EDITION #10, DECEMBER 2022

Australian Government

Australian Centre for International Agricultural Research

MUNG CENTRAL

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

Editorial

After a long gap members of the IMIN could meet face to face after the TropAg 2022 conference in Brisbane, Australia. The network was well represented at the TropAg conference. A new mungbean variety, Yezin-16, for the high premium sprout market segment, with green shiny bold seeds was released by the Myanmar Department of Agricultural Research. This variety is resistant to Mungbean Yellow Mosaic Disease (MYMD) as well as to Dry Root Rot disease. One of the new initiatives include on how Artificial Intelligence (AI) can be used for predictive crossing to better stack key traits. This edition also covers import of germplasm into Australia, the battle with bruchids and an overview of the bacterial disease affecting mungbean.

If you are interested in finding out more about collaboration with the IMIN, please email: ramakrishnan.nair@worldveg.org We hope you enjoy this tenth edition of Mung Central.

To access previous editions, visit: https://avrdc.org/wpfb_file_category/project_newsletters-mung_central_newsletter/

IMIN2 Team meeting in Brisbane

Contributed by: Thomas Noble, Department of Agriculture and Fishers, Queensland Government, Australia

On the 3rd of November, 2022 a large group of the IMIN II team met in Brisbane for a full day, presenting and discussing the breadth of activities completed and underway. It was great to catch up with colleagues some of us had not seen for many years and to meet all the new faces. The day began with Manoj Nayak from DAF who has just completed a pulse grain storage project, with relevant learning for our meeting attendees. Each partner country provided an updated on their activities; this was followed by a hands-on workshop with George Huang from Diversity Arrays on how to use the many features of KDManage. Roland Schafleitner and Ya-ping Lin presented on molecular genomics and automated phenotyping using the phenospex. Two PhD students from the University of Queensland, Shanice Van Haeften and Caitlin Dudley presented a session on the physiology research they have been undertaking to tease out yield components of mungbean. Lee Hickey from UQ also presented on how AI can be used for predictive crossing to better stack key traits. As the presentations and meeting came to an end everyone met at a local restaurant for dinner and conversation. It was a great day loaded with excellent information and highlighted all the great work being done around the world on mungbean.

Mung4sprouts from Myanmar

Contributed by: Mar Mar Win, Myanmar Department of Agricultural Research (DAR)

Yezin -16 is the new mungbean variety released by the Myanmar Department of Agricultural Research (DAR). Yezin -16 (Yezin-14 x YM-03-4-21) has shiny green bold seeds and is resistant to both Mungbean Yellow Mosaic Disease (MYMD) as well as to Dry Root Rot disease. It also has better sprouting quality than the current commercial varieties.

Grains and sprouts of Yezin-16

Australia imports Mungbean Germplasm

Contributed by: Thomas Noble, Department of Agriculture and Fishers, Queensland Government, Australia

As the summers continue to get hotter breeding for heat tolerance has become critically important to plant breeders around the world. The Australian breeding team is eagerly awaiting the arrival of 11 AVMU lines with known heat tolerance (HT). The HT lines will be used in the crossing program with the aim to develop varieties that will continue to yield under harsh conditions. A heat screening experiment that is underway in Kingaroy will screen 6 Indian elite breeding lines that were shared internationally and 1 line from Taiwan. We will be able to share with the project the outcomes of that heat screen next year.

Disease resistance continues to be at the forefront of the breeding program in Australia. The team primarily focusing breeding efforts on bacterial disease resistance as there are not chemical methods to manage the diseases. A further 5 AVMU lines will be imported with known resistance to MYMD, Anthracnose and Dry Root Rot resistance. Although these diseases are not currently an issue in Australia pre-emptive breeding with the material will safeguard the future of mungbean crops in Australia. Over the last couple of years there have been outbreaks of Anthracnose in soybean and with MYMD in Indonesia. It is just a matter of time before we expect to be dealing with these diseases.

Another set of material being imported is a cohort of 25 interspecific lines developed at the WorldVeg in Taiwan. The lines are a combination of crosses between *Vigna mungo* with Australian commercial varieties *Vigna radiata*. These interspecific lines are expected to provide resistance to bacterial disease, fusarium wilt and water logging tolerance.

Samples of the minicore are being prepared to be screened for compositional traits over the next year as below. The data gathered is correlated to vital nutritional profiling which will be highly valuable to the network and hopefully identify lines with exceptional profile

- Mineral composition Fe and Zn
- protein content
- amino acid profile
- fatty acid profile/lipid
- carbohydrates including total starch, insoluble and soluble
- total dietary fibre
- ash
- phytate
- moisture

Of unknown beetles and impending battles

Contributed by: Aparna Shivanna, World Vegetable Center, South & Central Regional Office, Hyderabad, India

Pulse beetles or Bruchids (Coleoptera: Chrysomelidae: *Callosobruchus*), are economically important storage pests in mungbean and other pulses. They have the potential to cause up to 100% loss if not managed from early infestations in storage. Adult bruchids lay eggs on seeds; emerging larvae bore into seeds and feed on it without causing any damage to the seed coat. The inconspicuous feeding habits of the larvae make it hard to recognize early symptoms of bruchid infestation.

