



DivSeek Connect

Official Newsletter of DivSeek International Network

Issue 6

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Welcome to the sixth issue of DivSeek Connect, where we present news, information, and perspectives from the world of plant genetic resources.

The DivSeek year has been off to a productive start with the first in-person AGM since 2020, and a successful inaugural workshop at PAG30 in San Diego.

In this issue of DivSeek Connect we report on the thematic hub focused on how pangenomics and haplotype catalogue (HapCat) approaches have an important role to play in characterisation of crop germplasm.

We also hear about the key role that the Crop Trust's GeneSys database plays in collating and coordinating information about the world's plant genetic resource accessions.

DivSeek is in active discussions with the Crop Trust, to identify areas of common and complementary interest, where we can work together effectively to maximise the information flow - from conservation to consumption.



Graham King

DivSeek International Network,
Executive Director

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DivSeek in San Diego – highlights from our AGM and PAG 30 workshops

On January 12, 2023, DivSeek International Network held its Annual General Meeting (AGM) in San Diego. After two years of COVID disruption, the meeting was an opportunity for members of the DivSeek community to meet face-to-face.

During the meeting, Executive Director Graham King presented on the progress made over the past year – such as hosting workshops at international conferences, and signing an MOU with the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

This was followed by an open discussion on key issues, including implementation of the DivSeek Strategic Plan 2021-2026, and approaches for identifying future funding opportunities.

A highlight of the meeting was a series of ‘flash talk’ presentations in which DivSeek members and hubs gave updates on their recent activities, including outreach events, training sessions, online workshops and software developments.

DivSeek hosted its inaugural workshop at the Plant & Animal Genome Conference (PAG 30) the following day.

With over 60 attendees, the workshop featured a broad and engaging set of presentations on the topic of information flow from gene banks to downstream characterization of genetic resources, alongside development of communities of practice and training the next generation of plant breeders for food and nutrition security in Africa.

The gathering then enjoyed a convivial and productive networking event, exchanging views on

opportunities and challenges for the future.

“Over the past few years, numerous conceptual and operational advances have occurred with the management of crop datasets – both genotypic and phenotypic,” says Stephen Kresovich, Professor of Integrative Plant Science at Cornell University and Chair of the Divseek Board of Directors.

“The AGM and [PAG 30] workshop provided the fora for thought leaders to update the community on this progress.”

Each of the six presentations spoke to the theme of optimising information flows for plant genetic resources (PGR). For example, Matija Obreza (Crop Trust) presented on GeneSys PGR, a platform for sharing information on genebank accessions, while Monica Carvajal-Yepes spoke about forming a community-of-practice to enable knowledge transfer among genebank managers.

The presentation slides from the AGM and PAG 30 workshops cover a broad range of topics and can now be downloaded from our website.

“As a plant breeder relying on PGR, the talks, both at the DivSeek AGM and workshop were informative and brought an awareness of different platforms and tools that are available for sharing and exploiting PGR,” says DivSeek Board member Julia Sibiya.

Beyond these presentations, many attendees particularly valued the opportunity to interact and enjoy the food and drink DivSeek provided. “Networking with scientists from different continents under a common theme of plant genetic

resources was a bonus,” says Sibiya, who is based in South Africa.

“The networking session allowed all participants to have added time to discuss a breadth of visions and details regarding information management to bridge crop conservation and use,” says Kresovich.

Written by: Kiri Marker

Here’s how pangenomics can help fast-track crop improvement

Recent advances in genomics technologies are providing plant breeders with new tools to improve crop yield, quality, and disease resistance. Two approaches that have been gaining increased attention in recent years are pangenomics and haplotype catalogue (HapCat) analyses.

These analytic methods are the primary focus of DivSeek’s Chickpea PanGenome & HapCat Hub, which is led by Professor Rajeev Varshney, Director of the Centre of Crop & Food Innovation at Murdoch University. The aim of the hub is to develop and refine tools and pipelines for pangenomic and HapCat analyses, using chickpea as a case species.

