life, which can help protect against losses during processing & handling.

As the market leader and the leader on R&D investments, Bayer Crop Science is in a unique position to shape what's possible for farmers, consumers, and the planet. We consistently seek to develop and offer products that have better benefits for farmers, while having less impact on the environment [1].

At Bayer, our vegetable seeds teams are constantly working to provide innovative solutions and new vegetable seeds for growers in the protected environments. We partner with growers to help them produce high-quality vegetables year-round, provide insights about the latest consumer needs and growing trends, and develop shared success for the entire value chain. In doing so, we are helping to advance the potential of all growing environments to provide year-round access to fresh fruits and vegetables using less land and natural resources.

Our **De Ruiter® brand**, has the strawberry **tomato Strabena** as an example of a solution to support growers in Europe to address postharvest crop losses by and reduce environmental impacts for tomatoes via packaging.

Strabena is a mini plum truss tomato launched in 2016 and been sold in several European countries. It outshines other varieties with its excellent (authentic aromatic) taste, unique strawberry shape, and **powerful green parts attached to its truss**.

Strabena is ideal to traders, growers, and retailers due to its consistency in taste, color, firmness, taste, and average fruit height year-round. On top of this, Strabena has one **unique benefit towards sustainability**. This variety has an **excellent attachment to the vine which means tomatoes do not fall off the vine** and even after one week, there are no loose tomatoes in the packaging [2].

Tomato is highly perishable in nature and incur high post-harvest losses due to unsuitable packaging method. Plastic packaging creates a modified atmosphere for the packed tomatoes which is suitable for increasing shelf life [3]. Plastic often serves to hold the tomatoes together. However, due to plastics' potential harm to the environment, the trend to reduce the use of plastic is continuing [4].

Strabena tomatoes' strong attachment to the vine reduces the need for plastic packaging, ensures good shelf life, and can protect against food loss during processing and handling. This strong truss feature is beneficial as it reduces losses during harvesting and packaging.

1- Source: Crop Protection Environmental Impact Reduction One Pager from BayerNet
2- Source: Strabena – so authentic, so aromatic. 2020. De Ruiter YouTube channel.
3- Source: Adhikari, Prashant & Dhakal, Amir & Pahadi, Kuldeep & Adhikari, Santosh & Ghimire, Prabin & Subedi, Sankhar & Ghimire, Dipendra. (2020). EFFECT OF DIFFERENT PLASTIC PACKAGING ON POSTHARVEST QUALITY OF TOMATO (LYCOPERSICON ESCULENTUM MILL.). Tropical Agroecosystems. 1. 15-18. 10.26480/taec.01.2020.15.18.
4- Source: Thompson, Richard C., Moore, Charles J., vom Saal, Frederick S., and Swan, Shanna H. (2019). Plastics, the environment and human health: current consensus and future trends. Philos Trans R Soc Lond B Biol Sci. 2009 Jul 27; 364(1526): 2153–2166.

Seminis® OrangeCandy® - SVMA6558

We're committed to provide the solutions growers need to grow more sustainably and profitably.

OrangeCandy® variety SVMA6558 offers an improved disease resistance package, good field holding ability and longer shelf life compared to the previous Seminis variety.

During three years with 12 Bayer trials in Murcia, Spain, we saw up to a **+13% yield increase** on average compared to our previous variety. In addition, this variety demonstrated up to a **~19% reduction of losses in the field due to less cracking and good field holding**.

Considering that **food loss is responsible by 8% of the total Global GHG emissions**[1], this is a great example on how innovation can help growers to reduce losses on the field and consequently could reduce GHG emissions from those losses.

We are providing a variety with higher yield and less losses to our customers, and it is aligned with what they were demanding from us.

1 - Source: United Nations

Onions that can help produce more with less

any way you slice it.

Minister onions

We are working to develop innovative varieties to help growers like you grow more with less, creating a healthier, sustainable future for us all.

At Bayer, our vegetable seeds teams are constantly looking for innovations and partnering with growers to help them produce high-quality vegetables year-round, provide insights about the latest consumer needs and growing trends, and develop shared success for the entire value chain. In doing so, we are helping to advance the potential of growing environments to provide year-round access to fresh fruits and vegetables using less land and natural resources.

Minister is an Intermediate day length Seminis® variety with high yield potential and an early harvest window and high uniformity that replaces the previous Seminis® brand onion generation, Caballero.