In India, among the several species of bruchids, two namely, *Callosobruchus chinensis* and *C. maculatus* have been extensively identified and studied. However, recent reports (Jha et al., 2022; Mannava et al., 2022) and observations indicate another species, *C. analis*, could also be a potential threat to the safe storage of mungbean. As *C. analis* is morphologically very similar to *C. maculatus*, it is very difficult to distinguish them, leading some to wonder whether its potential threat could have been so far understated due to incorrect taxonomic identity in several studies.

World Vegetable Center has been rigorously working to identify and use bruchid-resistant genotypes in breeding programmes since the early 1970s. As a result, V2802 and V2709 have been identified and used as parents to develop improved breeding lines that are thriving against *C. maculatus* and *C. chinensis* attacks. More than 10 lines (AVMU lines) have been confirmed at multiple locations to have bruchid resistance. However, with the recent observations on *C. analis* as a potential emerging pest in mungbean, there is urgency to explore new resources for emerging pest problems in India and other mungbean growing countries.

Adult females of different Callosobruchus species (Coleoptera: Chrysomelidae)

Mannava, N., Bandi, S. M., Chandra, A., Kumar, V., Aidbhavi, R., Singh, B., & Jambhulkar, P. P. (2022). Bionomics of *Callosobruchus analis* (F.) in ten common food legumes. Journal of Stored Products Research, 98, 102010.

Jha, A. N., Singh, S., Kumar, V., & Sau, A. K. (2022). A Comparative Study on the Susceptibility of Chick-pea Cultivars to the Insect *Callosoprocus chinensis* L. and Callosobruchus analis F. International Journal of Plant & Soil Science, 88-94.

Identifying and managing mungbean bacterial diseases

Contributed by: Thomas Noble, Department of Agriculture and Fishers, Queensland Government, Australia.

There are two bacterial pathogens in Australia that continue to cause severe losses in mungbean crops since the 1980s. *Curtobacterium flaccumfaciens pv. flaccumfaciens* (Cff) and *Pseudomonas savastanoi pv. phaseolicola* (Psp) causal agents of Tan Spot and Halo blight diseases. These diseases present under different climatic conditions, Tan Spot (Cff) favours dry and hot conditions (>28C°), the pathogen is xylem inhabiting and kills the plant through blocking water movement (Fig 1, 2). Halo blight (Psp) favours cool (18-24C°) wet conditions to thrive, inhabiting the apoplast while deploying a specialised protein secretion system to shut down the plants defences (Fig 3, 4). These pathogens have been identified among a large host range of pulse and bean species as well as many weed species. The diseases have been reported in major growing regions around the world such as China, Pakistan, and Nigeria. Although they have not been officially identified in Myanmar, Bangladesh, and India they may be present but not yet identified.

Bacterial diseases are harder to manage and control than fungal diseases as there are no effective chemical options to treat crops. Copper oxychloride and streptomycin are both known bactericides. However their effectiveness as seed treatments or use in crops is limited. Further to this they are expensive and antibiotics are not legal to use on crops in many countries such as Australia. Copper oxychloride has been reported as a foliar spray in orchards, but it is expensive, needs to be applied weekly, and has limited effectiveness for crops. Ultimately it is far more important to focus on breeding resistant cultivars, characterising and pathotyping the pathogen populations on a yearly basis, and generating/curating clean seed through cultural and farming practices.

- Seed production should be done in areas where the environment is not conducive to reproduction.
- Inspection of seed production plots for any signs of disease symptoms, aiming for a zero tolerance when signs of disease are present.
- Field hygiene through the removal of diseased plants, ploughing the previous crop into the soil and disinfection of equipment.
- Limit movement through the field, as the bacteria live as asymptomatic epiphytes and after slight damage can enter and cause disease.
- Control of weeds and removing prior crop volunteers as these pathogens have a wide host range and will survive on other hosts until the next crop is planted.
- Rotation of crops is critical to limit inoculum build up among many other benefits to the farming system.
- Isolation and curation of pathogen collections, 16S sequencing to confirm identity, pathotyping isolates against commercial varieties and elite material, and where possible qPCR testing of seed and leaf tissue from seed production areas to identify the presence of pathogens.