So, what is pangenomics, and how could it help plant breeders to create stronger, healthier, and more nutritious crop varieties?

Well, the ‘pangenome’ of a crop refers to the

complete set of genetic variants present across the entire species. To construct a pangenome map, scientists must sequence the whole genomes of a very large number of individuals.

This allows them to identify the large ‘core genome’ (i.e. DNA regions that are always the same and never change), as well as the smaller ‘accessory genomes’ (i.e. DNA regions that vary across individuals, and give rise to genetic diversity). Pangenomics is relatively new, but offers huge potential to accelerate crop improvement. When breeders or researchers want to identify candidate DNA sequences (e.g. for gene-editing, or selecting individuals for breeding programs), they often do a genome-wide association study (GWAS).

This involves sequencing the whole genomes of many individuals and comparing them to a single ‘reference’ genome, in order to identify genomic regions that vary across individuals. Homing in on those regions, they search for correlations between particular genetic variants (genotypes) and particular plant traits (phenotypes), such as growth rate, yield, or drought tolerance.

However, a reference genome can only tell you so much. “A single reference genome only tells you about genes of only one particular individual,” explains Varshney. “Pangenomics can tell you about all possible genes for a given crop species.”

The first crop pangenome was developed for maize in 2014. Since then, researchers have created many more, including major crop species like rice, soybean, and rapeseed.

In 2021, Varshney and his team built a pangenomic map for chickpea using sequencing data from 3,366 genomes. Along the way, they identified





Professor Rajeev Varshney (leader of DivSeek's Chickpea PanGenome & HapCat Hub) standing in a field of Chickpea (*Cicer arietinum*).

superior haplotypes for desirable crop traits, and 56 germplasm lines that could be used for bringing novel haplotypes into the elite germplasm through haplotype-based breeding.

“Now that we have identified superior haplotypes for agronomic traits such as seed size, we can develop assays for those haplotypes,” says Varshney. “[This means] chickpea breeding programmes like Chickpea Breeding Australia can start using this information to introgress superior haplotypes in commercial chickpea varieties.” This he says will provide higher yield and revenues to chickpea growers in Australia.

So, pangenomics lets us take stock of the diversity across an entire species, enabling us to approach crop improvement from a truly global perspective. HapCat analysis, on the other hand, usually focuses on a smaller population of individuals. Instead of trying to describe all possible genetic variants, HapCat analysis creates a “catalogue of haplotypes”.

This is basically a database of all individuals in a population, and the genetic variants they carry on each chromosome. This fine-scale information helps plant breeders select parents to cross together in order to produce superior offspring. Varshney's aim for the Chickpea PanGenome &

HapCat Hub is to develop and refine data tools and pipelines for using HapCat and pangenomics for crop improvement.

“At present, different research groups have specialized data analytical tools and pipelines that need specialized bioinformatics skills to run pangenome and HapCat analysis, he says. “We would like to refine those tools and pipelines so that they can be used by researchers with minimum bioinformatics skill.”

Developing user-friendly analytical tools is important, he says, because it helps to “democratize” the genomic sequencing era, and to bring its benefits to developing countries as well.

Beyond refining the toolkit and making it more accessible, Varshney also hopes to raise awareness for these methods and to educate the wider plant genetic resources community, through targeted capacity-building workshops and webinars.

Written by: Kiri Marker
Corresponding author: Rajeev Varshney

The image shows the exterior of an Illumina building. The facade is made of reddish-brown stone tiles. The word "illumina" is mounted on the wall in large, white, lowercase letters. A security camera is visible on the roofline to the right. The sky is clear and blue.

illumina

Illumina accepted as first partner organisation of DivSeek International Network

Illumina, an American biotechnology company known best for producing genomic sequencing technology, has just become the first official partner organisation of DivSeek International Network.