Minister offers to farmers an intermediate resistance to Fusarium Basal Rot [1] Basal rot is a widespread fungal plant disease caused by Fusarium oxysporum f. sp. Cepae and onion plants can be infected at any developmental stage, resulting in significant crop or storage loss of marketable bulbs.

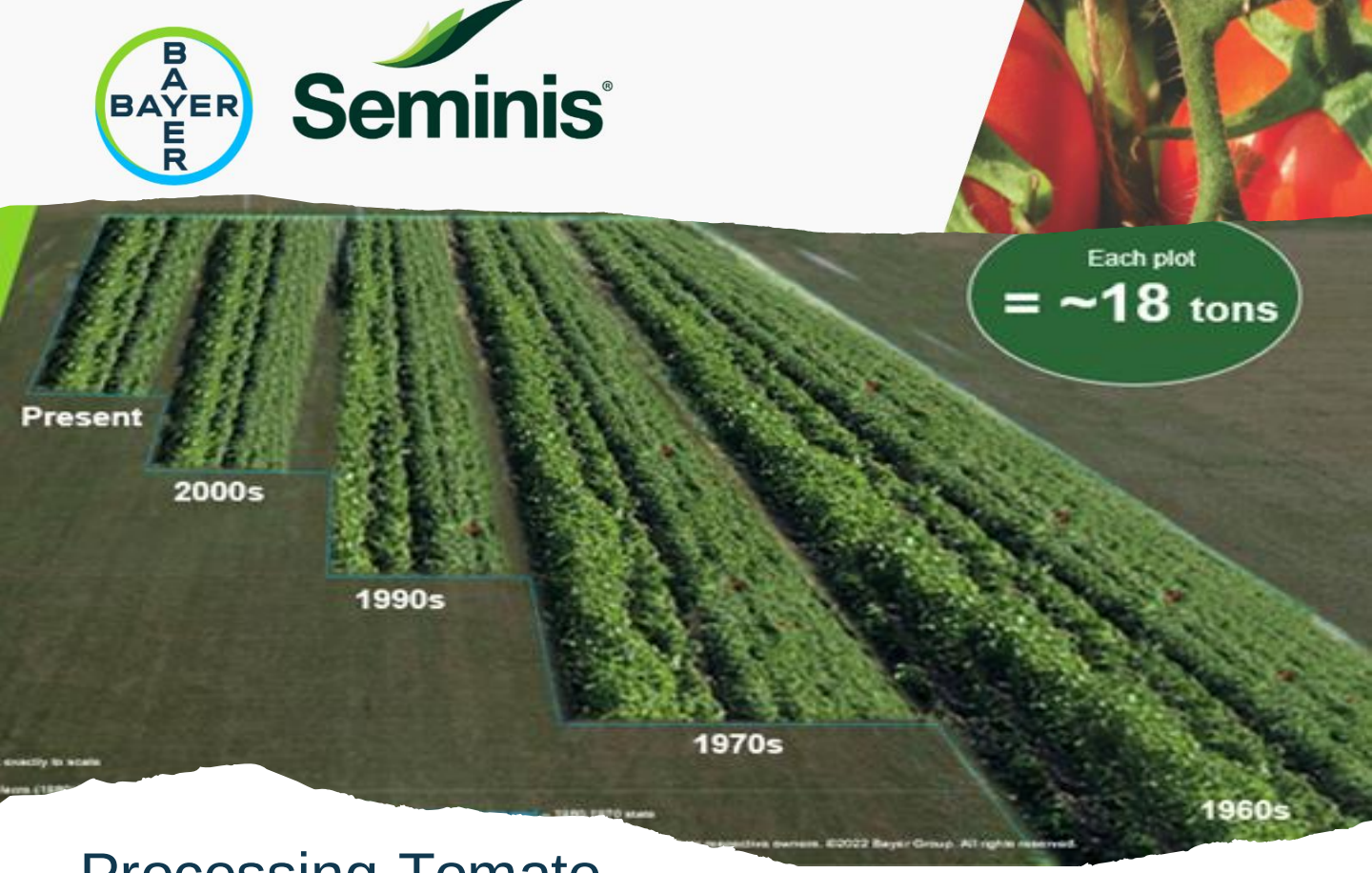
In 12 internal trials in California, Minister produced 10% [2] more per acre than the previous Seminis® Caballero variety, showing the potential to help growers to produce more with less land.

