HIGH IRON BEANS

A food that can change your business
and the world naturally

HarvestPlus
Better Crops • Better Nutrition

HarvestPlus: Leading a global movement to deliver more-nutritious crops

Beans have always been a good natural source of iron. But now, thanks to an innovative approach to the age-old process of natural crop breeding, the concentration of iron in beans can be boosted, making them even more nutritious.

At HarvestPlus, we work with world leaders in crop development and agriculture to unlock beans' genetic variation for iron from within global gene bank collections. We use non-GM, conventional breeding techniques to develop beans with up to 90 percent more iron than standard varieties.

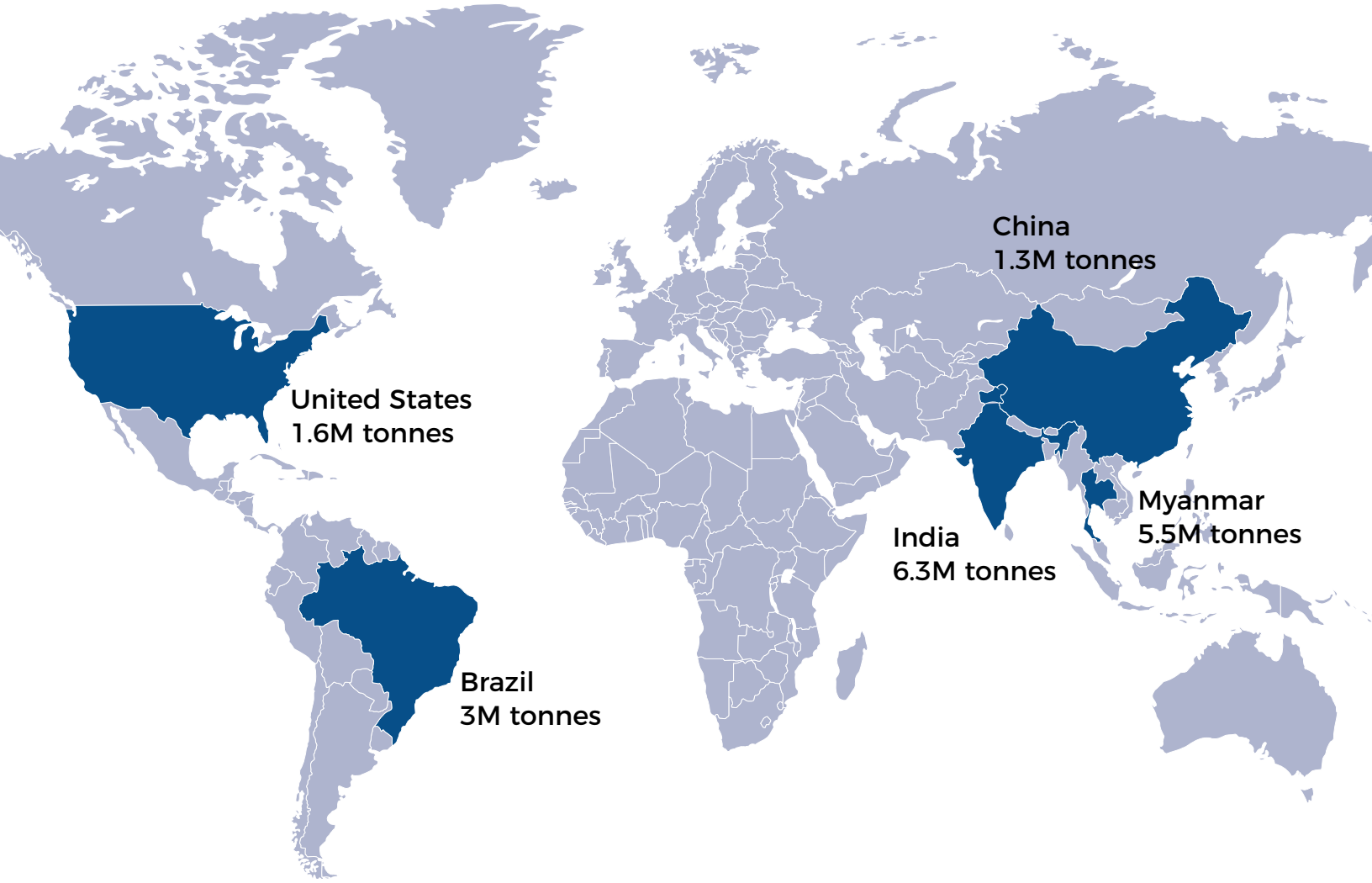
HarvestPlus, the global delivery organization for biofortified varieties, also works with partners to integrate these new beans into local food systems. This is now a proven and effective intervention to reduce micronutrient deficiencies, especially for iron.