Illumina technology has many applications across the life sciences. In recent decades, their integrated and desktop sequencing systems have become indispensable in the study of plant genetic resources (PGR), particularly in the area of crop genomics.

But alongside supplying the PGR community with sequencing tools, Illumina also actively supports research and collaboration in agricultural genomics.

“Genomics has the power to harness the potential of genetic diversity in domesticated crops and their wild relatives, ensuring sustainability and adaptability of global agricultural production,” explains Evgeny Glazov, Market Development Manager in Applied Genomics at Illumina.

“We work with experts around the world to develop genomic tools that support translational research and advanced breeding applications such as genomics selection.”

Through the Illumina Agricultural Greater Good Initiative, the biotech giant awards in-kind contributions up to US\$350,000 to scientists whose research increases the sustainability, productivity, and nutritional quality of the world’s food supply. Beyond this, they also facilitate collaborations between breeders and researchers. Their agrigenomics consortia allow members to pool

resources, share ideas, and may culminate in the development of custom products for crop species of interest.

The partnership between Illumina and DivSeek comes as welcome news to both parties. “The partnership is a natural fit that complements the strength and mission of both organizations,” says Glazov.

“We share the goal of increasing global awareness and understanding of biological diversity, and it makes sense for us to look for opportunities to advance this goal together.”

“DivSeek’s international reach and representation create a unique forum for discussing current and emerging challenges facing conservation, management, and traceability of plant genetic resources and identifying technological and other solutions to these challenges.”

In this flagship partnership arrangement, Illumina has agreed to support DivSeek’s mission by providing expertise (e.g. by contributing to the Genomics Working Group), assistance with funding applications, and philanthropic support for selected activities.

Excitingly, the partnership also means that Illumina may sponsor and potentially co-organise educational activities with DivSeek, like webinars, seminars, and workshops.

The first of these sponsored events was the inaugural workshop of the DivSeek Regional Hub for Australasia, which recently took place in Brisbane.

“The Australasian Hub meeting [was] an opportunity to bring together regional experts of the DivSeek network, and we [were] thrilled to be part of it,” says Glazov.

Written by: Kiri Marker
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GeneSys: a gateway into the world’s genebanks

“Databases, databases, and more databases.”

These are the words Matija Obreza uses to describe the digital landscape that crop scientists enter when faced with the challenge of locating data and germplasm for their next project.

Obreza is head of genebank information systems at the Crop Trust, the only organization whose sole mission it is to ensure humanity conserves crop genetic diversity in genebanks, and to make it more accessible. Among other things, the Crop Trust works closely with the International Treaty on Plant Genetic Resources for Food and Agriculture to create a global information system for crop diversity.

Crop genetic diversity is currently housed in many different forms. Amidst the vast pipeline of global agribusiness, genetic diversity is stored

across farms, fields and pastures (in-situ). But it is also stored ex-situ: in genebanks, laboratories, glasshouses, museums and herbaria worldwide.

This long-term ex-situ form of diversity conservation is the focus of the Crop Trust, where Obreza leads the ongoing development of Genesys. This online portal enables genebanks to share information about their crop diversity with users around the world.

It also allows scientists and breeders to quickly search for germplasm, to query its availability, and even to initiate requests for material. Genesys now contains more than 4 million genebank accessions, around half of the estimated total number in the world. But for the Genesys team, this is only the beginning.

“Many genebanks already participate in Genesys, but that’s not enough,” says Obreza. “We would like all genebanks to become part of Genesys, and so ensure that users have access to the most comprehensive and up-to-date information, which eventually translates into the development of new crop varieties that are better suited to the changing needs of agriculture.”

Since Genesys aggregates data from multiple sources in its central database, the various approaches to data management followed by different genebanks pose a challenge, and every partnership demands a different solution, he explains. “We invest a lot in improving information systems at genebanks, so that they are comfortable sharing their data with the outside world.”