To put this in perspective, we calculated the amount of land that switching varietals would result in if the demand created by California's onion consumption was met exclusively by Minister cultivation:

- Supposing that the 39.2 M California residents [3] can consume 20lbs of onions annually [4].
- Growers would need to produce 785M lbs of onions just for California.
- Given this, 1999 acres of Minister would be required to meet California's demand compared to 2199 acres of Caballero.
- The state would save 200 acres of land used for onion.

Data sources:
1 - Based on field data (2017-2021), in 12 in-field trials in California/USA (Counties: Five Points, Coalinga, Bakersfield, Kerman, Mendota, Helm and Stockton) comparing Caballero and Minister.
2 - https://www.vegetables.bayer.com/us/en-us/products/onion/details.html/onion_candy_usa_seminis_fresh_market_open_field_fresh_market_west.html
3 - CA Population
4 - Consumption - National Onion Association (onions-usa.org)
These are the California crops that use the most water (pressdemocrat.com)

Note: HR = High Resistance. IR = Intermediate Resistance. To find out more about disease resistance and the applicable levels of disease resistance, visit www.worldseed.org, and view the "Definition of the Terms Describing the Reaction of Plants to Pests for the Vegetable Industry" paper in the Vegetable Resources section. / Varieties claiming the same level of resistance against a specific pest may exhibit a different resistance response due to a different genetic makeup of a variety. It is to be noted that if a resistance is claimed in a plant variety it is limited to the specified biotypes, pathotypes, races or strains of the pest. (worldseed.org).



Processing Tomato

In California: Growing more with less

Advances in agriculture over the years demonstrate the major strides that innovation in agriculture have made to help farmers to produce more crops with less land. This is important as the amount of arable land and natural resources on the planet is fixed while the world population is growing at exponential rates. Continued investment in innovation will help agriculture to continue on a more efficient trajectory.

There have been several major advancements in California's tomato processing industry, and innovations are constantly allowing growers to do more with less. In California, the 1989 average yield was 31.5 tons/acre (77.8 t/ha) and in 2020 the average yield was 49.4 tons/acre (122 t/ha) a **274% increase in production** [1].

This steady increase in yields has allowed growers today to use **~64% less land** to produce the same quantities of tomatoes, with different technologies been adapted through the years:

- 1960s: Genetic Improvements - Introduction of disease resistance varieties, e.g., Fusarium resistant cultivars sustained production after this devastating disease spread thru out production regions. It allowed growers to increase production from ~18 tons/acre to ~22 tons/acre by 1970 (22% increase)
- 1970s: Genetic Improvements led to the development and launch of new hybrids with earlier maturity, higher yield and amenable to machine harvest. This allowed growers to increase production from ~22 tons/acre to ~31.5 tons/acre by 1990 (42% increase)
- 1990s: Genetic Improvements and Transplantation, as opposed to direct seeding, ensured plant vigor & sustained production during unpredictable weather patterns. It allowed growers to increase production from ~31.5 tons/acre to ~38 tons/acre by 2000s (27% increase)
- 2000s: Genetic Improvements and drip Irrigation improved water efficiency & sustained production during periods of water scarcity. It allowed growers to increase production from ~38 tons/acre to ~49.4 tons/acre by 2020s (31% increase)
- 2020s: Genetic Improvements and New Technologies – Currently, 49.4 tons/acre are produced. This steady increase in ton/acre has allowed growers today to use ~64% less land to produce the same quantities of tomatoes.

Bayer has played a prominent role by developing solutions to improve productivity and quality of processing tomatoes through breeding and crop protection solutions. Taking Bayer's SVTM 9032 variety as an inspiration, as it is a great example of innovation through early maturation. SVTM9032 not only has yields comparable to main season varieties, but with great consumer quality trait profiles *(color, serum, brix and jbost).* As an early maturing variety, SVTM9032 could mean up to 4.2 inches of water saved per acre – while producing excellent quality and quantity [2] .

Regardless of the geography, climate, or plant characteristics - sustainable production of processing tomatoes is continuously evolving to meet current and future challenges [3].

Sources:
Bayer Market Development
1 - USDA National Agricultural Statistics Service
2 - Disclaimer: SVTM9032 have not been tested head-to-head with other varieties. Data is extrapolated for example purposes.
3 - Production based not only on yield, but also in helping conserve natural resources to maintain an ecological balance.