The global bean market

4.2% global annual production growth rate

The global production of dry beans was 32.7 million metric tons in 2018, and is expected to register a compound annual growth rate (CAGR) of 4.2 percent during the forecast period through 2030.

BEAN PRODUCTION, 2019



Where do beans grow?

Beans are one of the first plants to have been cultivated by humans; for hundreds of years, beans have traditionally complemented energy sources in the diet to provide nutritionally complete meals. Beans will generally grow in most parts of the world, though different varieties are more suited to different climates. The world's leading growers of beans by volume are India, Myanmar, Brazil, the United States, and China.

Beans and other legumes are environmentally friendly. They work together with nitrogen-fixing bacteria called Rhizobia that live in the plant's roots. Rhizobia is a natural source of organic fertilizer and reduces the need to add industrial or chemical fertilizers. Nitrogen from the air diffuses into the ground and is chemically converted by Rhizobia into a form of nitrogen the plants can use.

Bean Nutrition

Beans are recommended as part of a healthy diet and are an excellent source of many nutrients. Frequent consumption of beans may result in health benefits such as reduced risk of heart disease, better glycaemic control, and weight management. Regular consumption of iron beans can also help improve iron stores in iron-deficient populations. On average, the iron content of beans is around 5.0 mg per 100 g (see the table below for the levels of iron in HarvestPlus varieties). HarvestPlus has a target breeding amount of 9.4 mg per 100g, and some varieties we have already hit that target.

BEAN NUTRITIONAL PROFILE

High in fibre
Average fibre content of beans is 17 to 25g per 100g; some varieties are as high as 28g/100g.

Sugars
Low in simple sugar. Some varieties have low levels of complex carbohydrates associated to digestive problems.

High in protein
19-24% g protein per 100g.

Low glycaemic index
Low in carbohydrates, high in fibre.

Gluten free
By nature, beans do not contain gluten.

Low fat
Low in saturated fat.

Lower cooking times and temperatures
Some varieties cook in as little as 30 minutes (30-60 minutes, after soaking).

Essential vitamins and micronutrients
Folate, zinc, potassium, calcium, manganese, magnesium, selenium, and others.

Market Forecast to 2030

Driven by global consumer demand for natural nutrition, high protein and meat free the bean market is growing. It is expected to continue an upward consumption trend over the next decade, experts believe the market volume will be 48 million tons by the end of 2030. High iron varieties can bring new products for old markets and old products for new markets where beans are not commonly consumed. High iron beans bring both food renovation and food innovation to the market.

The importance of iron & the prevalence of iron deficiency

Iron is an essential micronutrient and the most abundant trace mineral in the human body. It is a primary component of hundreds of proteins and enzymes and supports numerous functions within the body.

Why do we need iron? Authorised nutrient function claims for iron:

Iron contributes to normal cognitive development of children.

Iron contributes to normal physical work performance.

Iron contributes to the normal function of the immune system.

Iron contributes to normal cognitive function in children, adolescents and adults.

Iron contributes to normal formation of red blood cells and haemoglobin, which are important for normal oxygen transport in the body.

