Australian Government
Australian Centre for International Agricultural Research

EDITION #7, DECEMBER 2020

MUNG CENTRAL

The IMIN is a collaboration between The World Vegetable Center and international partners across Australia, Bangladesh, Kenya, India, and Myanmar to breed new mungbean lines with the hope of uncovering desirable traits for improved production across partner countries. This work is funded by the Australian Centre for International Agricultural Research (ACIAR)

Editorial

This newsletter is the testimony of the determination of all the partners associated with the IMIN program. All the stakeholders continued stepping towards their set forth goal, despite the chaos created due to the COVID-19 pandemic.

In spite of the challenges posed by the COVID-19, IMIN team could develop the unique 'Yellow Seed mungbean' in India, created gains of 'billion-dollar' success in Myanmar, initiated the research to address 'dual diseases resistance' in Australia, succeeded in reaching farmers with 'improved production technologies' in Tanzania. Let us celebrate these efforts with special mungbean recipe 'Onde-onde Ubijalar' and welcome the new year with new normality. Congratulations to all for keeping the spirit alive to move forward.

If you are interested in finding out more about collaboration with the IMIN, please email: ramakrishnan.nair@worldveg.org

We hope you enjoy this seventh edition of Mung Central. To access previous editions visit: https://aciar.gov.au/search?search_api_fulltext=Mung+Central+Newsletter

Story from India: Development of Yellow Seed Mungbeans

Contributed by - Aditya Pratap, Basavaraja T, Revanappa B and Gupta S

Yellow Seed Mungbeans

Mungbean has a strong penetration in local cuisine in different parts of India and finds variable preferences with respect to grain size, seed coat luster (shiny or dull), and seed coat color (green or yellow) based on their cooking type, aroma and taste. Majority of the consumers in the Indian sub-continent prefer shiny green grains, while shiny yellow grains are preferred in some parts of India, especially in West Bengal and few parts of Bangladesh and Sri Lanka.

The traditional mungbean cultivars possessing yellow seed coat color are known to be associated with a peculiar type of aroma which comes after boiling and therefore, have a considerable commercial interest. Among such cultivars of mungbean, 'Sona Mung' is popularly cultivated in the pockets of Ganga river basin of Malda District in the West Bengal and fetches a premium price owing to its organoleptic properties.

However, area under cultivation of 'Sona Mung' could not expand much due to the associated constraints such as indeterminate growth habit, asynchronous flowering, high susceptibility to yellow mosaic disease and long crop duration as compared to the modern mungbean cultivars which are determinate, synchronous, early maturing, disease resistant and high yielding. Keeping in view the above, effort was initiated at ICAR-Indian Institute of Pulses Research, Kanpur to improve the local cultivars of 'Sona Mung' through breeding efforts.

Initially, 3 elite mungbean cultivars viz., IPM 99-125, IPM 02-3, PDM 139 were crossed with a local landrace of Sona Mung collected from Malda District of West Bengal. All the crosses were advanced till F_7 generation between 2009-16 following pedigree method of breeding and single plant selections were done in each generation. Selection started from F_2 onwards for yellow seed coat colour and also for other desired traits such as, erect plant type, resistance to yellow mosaic disease, early and synchronous maturity. Plant-to-row progenies were grown in the next generation till superior fixed lines were isolated. Among the several genotypes obtained from the cross between IPM 99-125 x Sona Mung, the genotype IPM604-1-7 performed significantly better than the best check. Thus, the multilocation trials were initiated for genotype IPM604-1-7 in All India Coordinated Research programme on MULLaRP (AICRP-MULLaRP) during 2019. Currently, this genotype is in advanced stage of evaluation and is expected to be identified and released as superior yellow seed cultivar of mungbean. In the market, it will be a unique genotype available to the farmers with the advantages of aromatic yellow mungbean having additional majour desired traits such as, better disease resistance, wider adaptability along with other positive traits. Consequently, it has a potential to enhance the famer's socio-economic condition.

Story from Australia : Double trouble – a tale of two diseases

Contributed by - Araz Solman and Col Douglas

If you are asked to list the most common diseases of Australian mungbeans, chances of halo blight and powdery mildew are on the top of the list. There's a lot we don't like about these diseases including their economic impact and crafty ability to cause widespread impact which have proven to be quite a headache for farmers and pathologists alike.

Here is what we do know about these diseases:

- They both infect the same plant – mungbean
- They share certain characteristics – both flourish in cool, humid conditions.
- Both are on the mungbean pathology hit list here at DAF!