Focused breeding and innovative solutions to support growers to advance a carbon-zero future for agriculture

The Ansal Tomato

We offer innovative solutions to help farmers reduce food loss and waste on and beyond the farm

At Bayer, our plant breeders are working to develop climate smart varieties and have introduced a tomato variety with a demonstrated ability to reduce food loss and contribute to carbon reduction.

Ansal tomato variety, available in India and in additional 15 countries, offers great shelf life and fruit firmness, which has the potential reduce postharvest food losses.

In a 2019 case study by Wageningen University for Bayer, using product performance data from 2013-2017 from ~65 Bayer internal trials and post-harvest data from ~60 growers and ~10 dealers and exporters for the south and west India markets, **only about 8-10% of Ansal produce was estimated to be lost in the postharvest chain[1]** *(versus estimated loss of 20-25% for a leading competitor variety for India).*

Using the Agro-Chain Greenhouse Gas Emissions (ACE) calculator to calculate the product life cycle, Wageningen University determined that, such a **reduction in post-harvest losses could result in ~23% less kg of CO2e per kg of marketable crop[2]** *(versus the same leading competitor variety).*

Source: Broeze J, Guo X, Axmann H, Vollebregt M. 2019. A systemic approach for trade-off analysis of food loss reduction and greenhouse gas emissions. CCAFS Working Paper no. 289. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

1 - comparing to a Bayer previous variety and a market leading variety
2 - Wageningen University study found Ansal tomatoes reduce carbon emissions 25% with more produce reaching the consumer

Climate Smart
Resilient Farming

Huntington Sweet Pepper

Helping smallholders become more resilient to climate change

Smallholder farmers usually produce a wider range of crops to diversify their own diets and to mitigate the risk of possible disease or pests affecting crops. Diverse seed types and varieties or hybrid seeds can further minimize the risks farmers are facing today and the challenges imposed by climate change in the future.

Bayer's commitment to smallholders is reflected in our vegetable seeds organization. We are strongly committed to providing solutions that mitigate the risks for vegetable smallholder farmers and increase their productivity and income while helping them to become more resilient to climate change.

The Huntington Sweet Pepper variety is an example that **performs well in both low temperatures (5 ºC) and high temperatures (40ºC)** — making it a perfect tool to support smallholders in India.

The Vegetables by Bayer portfolio enables smallholders to become more productive and resilient, boosting food security and economic development.

Disclaimer: Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields.

Garden Bean Varieties for Smallholder Farmers in Central America & the Caribbean

Tiezo, Gouti and Kiboko

At Bayer, we've developed new seed varieties that directly address the effects of certain pest and climate conditions that have an impact on smallholder harvests*.

Smallholder farmers face unique challenges that require tailored solutions. We want to enable these farmers around the world by providing more access to agricultural solutions. We aim to support them through collaborative innovative seeds, partnerships and training that expand agricultural know-how to address their most challenging issues, such as borne diseases like Bean Common Mosaic Virus (BCMV), Anthracnose (Colletotrichum) and Halo Blight (Pseudomonas).

The main damage to the plants caused by these diseases are:

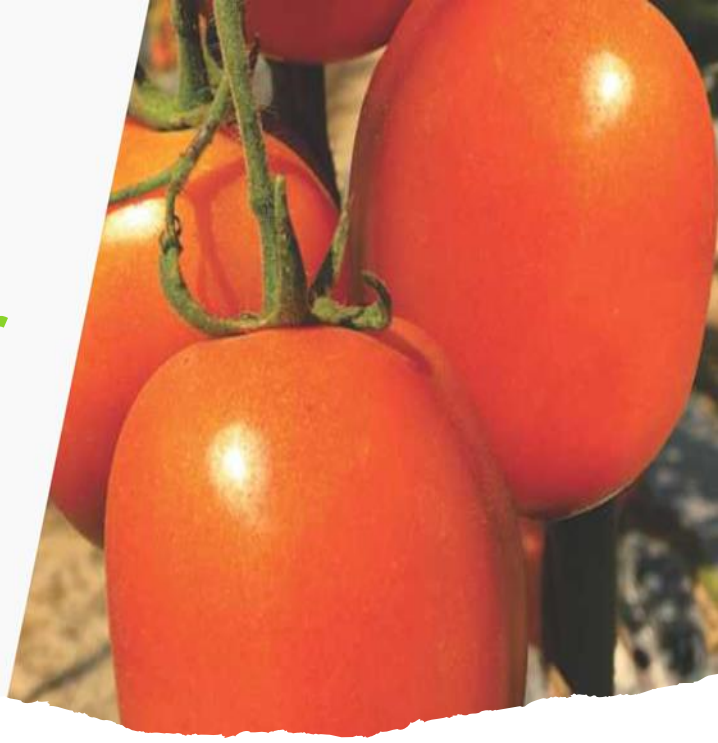
- BCMV causes raised, puckered or distorted leaves and stunted growth
- Anthracnose causes defoliation, lodging of plants or top die back of branches
- Halo Blight causes water-soaked spots and a greasy appearance
- Bean rust causes Pustules, defoliation with yield effect