If anyone would like further information or a copy of publications related to these diseases, please contact me at Thomas.noble@daf.qld.gov.au

Mungbean plant showing signs of Tan Spot disease wilting and chlorosis 10 days after stem inoculation.

Early stages of halo blight disease in the field, characteristic small wet necrotic lesions surrounded by a yellow halo.

Mungbean plant in the field displaying necrosis from late stage Tan Spot disease.

Mungbean plants in the field with late stage effects of halo blight disease.

Recipe: Mung *dhal* Barfi (Halwa)

-A popular Bangladeshi dessert

Contributed by: M Mahbubul Alam, Md. Jahangir Alam and Bonya Akhter, BARI, Bangladesh

Bangladesh celebrates several festivals throughout the year. Each festival has unique and special recipes varying across religion, location, culinary skills etc. The mung *dhal* barfi (Halwa) is one of the special dishes prepared during the holy 'Shab-e-Barat' festive, on the event of `Iftaar' on the holy Ramadan month and the wedding ceremony. It is also popular due to longer shelf life and served as dessert course in leading restaurants across the country.

Ingredients:

1 cup dehusked mung dhal, cup ghee, cup sugar, cup powdered milk, 1 tea spoon roasted almond, 1 tea spoon cardamom powder.

Procedure:

1. Rinse the mung *dhal* properly and soak them in enough water overnight.
2. Next morning, grind the soaked *dhal* using very less quantity of water.
3. Add ghee into the mung *dhal* paste and blend it.
4. Pour the mixture in to a non-sticky pan and cook it on medium flame with rigorous stirring to avoid sticking them on to pan.
5. When the entire liquid evaporates, add sugar and powdered milk. After few minutes it will turn into thick and yellow to golden brown colored mixture.
6. Then add 2-3 tea spoon ghee, roasted almonds and cardamom powder.
7. Pour the cooked mixture into pie-molds and cool it.

The Mung *dhal* Halwa is ready to serve!

Staff features

Australian mungbean pathology team expands with two new researchers

Dr. Thomas Noble, a senior researcher joined the Australian mungbean breeding team at Warwick, Queensland at the end of July 2022 to lead pathology research. Having worked in the agricultural science sector for over a decade he has focused his efforts on developing skills in genetic analysis of mungbean germplasm and the biological study of pathogens causing disease in mungbean. He undertook his PhD studies at QUT researching the host-pathogen relationship of bacterial pathogen Pseudomonas savstanoi pv. phaseolicola the causal agent of halo blight disease. He was awarded the first industry-based scholarship from the Australian Mungbean Association. Previously he worked as a research assistant on a Queensland Government funded project for the improvement of tropical pulses in Queensland from 2014. In this role, he helped develop and analyse two mungbean mapping populations, the Australian Diversity Panel and the mungbean NAM expanding his interest in researching innovative approaches to mungbean breeding and pathology. Before working at QUT, Dr. Noble received his bachelor's degree in biotechnology Innovation at QUT. Following his studies, he worked in several commercial based agricultural labs for companies such as Monsanto and SGS gaining a broad knowledge of the relationship between scientific research and industry.

Jake Bloomfield is our newest member, who joined the team in August 2022 as a technician. Originally from Killarney, Jake moved to Gatton to study agricultural science part-time at the University of Queensland. Working while studying, he has been in the agricultural industry for 5 years in wholesale production of seedlings, operating seeding machinery and grafting seedlings. Jake is excited about starting a career in agricultural research bringing together a long-time aspiration and

passion for his work. Although Jake is new to plant pathology and many molecular and microbiology techniques, his attention to detail and willingness to learn has seen him quickly expand his skill set.

For the past two months, Jake and Tom have been working on re-invigorating the isolate collection at The Hermitage through re-isolation and storage of pure colonies. They are also running glasshouse screening assay on elite breeding material for tan spot disease caused by *Curtobacterium flaccumfaciens pv. flaccumfaciens*. They will continue to refine and expand glasshouse screening protocols, conduct yearly disease surveys, pathotype isolates, sequence, and curate pathogen collections to ultimately deliver critical information to breeders and farmers.

Left to right are Thomas Noble, William Martin, Jake Bloomfield (back row); Merrill Ryan, Katie McIvor (front row).

WorldVeg team

Dr. Sai Prathap, received his PhD in Agriculture-Plant Pathology from Acharya NG Ranga Agricultural University, India / International Crops Research Institute for the Semi-Arid Tropics, India in 2020. He has joined as Plant Pathologist with the World Vegetable Center, South-Central Asia, at ICRISAT campus, Hyderabad, India in ACIAR funded International Mungbean Improvement Network (IMIN) phase-2. His professional interests include mycology, plant virology, molecular biology and host-plant resistance.

Conferences

Members of the IMIN attended the TropAg 2022: International Tropical Agriculture Conference at the Brisbane Convention and Exhibition Centre from 31 October 2022 to 2 November 2022.

