Pearl millet helps fight iron deficiency
Evidence from three bioavailability studies

Pearl millet has the potential to fight iron deficiency, the highest nutrient deficiency in the world especially prevalent among women and children across India and sub-Saharan Africa. Recent studies have shown that the bioavailability (absorption) of iron in pearl millet is high enough to provide more than 50% of the daily requirement for children or adult males. One meal of biofortified high-iron variety of pearl millet can meet approximately 50-100% of the daily allowance for iron helping combat iron deficiency for women, men and children.

Three studies that covered different age groups in different countries – young women in Benin, teenagers in Maharashtra, India, and very young children in Karnataka, India – have shown that the bioavailability of pearl millet is estimated at 7.4% for regular pearl millet as well as biofortified high-iron pearl millet. As a result, when the iron in pearl millet is higher, more iron is absorbed.

The study released this week, based in Maharashtra, India, with children aged between 12 to 16 years has found that among children who were iron deficient at the beginning of the study, 40% of the children consuming regular pearl millet and 64% of the children consuming high-iron pearl millet were iron replete at the end of the study. The study was reported in the *Journal of Nutrition* and funded by HarvestPlus.

During the study, one group of children ate bhakri (flat unleavened bread) made of high-iron pearl millet for their midday and evening meals while the other group ate bhakri made of regular pearl millet. The children also consumed a savory snack made of pearl millet through the day.

One study in Benin (2013) with young women aged around 20 years and another study in India (2013) with very young children (aged around 2.5 years) – have found that biofortification of pearl millet is highly effective in combating iron deficiency in millet-consuming populations.

According to WHO, anemia affects 1.62 billion people (24.8% of the population) globally. The highest prevalence is in preschool-age children (47.4%) and non-pregnant women (468.4 million). A staggering 2 billion people suffer from hidden hunger (lack of vitamins and micronutrients), according to the 2014 Global Hunger Index.

Lack of bioavailability studies for other millets, such as calcium for finger millet, are a constraining factor to widespread promotion of these healthy alternatives.
Enhancing hybrid vigor of sorghum and pearl millet brings enhanced benefits to smallholder farmers. A project in West Africa aims to bring the benefits of heterosis (hybrid vigor) to smallholder sorghum and pearl millet farmers and establish a solid foundation for hybrid development.

The project strives to establish functional heterotic groups for sorghum and pearl millet, determine selection strategies for effectively breeding hybrids for the major production systems of West and Central Africa (WCA), develop new and diverse hybrid parents with required adaptation and grain quality traits, and strengthen the WCA sorghum and pearl millet research capacity.

This project meeting of sorghum researchers from Nigeria and Mali provided an opportunity for presentation of results from the 2014 season and off-season nurseries. Based on discussion of the current results and stage of development of breeding materials, trials and crossing plans were made for the upcoming season.

In addition a training was conducted by Ibrahima Sissoko, ICRISAT-Mali, on the use of tablets for electronic data capture, image and audio recordings for trial plots using ‘Fieldlab’ software from the Breeding Management System (BMS).

A field visit to the off-season crossing block at ICRISAT-Mali enabled participants to see the backcrossing program for sterilization of new female parent A/B pairs and the crossing programs for two combining ability studies, one for the new female parental lines being jointly developed by Institut d’Economie Rural (IER) and ICRISAT, and one for the most promising male parents selected from backcross progenies from introgression into the elite male parent ‘Lata’.

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All three studies used the ICRISAT-developed high-iron biofortified pearl millet variety ICTP 8203 Fe. This variety was released as Dhanshakti in Maharashtra, India, in 2013 and for all-India cultivation in 2014. Dhanshakti is the first iron biofortified crop cultivar to be officially released in India. It has been included in the Nutri-Farm Pilot Program launched by the Indian government. The multi-location yield trials were conducted in collaboration with national partners Mahatma Phule Krishi Vidyapeeth, Dhule and All India Coordinated Pearl Millet Improvement Project, Mandor.