Despite sharing certain characteristics, these diseases have contrasting ways to attack and extract nutrients from the plant. Halo blight kills the host for nutrients whereas, powdery mildew requires a living host to survive. Nonetheless, recent field research by the DAF pulse breeding team shows that halo blight and powdery mildew can occur on the same leaf (Figure 1). This co-occurrence represents an unusual case of these diseases ganging up on the plant while still able to both survive despite different needs from the host.

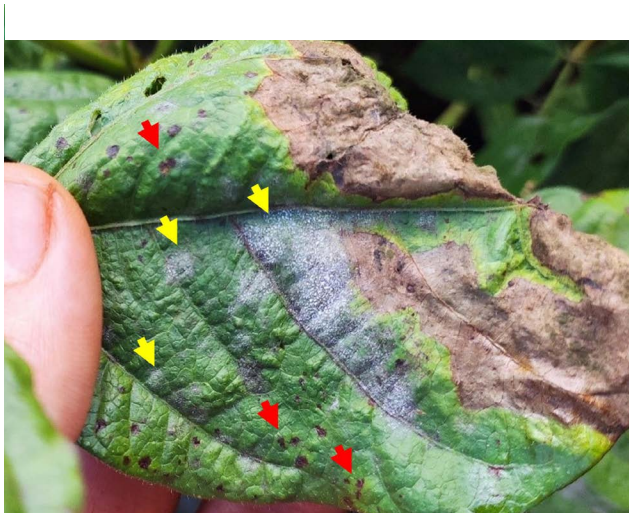

Figure 1. Symptoms of halo blight, indicated by the red arrows, often appear as dark water soaked round lesions that eventually develop surrounding yellow margins. Powdery mildew symptoms, indicated by the yellow arrows, are easily recognisable by the whitish, talcum-like, powdery growth on leaf surface. If left untreated, the whitish powder can develop into widespread bronze cover that can lead to premature defoliation and significant yield loss.

Researchers from Hermitage Research Facility in Southern Queensland have been conducting field trials, as a part of the International Mungbean Improvement Network funded by the Australian Centre for International Agricultural Research, screening a large set of mungbean lines for their reactions to of multiple diseases. We have developed a method based on spray inoculation to establish halo blight, whilst can rely on natural infection to establish powdery mildew. Our initial results suggest that some of the commercially available mungbean varieties have a typical inverse relationship in their reaction to halo blight and powdery mildew (Figure 2). If a variety is typically resistant to powdery mildew, it is often susceptible to halo blight and vice versa. This indicates that resistance to one of the diseases pre-disposes the variety to become susceptible to the other disease. However, when we evaluated disease reaction of lines from a large Australian diversity panels, we found that many lines don't conform to the same inverse relationship seen in the commercial varieties

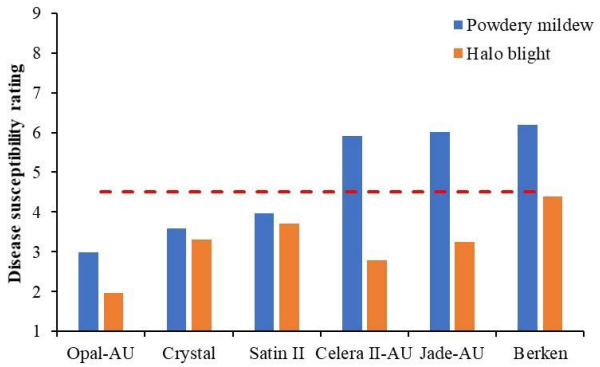

Figure 2. Susceptibility reaction of the commercial mungbean varieties to the disease caused by powdery mildew and halo blight.