Iron contributes to the reduction of tiredness and fatigue.

Globally, iron deficiency is one of the most prevalent malnutrition disorders, especially among children and women of reproductive age.

Many countries have adopted fortification programs to address this deficiency by increasing the micronutrient content of specific foods in a food system. While fortification is a proven, effective intervention to reduce iron deficiency, it only works well when it is applied to commonly consumed foods and that the intended consumers can access consistently.

Meanwhile, consumers are seeking “cleaner” labels and foods with fewer added ingredients. While fortification is effective, consumer trends in some markets show that consumers prefer foods that contain natural sources of vitamins and minerals, not additional ingredients on the label.

How much iron do we need?

The optimum amount of iron our bodies need to stay healthy varies by age group and population. In general, women of reproductive age need relatively more iron than other population segments, and women's iron need significantly increases during pregnancy. As a guide for everyone and generally for food labelling purposes, 14 milligrams per day is used as the recommended daily amount for food labelling purposes.

Why don't we get enough iron from our food?

There are two forms of dietary iron: haem and non-haem. Haem iron is readily absorbed and is found in animal-based foods, while the less absorbable non-haem iron is found in plant-based foods. Several factors such as iron status, iron requirements, and disease state can affect the amount of iron absorbed by our bodies from food.

The best dietary sources for haem iron are red meat, liver, poultry and fish. However, these foods are often expensive or not available in low-income, rural food systems and may in some instances not be culturally accepted. In many countries and cultures, religious beliefs do not allow consumption of specific meats or they are prioritized for male members of the household. Many consumers are also choosing to eliminate or reduce meat consumption for ethical, environmental, or health reasons.

Several staple crops and vegetables are good sources of non-haem iron such as leafy greens, pulses, nuts, and whole grains. However, absorption of non-haem iron is generally lower than haem iron and is affected by various factors in food. Phytates (a type of fibre in cereals and pulses), oxalates, tannins, and calcium can all bind non-haem iron in the intestine, which reduces absorption. Conversely, vitamin C (ascorbic acid) and other acids present in fruit and certain vegetables, aid the absorption of non-haem iron when eaten at the same time.

Working with expert breeders, HarvestPlus and its alliance partners are developing biofortified dry bean varieties that have higher iron levels. Some varieties have double the amount of iron than conventional beans. Recently, work has commenced on future varieties which have lower phytate levels. Beans also have high protein content and are a very popular and an excellent source of protein for non-meat food products (plant protein-based foods).

High iron beans contain a natural source of iron that is proven to be bio-available in several human studies.

Nutritious beans add value throughout the value chain

HarvestPlus varieties of high iron beans are a pioneering breakthrough that will be part of the solution for one of the world's biggest malnutrition problems in low- and middle-income countries and answer the needs of consumers in high-income countries. High iron beans can be the next global super food: nutrient dense, environmentally friendly and good for human health.

For Farmers

- I want to grow something that we can eat as a family and is good for us.
- I want to grow crops that are in demand.
- I need varieties with high yield and are easy to grow so I get a good price.

For Food Manufacturers and Retailers

- Iron beans are welcome news for a category that hasn't seen innovations or growth for many years.
- I want to be ahead of the competition with the next super food.
- I want to invest in foods that are not only good for profits and good for consumers, but are good for the world. Social responsibility is good for business.

For Consumers

- I want a naturally more nutritious version of the food I commonly consume.
- I want to buy healthy foods with less added ingredients.
- I want to buy foods that are good for me, good for the world, and good for the planet. I care about where my food comes from.

Standard beans contain 5.0 mg iron per 100g, depending on the variety. HarvestPlus varieties can have as much as **90% more iron.**

What iron bean varieties are available?

HarvestPlus and its partners have developed 60 varieties of high iron beans. If you are currently using dry beans, we can find you the comparable high iron variety.

This is a summary of the most common beans and their iron values.