Shout out to the genebanks!

Last week, Obreza and his team at the Crop Trust released the Genesys Strategy 2023-2025, which outlines their goals and planned activities for the next three years.

The strategy stresses the importance of meeting the needs of existing partner genebanks, saying that they deserve priority attention. “It is crucial that we address the needs of our partners,” says Obreza, “as they are in the best position to recommend Genesys to other genebanks. They wouldn’t do that if Genesys doesn’t work for them first.”

Genesys is a powerful tool for genebanks to share their data without losing ownership or autonomy. Many Genesys features are specifically designed to help genebanks in their work, such as tools for data cleaning and validation, or for embedding their Genesys database directly into their own websites, saving them time and money.

“Over the years we’ve developed many advanced tools that are not yet fully utilized by genebanks. We aim to change that with additional documentation and tutorials.”



The Ethiopian Biodiversity Institute is one of over 450 genebanks that provide data to GeneSys. (Photo: genesys-pgr.org).



Passport data on accessions like this one, from the Vietnam national genebank, are made available via GeneSys. (Photo: Michael Major for Crop Trust, croptrust.org)

Users of crop data, rejoice!

Genesys considers itself an interface between providers (genebanks, genebank curators, data managers) and users (breeders, scientists, etc.) – of both germplasm and data. As such, their strategy also focuses on strengthening ties with the plant breeder community in order to better understand their needs.

Earlier this year, Obreza gave a presentation about Genesys to a room full of genomic scientists at DivSeek International Network’s PAG30 workshop. Training and networking events like this help to raise awareness of Genesys within the plant genetic resources (PGR) community and promote its use.

They also provide a platform for community discussion between users of plant genetic data (like breeders and scientists) and those at the forefront of developing information systems for those data.

Ultimately, the more breeders use Genesys to access data and germplasm, the better our global scientific community will become at developing future-proof crop varieties. To this effect, Genesys also places emphasis on developing features that meet the demands of their community of data users. While of course never forgetting that genebanks need to be happy first of all.

Written by: Kiri Marker

Corresponding authors: Matija Obreza, Luigi Guarino

Upcoming Events

Galaxy

International Galaxy Community Conference (GCC2023)

24 – 27 April, 2023
Padova, Italy

An annual gathering of the Galaxy community with training, talks, posters, demos, meetups and more. More information at biocommons.org.au



Global Sorghum Conference

5 – 9 June, 2023
Montpellier, France

A conference to connect the broader global sorghum community to identify solutions to challenges facing agriculture and food security. More information at 21centurysorghum.org



ISF World Seed Congress

5 – 7 June, 2023
Cape Town, South Africa

Organized by the International Seed Federation (ISF), this business-centered event incorporates both in-person and virtual opportunities. More information at congress.worldseed.org

AG2PI

AG2PI Conference

15 – 16 June, 2023
Kansas City, USA

Mapping the future of agricultural genome-to-phenome research via talks, roundtables and networking. More information at ag2pi.org



16th International Biocuration Conference

July 2023
Brisbane, Australia

A unique event for curators and developers of biological databases to discuss their work, promote collaborations, and foster a sense of community. More information at biocuration.org



International Plant & Animal Genome Conference Australia (PAG Australia)

20 – 22 September, 2023
Perth, Australia

This is a shorter 3-day version of PAG that focuses on genome research occurring in Australia and the Asia Pacific region. More information at intlpageaustralia.org/23



XXIII International Congress of Genetics

16 – 21 July, 2023
Melbourne, Australia

Global forum covering discoveries and technological advances in genetics and genomics across health, agriculture and conservation. More information at icg2023.com.au



Call out for Newsletter Contributions

We are keen to receive any content, short or long, from Members and Observers, organisations and individuals. We welcome your news updates, opinion pieces, research abstracts and upcoming conferences.

Contact info@divseekintl.org with 'Connect' in the email subject.



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