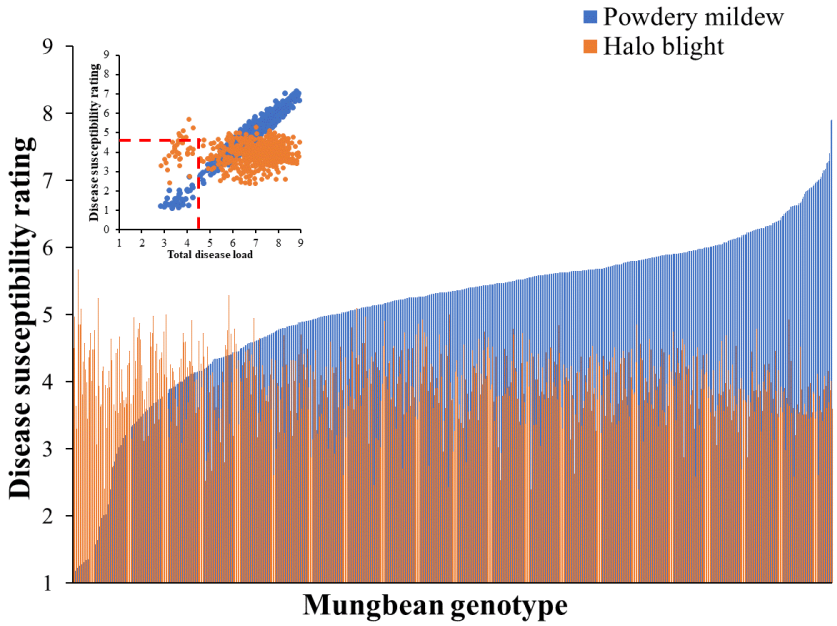

Figure 3. Susceptibility reaction of the diversity breeding panel also shows a typical inverse susceptibility to powdery mildew and halo blight. Insert linear regression graph shows that many breeding lines have resistant reaction to both diseases which is promising for the development of breeding donors with good reaction to both diseases. Susceptibility reactions are measured on a 1-9 scale with 1 indicating resistant reaction and 9 indicating dead plant. Dotted red line is set at 4.5 indicating moderately resistant reaction.

This finding provides promising results for the development of parental lines for a breeding population that have resistance to both halo blight and powdery mildew. Plant breeders can then cross these traits from donor lines into high yielding and agronomically varieties to minimise the impact of major diseases. Efforts to breeding mungbean varieties with good resistance to major diseases will also be informed by research into how prevalent these diseases are in mungbean growing regions and how they infect the plant. Information about prevalence and infection strategy will support the design of disease screening to broaden the spectrum of disease resistance whilst maintaining a reliable yield and agronomic package. A new variety would be of limited value to farmers if it has good resistance to one disease but high susceptibility to another equally important disease in the region.

Story from Myanmar : The billion-dollar bean

Contributed by - Pepijn Schreinemachers

The mungbean varieties developed by World Vegetable Center (WorldVeg) and released by the Department of Agricultural Research in Myanmar created economic gains of USD 1.4 billion from 1980 to 2016 and the benefits from this billion-dollar bean are expected to continue into the next decade.

The Mungbean is generally considered a minor crop in most places. But not so in Myanmar, where mungbean is one of the country's main crops supporting the livelihoods of about 637,000 smallholder farm households.

Myanmar accounts for 30% of global mungbean production and is by far the largest exporter of this green bean. The crop fits well in the country's rice-based cropping systems and the output is largely sold to India rather than consumed in country.

World Vegetable Center researchers began mungbean breeding activities in 1972. WorldVeg and the Department of Agricultural Research in Myanmar have been working together since the 1980s to introduce new varieties with higher yield, short maturity and better disease resistance particularly to mungbean yellow mosaic disease. These improved varieties resulted from a long-term collaboration with national mungbean programs in India, Philippines, Thailand and Pakistan. There are nine improved mungbean varieties available in Myanmar, and five of these came from the WorldVeg program, Jointly, these five varieties have been adopted on 77% of the country's mungbean area.

A study funded by the UK Government's Department for International Development (DFID) (now the Foreign, Commonwealth and Development Office, FCDO) and led by Teresa Sequeros, an independent consultant hired by WorldVeg, estimated the economic impact of these varieties for Myanmar. The study used the economic surplus model a well-established method to quantify the economic impact of agricultural technologies at the aggregate level.

The results show that mungbean research and development in Myanmar created total economic gains of USD 1.4 billion from 1980 to 2016.

Of these gains, 95% accrued to smallholder farmers and 5% accrued to consumers in Myanmar (as most of the output is exported). Extending the analysis up to 2030, when the current varieties may be replaced by newer ones, suggests total economic gains of 3.7 billion.

These economic gains were made possible by international donors and the Myanmar government, which invested about US$ 5 million in mungbean R&D for Myanmar from 1980 - 2016. Calculations suggest that one dollar invested in mungbean R&D gave a mean return of 92 dollars until 2016, and will give a mean return of 181 dollars until 2030. This is an attractive return on investment for international donors, which included DFID and other long-term strategic donors of the Center.

However, the study also shows it took 20 years between the research investment and the start of impact illustrating the fact that investments in agricultural research require a long-term, patient perspective.