Colour / market class	Variety name	Iron content (mg/100g)	Protein (%)	Percentage of recommended daily amount per 100g consumed
Black	ICTA Chorti-ACM	9.5		67.9
Small Red Kidney	BIO-101	8.3		59.3
Red Mottled	BIO-102	8.6		61.4
Red Mottled	RWV 2245	7.2 - 7.6	18.8	51.4
Red Mottled	MAC 44	7.8 - 8.5	20.7	55.7
Sugar (pinto)	MAC 42	9.1	22.6	65.0
Sugar (cranberry)	RWR 2154	6.8 - 7.3	20.5	50.7
White (navy)	CAB 2	7.6 - 8.5	22.5	54.3
White (navy)	Jasmine	8.6 - 9.4		67.1
Pink (salmon)	RWV 1129	7.7 - 8.1	22.4	55.0
Yellow (brown)	NARO-3	6.5 - 8.1	23.4	50.0
Red mottled	NUA 45	6.4 - 6.8		43.6

Zinc: An added bonus

Zinc deficiency is also a major public health problem in many countries. Zinc is necessary for optimal immune function, and deficiency is associated with an increased incidence of diarrhea and acute respiratory infections. It is a major cause of death in children younger than 5 years of age. Globally, it is estimated that 17.3 percent of the population has inadequate zinc intakes, with the highest estimates in Africa (23.9 percent) and Asia (19.4 percent).

In developing high iron bean varieties, zinc comes with the iron. Iron and zinc are co-localized in the grain, and biofortified varieties contain more zinc than standard varieties.

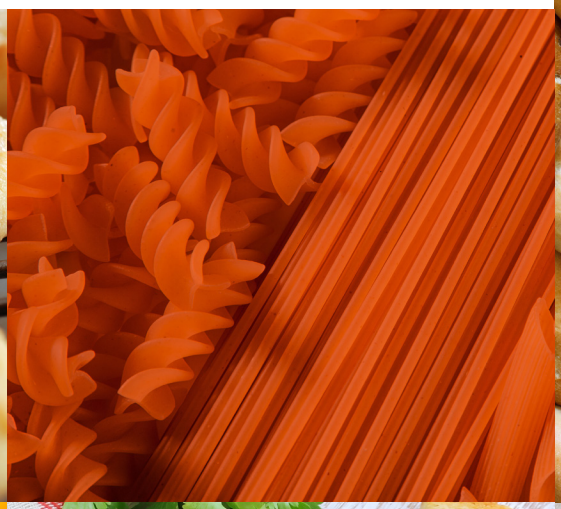
Communicating nutrition and health claims to consumers

HarvestPlus has developed labelling guidelines for many countries which which make it incredibly easy to make iron content claims, nutrition function claims, and comparative claims.

For example, and depending on the food format, a product could carry the following claims:

- Naturally high in iron
- Iron helps to reduce tiredness and fatigue
- Contains 50 percent more iron than other bean products

Product innovation and renovation with iron beans



Working with smallholders

Beans are a core crop for the HarvestPlus program. They are a rich source of nutrition for low-income smallholder farming families who also depend on beans as a source of income. HarvestPlus has many years of experience working with beans and can help you find the right bean to grow in the right climate.

HarvestPlus can enable supply chains for you and your business. Depending on the type of bean you are interested in and the location of your manufacturing plant, we can enable sustainable, secure supply chains with traceability processes for genuine quality iron beans. Using this route, we find a competitive price and added value, and in so doing, you will be providing market access for the world's most vulnerable smallholders.

Switching your current growing practices

It is not always possible to work with smallholders and you may already be working with leading growers and have a strong and dependable supply chain. In this case, we can work with you and your growers to switch your current varieties with the high iron alternatives. The expert plant breeders, agronomists, farmers, and food technologists at HarvestPlus will help at every step of the way. This work provides a revenue stream for our non-profit organization and, crucially, brings in investment and awareness of the problem and solution. We have several services available to assist with your transition to the naturally nutritious variety.

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