Pearl millet is a hardy, drought-tolerant crop, often the only crop, that can grow in the arid degraded soils across the drylands of the world. It is a staple grain across many states of India and across large parts of sub-Saharan Africa. It is a significant source of iron and zinc and has been shown to account for 19-63% of the total iron and 16-56% of total zinc intake from all food sources in pearl millet growing states of Maharashtra, Gujarat and Rajasthan in India. It is also the cheapest source of these micronutrients as compared to other cereals and vegetables. Thus pearl millet biofortification opens up the possibility of a cost-effective strategy to beat malnutrition in women and children while simultaneously providing smallholder farmers a climate-ready crop to face the vagaries of climate change.

ICRISAT’s work in pearl millet biofortification is supported by HarvestPlus.

The pearl millet biofortification activity is part of the CGIAR Research Program on Agriculture for Nutrition and Health. Read more about pearl millet http://exploreit.icrisat.org/page/pearl_millet/680

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1 This is based on consuming 100 grams for infants/children and 200 grams for an adult and comparing with the recommended daily allowance from the Indian Council of Medial Research. Daily allowance is reached for infants and adult males and approximately 50-60% is reached for children and women

2 http://www.who.int/vmnis/anaemia/prevalence/summary/anaemia_data_status_t2/en/


Farm income insurance can mitigate risks for smallholder farmers

**Freak weather causing multiple shocks in eastern India**

Recent forecasts of the impact of El Nino predict that the monsoons over India are likely to be less than normal. According to a BBC report\(^1\), reduced rainfall could be felt in India and West Africa as early as June. A single crop failure can push farmers into a debt trap from which they may never recover. In such circumstances farm income insurance can be an important safety net to prevent agrarian distress.

Coping with monsoon vagaries is a constant challenge for smallholder farmers. This was studied in the Village Dynamics in South Asia (VDSA) project villages in eastern India (spread over 6 districts in the states of Bihar, Jharkhand and Odisha). These villages received good rainfall only in two of the last four years, though even in these two years the total rainfall was 20-30% less than the long-term average in Bihar and Jharkhand.

To compound the problem, untimely rains in March-April 2015 have caused immense misery to farmers. “I spent `10,000 per acre in wheat cultivation. Due to strong hot wind followed by stormy rain, my wheat crop was completely damaged. We will now earn hardly `2,000 per acre,” said 50-year old Rameshwar Manjhi of Inai village of Bihar. The loans that he had taken add to his woes. “I took a loan of `50,000 from local moneylenders at an interest rate of 24% per annum to pay the landowner the leasing rent. But, we lost everything.”

**Plight of smallholder farmers**

In the two study villages of Bihar (Inai and Susari of Darbhanga district), majority farmers are marginal farmers (<1 acre land holding). Rice and wheat are the major crops. This year, the wheat crop was good and farmers were expecting about 25-30 quintal/ha (2,500-3,000 kg/ha) grain yield along with 30 quintal (3,000 kg) of straw as by-product. Rameshwar Manjhi, whose family depends on farming and wage labor, said, “I was able to harvest only about one-fourth of this – 650 kg/ha of wheat and 650 kg/ha of straw. I don’t know of any insurance scheme which will help me in such a situation.”

**Crop insurance still a distant dream**

A number of government crop insurance schemes – starting with the Comprehensive Crop Insurance Scheme (CCIS) introduced in 1985 to weather-based insurance in 2004 and finally to the latest National Crop Insurance Programme (NCIP) introduced in all districts from rabi 2013-14 – have not been effective in offering any relief to farmers in eastern India. Under NCIP, around 20 insurance companies are empanelled to provide crop insurance to the farmers but awareness among farmers is low. Under the category of rural insurance, most of these companies offer insurance cover for: (i) produce stored for commercial sale, (ii) weather insurance and (iii) livestock insurance. During rabi season in 2012 and 2013, none of the farmers in the VDSA villages were covered by empanelled companies which includes the Agricultural Insurance Company of India Ltd, one of the largest insurers in the country. To compound the problem, no company has a presence in the two villages.

**Streamlining initiatives of institutional credit and insurance**

Like Manjhi, there are 16 million farmers in Bihar, many of them borrowing money at very high interest rates from local moneylenders or relatives for their farm operations. In case of crop failure, farmers become indebted for life. A safety net in the form of farm income insurance can greatly help resource-poor smallholder farmers. However to be effective:

- All categories of farmers – landowners, sharecroppers or lease-land growers should be included. To augment income, smallholder farmers take additional land on lease. Though leased land is covered under the scheme, farmers cannot benefit since they do not possess the necessary documents.
- There should be sufficient publicity and awareness about such schemes among the farming community especially in remote regions. In the VDSA villages, data reveals that not a single farmer is aware of these schemes. For the schemes to have an impact, creating awareness among farmers is crucial for success.