Tiezo, Gouti and Kiboko varieties have broader disease packages to those diseases that allow fewer fungicide applications****. Growing these three garden bean varieties enable farmers to have similar or increased yield potential and help to reduce the amount of fungicide applications up to 50%***.

At Bayer we have seen the impact that innovation can bring. With these garden bean varieties, Bayer helps smallholder farmers protect their crops and their income potential.

Sources:
* https://www.bayer.com/en/agriculture/smallholders
** https://plantix.net/en/library/plant-diseases
*** according to Bayer R&D and based on variety performance in the Guatemala trial in 2020
**** https://www.bayer.com/en/agriculture/reducing-agricultures-impact-environment/ *Despite our market leadership, Bayer's environmental impact of crop protection is already exceptionally low and we will reduce it further by continuing to develop and offer innovative solutions that will help growers with their harvests*
*****compared to Bayer's other varieties*

Note: HR = High Resistance. IR = Intermediate Resistance. To find out more about disease resistance and the applicable levels of disease resistance, visit www.worldseed.org, and view the "Definition of the Terms Describing the Reaction of Plants to Pests for the Vegetable Industry" paper in the Vegetable Resources section. Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. Any recommendations provided on this material are based upon field observations and feedback received from a limited number of trials and geographies



Helping Smallholder Farmers in India Produce More With Less

Seminis® Aryaman

One of our major hybrids helping smallholder growers with a better crop protection management with its disease resistance package and earliness as well as contributing to lesser food loss with its excellent fruit quality attributes.

Aryaman is an early hybrid with high yield potential and excellent fruit firmness mainly bred for Western India.

- It has a leathery dark green foliage with balanced foliage/ fruit setting having very **high resistance to blight and tomato yellow leaf curl virus** (TYLCV).
- Aryaman bears a medium sized fruit (80-90 grams) in a cluster and contributes **excellent yield (10-15%** extra than Seminis® Garv and a competitor's leading variety). It has excellent size uniformity until last harvest with very good pericarp thickness, small scar, and attractive fruit - bright red skin with elongated square shape.
- Because of its earliness, we can expect a week early in maturity which potentially could **save ~6.5% of water per acre**.
- Additionally, Aryaman shows **9-10% less overall loss from harvesting to reaching consumers** *(when compared to Garv and a competitor's lead variety)*. Based on this food loss estimates, Aryaman shows it is best suited for long distance transportation (500-1000 km) and for local market needs with its excellent firmness.

As much as 40% of all tomatoes grown in India are lost before they reach small market stalls or supermarket shelves which affects income of smallholder farmers and contributes to significant (nutritional) food loss and impacts food security.

Disclaimer:
1: This is an approximate calculation on water efficiency compared to the other two hybrids. Tentative calculations and depends on precipitation from that season and average RF in MH is 600 mm. This water calculation is based on 6000 plants per acre and 6000 drippers per acre with 2 litres per hour discharge capacity and irrigation on alternate days for one hour. Conversions for litres/acre to litres/ha: 1 liter/acre = 2.471 liters/ha]
2: Calculation's backup: This is if we are using 5kg/lit of active ingredient (a.i) in Garv and a competitor's market leading variety. *[2307 grams (2.3 kg) and 1682.3 ml (1.6 lit) total amount of active ingredients sprayed in Aryaman; 2966 grams (3 kg) and 1993.55 ml (2 lit) = Garv; 2966 grams (3 kg) and 1993.55 ml (2 lit) = competitor's market leading variety.

Sources:
Data collected from 2016 to 2019 trials in the primary target market i.e., Central West India (Maharashtra region)
https://www.bayer.com/en/agriculture/reducing-agricultures-impact-environment
https://www.betterlifefarming.com/our-stories/helping-indian-smallholders-tackle-food-loss/

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The health of the world grows with you.

Access success stories deck for external presentations here
For more success stories here

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