The varieties that made such large impact in Myanmar contained germplasm supplied by the national agricultural research programs of India, Pakistan, Thailand, the Philippines, and perhaps also other countries. The unconditional sharing of plant genetic resources between national agricultural research systems in Asia was a key contributor to the success of the mungbean breeding initiative. Future gains in mungbean breeding will continue to depend on this spirit of collaboration.

Story from Tanzania: Popularising Mungbean production technology

Contributed by - Ester Simfukwe, Henry Mvungi, Papias Binagwa, John Msaky and Ramakrishnan Nair.

Earlier this year, as part of the UK Government's Department for International Development (DFID) (now the Foreign, Commonwealth and Development Office, FCDO) project, WorldVeg in collaboration with Tanzania Agricultural Research Institute (TARI) conducted a mungbean value chain analysis in Tanzania, with the view of scaling up the mungbean production in the country.

The baseline survey on adoption and value chain analysis revealed constraints to mungbean production are the lack of knowledge on production among the famers and, poor access and availability of improved mungbean seeds. To address these issues, a 'Training of trainers (ToTs) approach' was adopted to ensure scale-out of mungbean technologies to farmers and Government extension staff.

The total of 1577 farmers and extension staff from Mwanza, Simiyu, Tabora, Morogoro, Mtwara and Kilimanjaro regions in Tanzania received the ToTs training.

The participants developed skills and knowledge of different technologies such as Mungbean agronomic practices, Seed production, Integrated Pest Management, Agribusiness and Mungbean processing. Participants also learned to prepare mung bean recipes.

Each trainee received a pamphlet covering the above topics and trained farmers were given 15g pack of improved mungbean varieties such as NURU or IMARA for establishing demonstration plots for the purpose for training more farmers in their respective villages.

If one trainee reaches at least ten farmers, we are expecting the multiplier effect of the ToTs strategy to reach 15770 farmers and 1000 demonstration plots. Overall, scaling up of mungbean production technology dissemination was deemed as the success as participation rates reached more than 80%.

Table 1: Statistics of participants on ToTs of Mungbean value chain actors per region.

Region	Train of Trainers (ToTs)	Extension	Farmers	Female	Male
Mwanza	245	108	137	99	146
Simiyu	243	79	164	108	135
Tabora	258	132	126	99	159
Morogoro	236	105	131	50	186
Mtwara	337	120	217	67	270
Kilimanjaro	258	108	150	56	202
Tota ToTs	**1577**	**652**	**847**	**479**	**1098**
Expected	*1808*	*904*	*904*	*Expected 50/50*	
Training Impact %	***87.22***	***72.12***	***93.69***	***30.37***	***69.62***

ToTs on Mungbean value chain training at Morogoro (Picture credit- Meshack Makenge)

Have a nice cooking!
This onde-onde is really yummy

Recipe- Onde onde ubijalar

Contributed by Erliana Ginting and Ratri Tri Hapsari

Mungbean is being used as staple food since a long time and also as snacks and drink in Indonesia. There are several recipes prepared form of seeds, sprouts and flour. One of the recipes created by ILETRI is "Onde onde ubijalar". It is prepared from purple swet potato mash and mungbean (dhal). This mash is a good combination of sweet potato and mungbean which has a high antioxidant, easily digestible protein, vitamins and minerals. This food is an attractive and tasty snack.

Ingredients:

Outer skin:

1. Sweet potato mash -2 kg
2. Tapioca flour -250 g
3. Glutinous rice flour -500 g
4. White sugar -200 g
5. Sesame seed -500 g
6. warm water -100 ml

Filler:

1. Polished mungbean (dhal) -500 g
2. White sugar -350 g
3. Salt - ½ a teaspoon

Preparation methode:

1. Soak the mungbean dhal for 60 minutes
2. Steam it for 30 minutes
3. Add sugar and salt. Blend well until it becomes a homogenous mixture
4. Shape the mungbean mash into small balls

Dough skin:

1. Put all ingredients
2. Pour water gradually, knead them until the the dough turns to homogenous mixture

Onde-onde:

1. Get a dough and flatten it, then put the mungbean filler inside. Roll it using hands manually, form into spheres (round)
2. Coat the ball with sesame seeds evenly and deep fry using low heat with occasional turnings
3. When it floats on the oil, remove and drain.

Future Newsletters

The IMIN aims to publish a semi-regular newsletter and is now calling for submissions for the next edition. Please email aparna.shivanna@worldveg.org to submit articles or for further information on the newsletter.