*With inputs from VDSA field investigators - Dayanand Tripurari and Gunjesh Kumar.*

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New publication

Estimating shadow prices and efficiency analysis of productive inputs and pesticide use of vegetable production

**Authors:** Singbo AG and Lansink AO and Emvalomatis G

**Published:** 2015. European Journal of Operational Research, 245 (1). pp. 265-272. ISSN 0377-2217

**Abstract:** This paper analyzes technical efficiency and the value of the marginal product of productive inputs vis-a-vis pesticide use to measure allocative efficiency of pesticide use along productive inputs. We employ the data envelopment analysis framework and marginal cost techniques to estimate technical efficiency and the shadow values of each input. A bootstrap technique is applied to overcome the limitations of DEA and helps to estimate the mean and 95 percent confidence intervals of the estimated quantities. The methods are applied to a sample of vegetable producers in Benin over the period 2009–2010. Results indicated that bias corrected technical efficiency scores are lower than the initial measures and the former estimates are statistically significant. The application results show that vegetable producers are less efficient with respect to pesticide use than other inputs. Also, results suggest that pesticides, land and fertilizers are overused.

http://oar.icrisat.org/8739/

Most cited

According to Google Scholar, the paper titled “Nature of Gene Action and Maternal Effects for Pod Borer, Helicoverpa armigera Resistance and Grain Yield in Chickpea, Cicer arietinum” authored by Dr Hari C Sharma, Principal Scientist – Entomology, ICRISAT, which was published in January, Vol. 4, No. 1, 2013, has been downloaded 1,177 times. Another paper titled “Protease Inhibitors in Wild Relatives of Pigeonpea against the Cotton Bollworm/ Legume Pod Borer, Helicoverpa armigera” published in May, Vol. 3, No. 5, 2012 has been downloaded 1,737 times. The American Journal of Plant Sciences congratulated Dr Sharma for his popular papers in the journal.

New project

**Project title:** Services for conducting of a study to assess the socio-economic and bio-physical impact of Conservation Agriculture on smallholder farmers in Southern Africa; case studying Malawi, Zambia and Zimbabwe (FAO Technical Support to the COMESA-EAC-SADC Programme on Climate Change Adaptation and Mitigation in the Eastern and Southern Africa Region)

**Principal Investigator:** Dr K Mazvimavi

**Investor:** FAO-Southern Africa

**Aims:** The purpose of this study is to assess the practice, and adoption of conservation agriculture (CA) and its social and economic impacts in southern Africa, namely in Malawi, Zambia and Zimbabwe.

**Project Outcome:** Enhanced knowledge by policy makers, communities and development partners on the impacts of CA on smallholder farmers in southern Africa.

**Project outputs:**

- A detailed work plan for the assessment of social and economic impacts of CA and the methodology and tools that will be used.
- A report that provides a critical assessment of the social and economic impacts of CA on smallholder farmers in Southern Africa, focusing on Malawi, Zambia and Zimbabwe.

Reader’s comment

Attracting youth to agriculture is a major challenge not only in Africa, but for any country in the world. This is because agriculture, in general, and rainfed agriculture in particular, have been less profitable due to climate change and various other soil-based and crop-based constraints. Modernization of agriculture with improved mechanization of different agricultural operations from land preparation to harvest/post-harvest, especially due to labor shortage, is the need of the hour. Scaling-up of watershed management for better adoption of improved technologies is an important activity. Glad that you are making efforts to deliver risk resilient and productive cultivars to small farmers, apart from harnessing the power of nutri-cereals in different regions. I am sure rainfed agriculture would get revitalized with ICRISAT’s better plans, especially based on science-led interventions, and would improve the productivity of crops in different states in India.

Dr GR Maruthi Sankar, Ex-Principal Scientist (Agricultural Statistics), AICRP for Dryland Agriculture, CRIDA, ICAR, Santoshnagar, Hyderabad