Nair RM, Alam AKMM, Pratap A, Soehendi R, Karimi R, Win MM, Ryan M, Van Haeften S, Hickey L, Gowda A, Shivanna A, Schafleitner R, Lin Y-P, Lee C-R, Huttner E. 2022. Genomics and phenomics assisted Mungbean breeding. Abstracts (oral): TropAg 31 Oct-2 Nov, Brisbane Convention and Exhibition Center, 235.

Alam AKM, Azam MG, Sarker D, Hossain MA, Nair RM. 2022. Identification of Mungbeans using Multivariate Technique and Multi-Trait Index Approach Abstracts (poster): TropAg 31 Oct-2 Nov, Brisbane Convention and Exhibition Center, 68.

Chaitanya AK, Gowda A, Nair RM, Pithabhai CC. 2022. Effect of Elevated CO2 on *Macrophomina phaseolina*-Mungbean Interaction and Associated Defence Responses Abstracts (poster): TropAg 31 Oct-2 Nov, Brisbane Convention and Exhibition Center, 140.

Shivanna A,War AR, Nair RM. 2022. Cowpea Aphid (*Aphis craccivora* Koch.) Resistant Resources in Mungbean Mini-core Abstracts (poster): TropAg 31 Oct-2 Nov, Brisbane Convention and Exhibition Center, 218.

Kumari G, Shanmugavadivel PS, Tiwari P, Abrol S, Gore P, Tripathi K, Nair RM, Kumari J, Gupta S, Pratap A. 2022. Genetic Diversity and Association Studies for Agronomic Traits in *Vigna* Species Abstracts (poster): TropAg 31 Oct-2 Nov, Brisbane Convention and Exhibition Center, 272.

Pratap A, Akram M, Gupta S, Naimuddin, Saabale PR, Basavaraja T, Tiwari P, Nair RM. 2022. Identification of New Sources of Resistance to Yellow Mosaic Disease in Mungbean Abstracts (poster): TropAg 31 Oct-2 Nov, Brisbane Convention and Exhibition Center, 273.

Research Articles

Elmerich C, Pandey AK, Vemula A, Rathore A, Nair RM. 2022. Blackgram-*Macrophomina phaseolina* Interactions and Identification of Novel Sources of Resistance. Plant Disease. doi: 10.1094/PDIS-11-21-2588-RE.

Gore PG, Gupta V, Singh R, Tripathi K, Kumar R, Kumari G, Madhavan L, Dikshit HK, Venkateswaran K, Pandey A, Singh N, Bhat KV, Nair RM, Pratap A. 2022. Insights into the genetic diversity of an underutilized Indian legume, *Vigna stipulacea* (Lam.) Kuntz., using morphological traits and microsatellite markers. PLoS One. Jan 19;17(1):e0262634. doi: 10.1371/journal.pone.0262634.

Kumari G, Shanmugavadivel PS, Lavanya GR, Tiwari P, Singh D, Gore PG, Tripathi K, Nair RM, Gupta S and Pratap A. 2022. Association mapping for important agronomic traits in wild and cultivated *Vigna* species using cross-species and cross-genera simple sequence repeat markers. Frontiers in Genetics. 13:1000440. doi: 10.3389/fgene.2022.1000440

Priti, Sangwan S, Kukreja B, Mishra GP, Dikshit HK, Singh A, Aski M, Kumar A, Taak Y, Stobdan T, Das S, Kumar RR, Yadava DK, Praveen S, Kumar S, Nair RM. 2022. Yield optimization, microbial load analysis, and sensory evaluation of mungbean (*Vigna radiata* L.), lentil (*Lens culinaris* subsp. *culinaris*), and Indian mustard (*Brassica juncea* L.) microgreens grown under greenhouse conditions. PLoS ONE 17(5): e0268085. https://doi.org/10.1371/journal.pone.0268085

Singh CM, Kumar M, Pratap A, Tripathi A, Singh S, Mishra A, Kumar H, Nair RM, Singh NP. 2022. Genome-Wide Analysis of Late Embryogenesis Abundant Protein Gene Family in *Vigna* Species and Expression of VrLEA Encoding Genes in *Vigna glabrescens* Reveal Its Role in Heat Tolerance. Frontiers in Plant Science 13, DOI=10.3389/fpls.2022.843107

Singh P, Pandey B, Pratap A, Gyaneshwari U, Nair RM, Mishra AK, Singh CM. 2022. Genetic and Genomics Resources of Cross-Species *Vigna* Gene Pools for Improving Biotic Stress Resistance in Mungbean (*Vigna radiata* L. Wilczek). Agronomy. 2022; 12(12):3000. https://doi.org/10.3390/agronomy12123000