For further information on the IMIN:
Project Leader: Dr. Ramakrishnan Nair
E: ramakrishnan.nair@worldveg.org
P: +91 40 30713754 F: +91 40 30713074

Publications

1. Farnworth CR, San AM, Kundu ND, Islam MM, Jahan R, Depenbusch L, Nair RM, Myint T, Schreinemachers P (2020). How Will Mechanizing Mung Bean Harvesting Affect Women Hired Laborers in Myanmar and Bangladesh?. Sustainability. doi.org/10.3390/su12197870

2. Mishra GP, Dikshit HK, S. V. R, Tripathi K, Kumar RR, Aski M, Singh A, Roy A, Priti, Kumari N, Dasgupta U, Kumar A, Praveen S and Nair RM (2020) Yellow Mosaic Disease (YMD) of Mungbean (*Vigna radiata* (L.) Wilczek): Current Status and Management Opportunities. Front. Plant Sci. 11:918. doi: 10.3389/fpls.2020.00918

3. Reddy VRP, Das S, Dikshit HK, Mishra GP, Aski M, Meena SK, Singh A, Pandey R, Singh MP, Tripathi K, Gore PG, Priti, Bhagat TK, Kumar S, Nair R, Sharma TR (2020) Genome-Wide Association Analysis for Phosphorus Use Efficiency Traits in Mungbean (*Vigna radiata* L. Wilczek) Using Genotyping by Sequencing Approach. Front Plant Sci. doi: 10.3389/fpls.2020.537766

4. Singh B, Das A, Parihar AK, Bhagawati B, Singh D, Pathak KN, Dwivedi K, Das N, Keshari N, Midha RL, Kumar R (2020) Delineation of Genotype-by-Environment interactions for identification and validation of resistant genotypes in mungbean to root-knot nematode (*Meloidogyne incognita*) using GGE biplot. Scientific reports. doi.org/10.1038/s41598-020-60820-x

5. Singh CM, Pratap A, Gupta S, Biradar RS, Singh NP (2020) Association mapping for mungbean yellow mosaic India virus resistance in mungbean (*Vigna radiata* L. Wilczek). 3 Biotech. doi.org/10.1007/s13205-019-2035-7

6. Sokolkova A, Burlyaeva M, Valiannikova T, Vishnyakova M, Schafleitner R, Lee CR, Ting CT, Nair RM, Nuzhdin S, Samsonova M, von Wettberg E (2020) Genome-wide association study in accessions of the mini-core collection of mungbean (*Vigna radiata*) from the World Vegetable Gene Bank (Taiwan). BMC plant biology. doi.org/10.1186/s12870-020-02579-x

7. Tollo JA, Ojwang PP, Karimi R, Mafurah JJ, Nzioki HS (2020). Genotype-by-environment interaction and stability of resistance in mungbean landraces against common bacterial blight across semi-arid environments. Euphytica. doi.org/10.1007/s10681-020-02705-8

Staff feature From India

Dr. Aparna S

Dr. Aparna S, recently joined the International Mungbean Improvement Network. She has been appointed as Entomologist by the World Vegetable Center, South Asia/ Central Asia team at ICRISAT Campus, Hyderabad. Aparna will be working on Integrated Pest Management (IPM) with legumes and vegetables. Her primary focus will be on screening the insect resistant lines, conduct laboratory, glass house and field experiments, data collection and maintenance related to insect pests of mungbean. She will be involved in providing the IPM trainings to farmers and technical staffs associated with regional center of World Vegetable Center. Aparna has completed her bachelor's and master's degree in Agricultural Sciences from University of Agricultural Sciences, Bangalore, India. She worked on the diversity and seasonality of Scarab beetles during her master's graduation. Later, from 2016 onwards, in collaboration with I & B seeds Pvt Ltd. and GIZ-GIC project, developed IPM components for management of the tomato pinworm, *Tuta absoluta* for her PhD dissertation.

Project News & Events

12, August, 2020: the book "Mungbean Genome" edited by Ramakrishnan M. Nair, Roland Schafleitner and Suk-Ha Lee was virtually released by Eric Huttner on 12, August, 2020.

12, August, 2020: Virtual workshop on "KDDart database management system and application" was held on 12, August, 2020.

Upcoming:

8-9 December, 2020: International Mungbean Improvement Network with support from Syngenta Foundation for Sustainable Agriculture is conducting a virtual workshop on Demand Led Breeding (DLB) for all the partners associated with IMIN on 8 and 9 December, 2020.

Follow Australian Mungbean work on Instagram at mungbean_au